Marco De Marco · Dov Te'eni
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Editors

Information Systems: Crossroads for Organization, Management, Accounting and Engineering

ItAIS: The Italian Association for Information Systems

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Introduction

Information Systems is a relatively new discipline, albeit prefaced by a fascinating history. Like all new disciplines, it took a huge effort before it finally earned recognition as a discipline in its own right, and not as a subset of other already entrenched disciplines. After taking a few years to debate whether IS could rightfully be called a discipline, most would agree that indeed it was a discipline and, moreover, that it could be considered a reference discipline.

In addition, the fact that IS has a hybrid nature, made up of two different but interacting strands – technical on the one side (computer science and natural sciences) and humanistic on the other (organization science and social sciences) – was rebutted by the louder voices in the debate on the nature and content of Information Systems. Nevertheless, even though the earliest Information Systems studies focused mainly on the technical side, since then the importance of the humanistic side has grown considerably.

But what exactly are the distinctive features of the IS discipline?

It would be very helpful to have a basic and widely accepted definition of the diacritical features of Information Systems today. Computer Science, Information Science, Engineering Science, Management Science and Organization Science are just some of the disciplines that cross our path when we start to look more closely at the use of computers in the workplace. Intersections both manifest and complex that lead us to raise an obvious question "Do we really need another area of study? What areas of interest are not already covered by the other disciplines?"

Information Systems studies is the umbrella for a striking variety of research contributions, from those that address subjects such as computer performance measures to those that explore the psychological models of human behaviour, from papers on the strategic issues of e-government projects to the study of semantics and ontology.

The scope of IS covers a broad spectrum of subjects, but is also a constantly shifting landscape, shaped by ongoing and significant change. A comparison of the IS studies produced in the 1970s with those of the present day shows just how much that landscape has changed, as we will see in the following sections. The probable causes are many, although the fast rate of technological innovation in the IT arena is

indubitably a key driver. As a consequence, IS contributions are evolving in step with technological developments and the need for new IS studies generated by IT-enabled organizational innovations is now more likely than the other way round.

As a result, the publications authored by a great number of scholars play a major role because they frame the topical subjects that come to light as the discipline evolves. Indeed, the fact that the IS discipline is highly dependent on technological advances and on the changes in the way technology is used in our daily life transform the choice of the subjects of study into a moving target.

The editors of such publications face a tough yet challenging job when it comes to grouping together the various papers into homogeneous chapters.

In this book, we have chosen to present the following chapters:

- eServices in Public and Private Sectors
- Organizational change and the Impact of ICT in Public and Private Sectors
- Information and Knowledge Management
- Human-Computer Interaction
- Information Systems, Innovation Transfer, and new Business Models
- Business Intelligence Systems, their Strategic Role and Organizational Impacts
- New Ways to Work and Interact with the Internet
- IS, IT and Security
- Blending Design and Behavioral Research in Information Systems
- Professional Skills, Certification of Curricula, On-line Education and Communities
- IS Design, IS Development, Metrics and Compliance
- ICT4LAW: Information and communication technologies to help firms, public administrations, legislators and citizens to operate in a highly regulated world.

By making this choice we hope to both provide a service to our academic community and to play our part in the drive to define the subjects and the research methodologies of our discipline and, thus, to help sharpen the focus on IS and its eclectic/hybrid nature.

Marco De Marco
Dov Te'eni
Valentina Albano
Stefano Za

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Part I
eServices in Public and Private Sectors

A Service Classification Model for Value Co-creation in IT Outsourcing Services

Gerasimos Kontos and Konstadinos Kutsikos

Abstract Despite the abundance of IT outsourcing activities, many IT outsourcing service consumers are often unsatisfied. A commonly cited reason in the research literature is that IT outsourcing providers still struggle to define the right combinations of resources and capabilities that lead to successful service configurations. The latter is the focus of Service Science, a discipline that views organizations as dynamic service systems that integrate acquired resources with their own in order to create service offerings. By combining basic principles of Service Science, Resource-based Theory and Dynamic Capabilities Theory, we develop a conceptual framework for classifying IT outsourcing configurations (i.e. service offerings) in order to help IT outsourcing service providers make informed decisions on which capabilities to develop or improve for different client needs, which inevitably results in different value creation processes. The framework is presented as a 2×2 classification matrix of outsourcing configurations, along with details for one of these, by using the e3-value ontology. We conclude this paper by highlighting limitations of our approach and indicating future research directions.

1 Problem Statement and Motivation

Firms across the globe increasingly realize that they need to focus on their core competencies while forming strategic alliances with external partners for delivering integrated products or services to their clients.

Interestingly, and despite the abundance of IT service outsourcing activities ("outsourcing maturity") [1], many IT outsourcing service consumers are often unsatisfied, which results in contract renegotiations or even terminations [2]. A reason that is often cited in the research literature is that IT outsourcing providers

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still struggle to define the right combinations of resources and capabilities that lead to successful service configurations [2].

The latter is the focus of Service Science, an emerging academic discipline which views organizations as dynamic service systems that integrate acquired resources with their own for creating service offerings. In the IT outsourcing realm, this implies that an IT outsourcing provider (a service system) may exchange resources, skills and competences with partners and suppliers (service systems) in order to deliver an integrated service offering to a client (a service system). These co-production activities imply value co-creation for all parties involved, as captured by the resulting configurations of resources and capabilities.

Our research adopts a Service Science-driven viewpoint and aims to explore a relevant research question: what are the different configurations of resources and capabilities that can be identified within an IT outsourcing service provider? Answering this question will enable us to conceptualize how different classes of capabilities relate to different outsourcing configurations and which matches have the potential to act as sources of competitive advantage. The end result should help IT outsourcing service providers to gain a better understanding of their value propositions to clients and allow them to tailor their capabilities to the specific requirements of the various sourcing projects they are engaged in.

The remaining of this paper is organized as follows. We set off by describing basic principles of service science, before presenting fundamental concepts of the Resource-based theory, the theory of Dynamic-capabilities and their relation to service sourcing. By combining the findings, we develop a conceptual framework for different IT outsourcing configurations (i.e. service offerings) for helping providers make an informed decision on which capabilities to develop or improve for different client needs, which inevitably results in different value creation processes. We then present in detail one of the four sourcing configuration classes using the e3 value business ontology [3]. We conclude the paper by highlighting limitations of our approach and indicating future research directions.

2 Theoretical Background and Relevant Literature

2.1 Service Science and Value Co-creation

Service Science aims to categorize and explain the many types of service systems that exist, as well as how service systems interact and evolve to co-create value [4]. [5] further elaborate on the notion of service systems, by abstracting them as dynamic configurations of people, technologies, and resources connected to other service systems through value propositions. Hence, all service systems are resource integrators that transform internal and market-acquired resources (knowledge and skills) into service offerings that have value for themselves and others. Furthermore, a B2B relation can be examined as a service system as long as value is

co-created for all stakeholders involved, regardless of whether such value is commercial, multi-faceted or results from (semi)automatic or purely manual processes [6].

The model of competition within the context of service science is linked to efforts made by service providers to improve the management of the value co-creation process better than other service providers can do [7]. Within this logic, the ability of an IT outsourcing service provider to create value for its clients does not only arise from its core and distinctive resources but also from its capabilities to match these resources with acquired ones, in order to create new service offerings by exploiting different resource configurations [1]. At the same time, IT outsourcing client involvement, even in the simple form of merely selecting an outsourcing service offering, is equally important for value creation in a B2B contract.

2.2 IT Outsourcing Relationships

There are several approaches for classifying IT outsourcing relationships, as defined in the relevant research literature. [8] defined four main types of IT outsourcing relationships along two dimensions: "strategic intent" and "technical capability." The resulting possible relationships are: Technical Supply Relationship, Business Service, Business Alliance and Technology Partnering.

Based on the notion that outsourcing relationships are not static, but change and evolve over time, [9] classified outsourcing relationships into four types: support, alignment, reliance, and alliance. Such a classification can be used to depict both static and dynamic aspects of client-provider relationships, as well as examine an organization's changing outsourcing relationships over time within or across the four relationship cells.

These classification approaches although useful for a more systematic understanding of outsourcing arrangements are single-sided, as they classify outsourcing arrangements from the client's perspective only. As the field of IT outsourcing has become more diversified, it becomes necessary to highlight both the service provider's perspective as well as the capabilities it needs to possess to comply with the needs of its clients [2]. Overall, it is access to these capabilities and the service provider's service configurations that influence a client's decision to engage in an outsourcing contract [1].

2.3 Resource-Based Theory (RBV) and Dynamic Capabilities Theory (DCT)

RBV aims to explain a firm's ability to stay ahead of the market in turbulent and uncertain environments by looking at unique configurations of resources inside and

outside the firm [10]. [11] suggests that IT resources have no competitive value on their own – only if they are combined in unique patterns which are difficult to be imitated then they are likely to be a source of sustained competitive advantage. These combinations enable new functionalities and improve an IT outsourcing provider's performance.

Dynamic capabilities theory is a valuable extension of RBV. As noted by [12], dynamic capabilities are the organizational and strategic routines and processes, by which firms achieve new resource configurations to address client demand. In the IT outsourcing domain, research on service providers' specific capabilities has been largely neglected [2], with a few notable exceptions [13], [14]. Unfortunately, even the latter fall short from providing a comprehensive view on the relation of IT outsourcing service provider capabilities to different sourcing configurations and how the latter may impact the performance of an IT outsourcing engagement.

3 A Service Science-Driven Framework for IT Outsourcing Service Configurations

Our research adopts the service science viewpoint for exploring how the capabilities of an IT outsourcing service provider (a service system) can be combined with ones acquired from partners (service systems) in order to create successful IT outsourcing configurations (service offerings). To that extent, we propose two parameters to be used as axes in our conceptual framework.

The first axis considers the extent to which the resources that constitute the outsourcing configuration manifest functional dependency which makes it difficult for competitors to imitate. It is comprised of two resource types. *Combined resources* refer to the combination of two or more resources that exhibit no functional dependency among each other. Hence, rendering them in isolation will generate the same aggregate value. *Dependent resources* exhibit functional dependency among constituent resources. Hence, they cannot simply be recreated by rendering the individual parts independently.

The second axis considers the type of capabilities that the IT outsourcing service provider employs for tailoring IT outsourcing service configurations to different service consumer needs. We adopt the empirical findings of [15] and the distinction suggested by [16], and propose that a service provider's specific capabilities can be hierarchically classified as "operational" and "dynamic" capabilities. Operational capabilities are required for supporting the day-to-day IT outsourcing operations. Dynamic capabilities evolve from operational capabilities and lead to unique outsourcing configurations which are more difficult to be imitated or substituted.

The proposed axes enable us to create a theoretical model for exploring the tradeoffs associated with different IT outsourcing service configurations and their relation to IT outsourcing service provider capabilities. As a result, there are four types of co-created outsourcing service offerings, depicted as a classification matrix (Fig. 1).

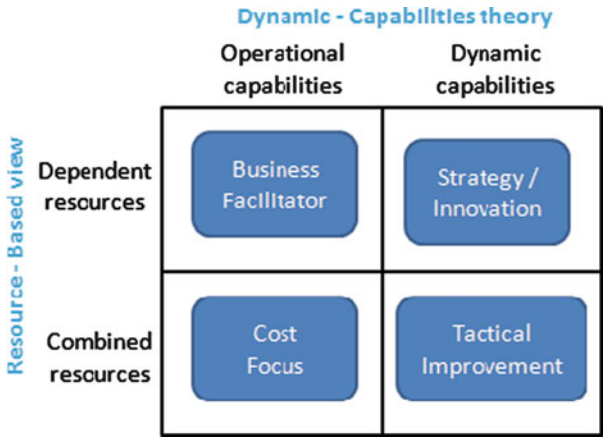

Fig. 1 Our classification matrix of IT service configurations

The starting point of the classification matrix is the **Cost Focus** class of service offerings, aimed at cost-minded service consumers. The service provider (a service system) works with a small number of partners (other service systems) and establishes market-like transaction relationships. Contracting costs, coordination costs and structural risks are low, due to the lack of specific investments in proprietary resources of external suppliers. Given the absence of structural dependencies between resources, switching costs to other partners are also low. As a result, value co-creation opportunities are limited to revenue sharing, since access to partners' competences and resources (know-how, technical talent, high-quality infrastructure) is limited or ad-hoc. The service provider utilizes operational capabilities, implying limited effort for managing the value co-creation process. Commodity IT infrastructure services is a prominent example of this offering.

Service providers that offer **Business Facilitator** configurations aim to exploit opportunities of functionally dependent offerings in order to achieve better service orientation, more (business) flexibility, quality improvements and joint product and service development with partners. Thus, significant investments are made from a service provider for coordinating and integrating resources. Although the latter manifest functional dependency, the service provider utilizes operational capabilities, which inevitably shape the nature of the offering as an "enhanced" type of the cost focus approach. One example of such offering is a semi-customized IT outsourcing service.

Service providers that offer **Tactical Improvement** offerings aim to position themselves as technology leaders by delivering cutting edge IT, or by providing long term reliable IT services. Service provider's experience and leadership is a critical influential factor along with its know-how to control the various partners that are involved in outsourcing configuration development (i.e. service offering). Similar to the cost-focus configuration, this one exhibits low structural and operational risks, but best-of-breed capabilities are used. On the other hand, coordination risks are high given the expectations of the service provider from its partners. In the long-run, economies of scale are possible, though for this to happen strict

governance and management processes are required. One example of such offering is IT outsourcing services based on a proprietary hardware infrastructure.

Vendors that pursuit **Strategy/Innovation** offerings engage in value co-creation activities, aiming to innovate and enhance their business value through knowledge acquisition and transfer, joint product and service development, and access to highly skilled IT personnel and competences. It is also inevitable to exploit economies of scale, since partners have to focus on resolving various organizational or managerial constrains like cultural differences, team building and the development of a co-creation agreement. Value co-creation opportunities in this configuration class can be exploited to their fullest, by enabling mutual access to best-of-breed competences and resources of all involved partners. To ensure proper alignment and avoid opportunistic behavior, the service provider should develop formal policies and guidelines in order to educate its partners for value co-creation. One example of such offering is IT outsourcing services through highly customized proprietary knowledge processing applications.

4 An Example Business Scenario

For illustrative purposes, this section presents a Strategy/Innovation outsourcing configuration example. As part of our research work, we used the e3-value business ontology [3] for formally exploring this scenario (Fig. 2).

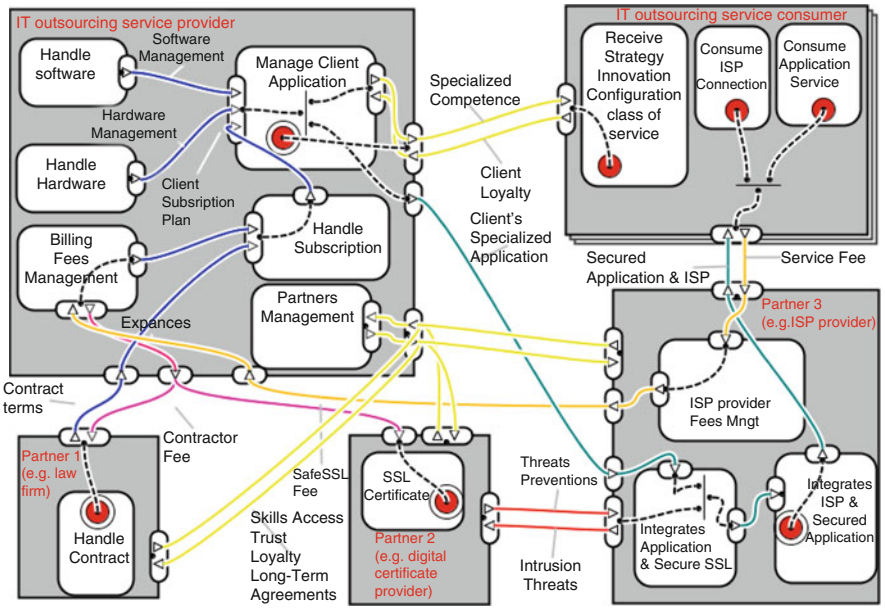

Fig. 2 e3-value representation of a Strategy/Innovation outsourcing configuration example (*yellow lines* represent value co-creation activities; *green lines* refer to the integrated outsourcing offering; *orange lines* represent fees collected by the IT outsourcing service provider)

The *IT outsourcing service provider* offers the business service *Manage Client Application*, which provides a highly specialized and tailor-made software application (e.g. knowledge processing application). The service provider's strategic intent is to work with partners on contracting, SSL certificate provision and ISP provision, while maintaining its distinctive resources "in-house" (i.e. hardware, software, billing and service consumers management). The result is an integrated service offered to the *IT outsourcing service consumer*.

For the service provider, the *Manage Client Application* offering reflects a **Strategy/Innovation** configuration, as it results from a unique combination of specialized resources provided through value co-creation activities between the provider and its partners (i.e. access to specialized resources and competences, mutual trust, loyalty, long-term agreements). The service consumer receives the co-created value of the integrated solution that results from the service partners' value co-creation activities. Hence, the service consumer inevitably positions itself as an active value co-creator, by establishing long-term loyalty agreements with the provider and exploiting the service provider's specialized integration of partner competences. All partners control the architecture of the configuration as a "decentralized offering", while allowed to access each other's knowledge, skills and competences. Switching costs for the IT outsourcing service provider are high, given the structural dependency with the resources of its partners.

Levels of commitment and trust are also high, which inevitably requires experience and leadership on the service provider side, along with formal policies for educating its partners for successful value co-creation. As partners work together, mutual trust and access to shared capabilities become key success factors to ensure that the service provider's and its partners' needs are aligned. For assisting trust development and successfully managing the long-term value co-creation activities with its partners, the service provider has established a specialized business unit called Partners Management.

5 Conclusion and Further Research

Our research adopts a Service Science-driven viewpoint and aims to explore the different configurations of resources and capabilities of IT outsourcing service providers. By combining basic principles of Service Science, Resource-based Theory and Dynamic Capabilities Theory, we developed a conceptual framework for classifying IT outsourcing configurations (i.e. service offerings). It is comprised of four configuration classes and each class is characterized by a number of managerial parameters. Although we have no empirical validation yet, the theoretical findings shed light on how IT outsourcing service providers may embark on a decision process regarding the integration of resources and capabilities for creating commercially attractive service offerings.

Two further directions for research have been identified. First, our conceptual framework must be embedded in a real-world context to evaluate its utility for

different outsourcing service configurations. Second, the ability of a service provider to effectively select and manage its partners would be enhanced by the use of a standard service description language that captures service requirements in a uniform way. To that extent, we started using USDL (Unified Service Description Language) [17] for describing the resources that partners employ in different IT outsourcing configurations.

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Sustained Competitive Advantage Using Business Entities (SCUBE): A Practical Approach for Business Agility

Matteo Della Bordella, Rong Liu, Aurelio Ravarini, Frederick Y. Wu, and Anil Nigam

Abstract Enterprises competing in today's highly dynamic business environment aim at achieving Sustained Competitive Advantage (SCA) as defined by Barney. In this paper, we present an operational method and the protocol for its application for realizing SCA through Business Entity analysis. Business entity-centric modeling has been a successful approach in rethinking and revolutionizing business operations, in a number of engagements. Our method provides a path from SCA-generating strategies to Business Operations and Business Entities. Our approach leverages key constructs from OMG's Business Motivation Model (BMM) and emphasizes the analysis of Influencers – factors that have the capability to impact an enterprise's strategies that generate SCA. Further, these strategies are used to formulate Business Operations that can be defined by Business Entities. IT applications can be generated from the Business Entities using Model-Driven Architecture. Therefore, these discovered Business Entities actually provide a valid scope for innovating Business Operations and developing IT applications that result in SCA for the business.

1 Introduction

Now, more than ever, within the current economical crisis, it is imperative that businesses adapt effectively to the changing environment. Towards this end businesses need to innovate strategically to achieve *sustained competitive advantage* (SCA) [1]. A firm is said to have SCA when its competitors cannot imitate its

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core strategy or are unable to duplicate the benefits of the strategy. Therefore, it is critical to develop the right business strategies to revolutionize business operations, and to implement appropriate IT systems to support the operations.

While identifying which strategies can generate SCA is one issue, another issue is to design business operations and IT systems which can be well aligned with the strategies.

Model-Driven Business Transformation (MDBT) [5, 6] extends MDA [9] by replacing the computation-independent model by a Strategy Model and an Operation Model. To ensure a successful top-down transformation, the Strategy Model captures business goals and the Operation Model describes business operations for achieving the goals. A business artifact-centric approach is a business-friendly technique for modeling Business Operations [2, 7].

We provide a methodology that unifies the SCA approach with the business-artifact approach to span the distance from strategy formulation to the realization of business operations and thus enables a company to adapt its business and its operation to rapidly changing environments. This method leverages constructs that have been standardized by the Object Management Group in its Business Motivation Model (BMM) [8].

In this paper, we extend from our previous work to provide practical guidelines for implementing the methodology. Towards this end we will focus on protocols that enable practitioners to execute the essential steps in the method. The remainder of the paper is organized as follows. In Sect. 2 we provide a brief account of Business Motivation Model, the concepts of Sustained Competitive Advantage, and the Resource Based View of the firm theory. In Sect. 3 we describe the proposed method along with protocol (or practice) notes. We conclude with a brief description of our future research.

2 Theoretical Background

2.1 Business Motivation Model (BMM)

The Business Motivation Model [8] is a standard adopted by the Object Management Group (OMG) in 2005, and the current version (1.1) was published in May, 2010. The BMM is a structure for developing, communicating, and managing business plans. It encompasses top-level strategic concepts such as Goals, Objectives, and Resources, but its scope ends at the boundary with Business Operations. Furthermore, the BMM has a formal meta-model that includes a vocabulary and a catalog of concept definitions.

The overall meta-model is organized into two related hierarchies that are rooted in Means and End respectively. Means is anything that may be called upon, activated, or enforced to achieve Ends. Desired Result, which is a target that an enterprise intends to maintain or sustain, is a specialization of End. There are two types of Desired Result: *Goal* and *Objective*. A Goal is a state to be brought

about by appropriate means. An Objective is a specific time-targeted, measurable, attainable target that an enterprise seeks to meet. An Objective quantifies a Goal.

A Course of Action, is defined as a plan for configuring some aspect of an enterprise undertaken to achieve ends, is a specialization of Means. Of the types of Courses of Action, the most significant here is *Strategy*, which is an element of a plan devised through the science and art of business leadership exercised to ensure the most advantageous conditions [8].

The next relevant element in the BMM is *Influencer*. An Influencer is neutral but has the capability to impact the enterprise in its employment of Means or achievement of its Ends [8]. Specifically, an Influencer can affect the Strategy of an enterprise. Influencers can be *Internal* or *External* depending on whether they are inside or outside the enterprise. Competitor, Customer, Regulation, Partner, Environment and Technology are categories of *External Influencers*. Corporate Value, Infrastructure, Assumption, Habit, Issue, Management Prerogative and Resource are categories of *Internal Influencer*. According to BMM [8] "An Influencer is something that can cause changes that affect the enterprise in its employment of its Means or achievement of its Ends" implies a direct relationship between Influencer and the Means of achieving Ends. This implies the relationship that an Influencer can affect a Course of Action. To summarize the relevant relationships we will use from the BMM, *an Influencer can affect the Strategy that an enterprise uses to channel its efforts toward the achievement of its Goals and Objectives*.

2.2 Sustained Competitive Advantage (SCA) and Resource Based View

The Resource Based View of the firm theory (RBV or RBT) [1] proposed by Barney in 1991 has the objective to understand how a company can achieve a *Sustained Competitive Advantage* (SCA) by implementing strategies that exploit internal strengths, through responding to environmental opportunities, while neutralizing internal threats and avoiding internal weaknesses. SCA can be achieved through *firm resources*. This view brings out two important concepts, SCA and firm resources. *A firm is said to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy* [1]. In this view, firm resources are defined as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of or implement strategies that improve its efficiency and effectiveness", and a firm resource that has the potential to provide SCA must have the following four characteristics:

- *Valuable* – enabling a firm to conceive of or implement strategies that improve its efficiency and effectiveness,

- *Rare* – not possessed by a large number of competitors or potential competitors,
- *Imperfectly imitable* – cannot be obtained by firms that do not possess it, and
- *Not substitutable* – there are no strategically equivalent resources that are themselves not rare or imitable.

Aware of the broad discussion among scholars about the concepts or *resource* and *capability,* we referred to Barney's definition of resource, which includes the concept of capability. *Capabilities* refer to an organization's ability to assemble, integrate, and deploy valued resources, usually, in combination or co-presence [11]. Firms create competitive advantage by assembling resources that work together to create organizational capabilities, also Penrose [10] sustain that firms can create economic value not due to mere possession of resources, but due to effective and innovative management of *resources* On the definition of SCA, apart from some discussions about the sustainability and duration of the competitive advantage [12] there is a good level of agreement among scholars. Motivated by RBV, in this paper, we propose a new methodology to investigate the sources of SCA. Following the definition of SCA which really emphasizes strategies, in this paper, we examine two specific aspects of strategies for the source of SCA: (1) specific internal or external factors that have the capability to impact strategies of an enterprise, and (2) business behaviors that realize strategies. The first aspect corresponds to Influencers in BMM. Inspired by the analysis of firm resources, we also examine if an Influencer has the same characteristics to determine its potential to generate SCA through strategies. The second aspect is referred to as business operations. Since the business entity approach has been used effectively for modeling business operations [2, 3], we indirectly create the linkage between SCA and business entities. Accordingly, an enterprise can use business entities as a vehicle for revolutionizing operations and developing supporting IT applications. Therefore, different from conceptual analysis of firm resources as the source of SCA, our proposal aims to provide an actionable method to help enterprises choose the strategies that generate SCA. This method provides practical guidance being made up of a set of formalized steps. in the attempt to fill in the gap between the exposition of a theory of Strategic Management as the RBV is, and the pragmatism of the models used by software engineers (of which BMM is a typical expression). A methodology with this characteristic represents an original contribution to both the Strategic Management and the Software Engineering field.

3 Methodology: Sustained Competitive Advantage Using Business Entities (SCUBE)

In this section, we describe our methodology for choosing strategies that generate SCA (i.e. *SCA-generating Strategies*) through analyzing Influencers and then business operations and Business Entities that realize these strategies. We illustrate the methodology, called "*Sustained Competitive Advantage Using Business*

Entities" (SCUBE) and we explicitly detail the research protocol for the applicability illustrating the roles involved and the question that need to be asked in each of the steps. It should be noted that we do not suggest that automation of this method is feasible, as most steps require deep business knowledge.

3.1 Methodology: SCA Using Business Entities (SCUBE)

Input: Defined Desired Results, Strategies that channel efforts towards the achievement of the Desired Result, and Influencers using the adapted BMM model

Output: Business Operations responsible for SCA and Business Entities produced by these Operations

Step 1: Examine if an Influencer or a combination of Influencers is valuable, rare, imperfectly imitable, and not substitutable. Select the Influencers that satisfy these properties.

Step 2: Describe Strategies that are impacted by the Influencers selected in Step 1. These are SCA-generating strategies.

Step 3: Identify Goals that are achieved by these SCA-generating Strategies.

Step 4: Identify Objectives which quantify each of the Goals.

Step 5: Identify Operations that achieve these Objectives

Step 6: Identify Business Entities produced by these Operations. Thus, these Business Entities can lead to SCA.

The **input** to our proposed methodology is Desired Results (Goals and Objectives), Strategies, and Influencers specified following the adapted BMM model. Traditional methods, for example, Balanced Scorecard [4] can be used to help an enterprise define Goals and Strategies to achieve these Desired Results. Identifying all the inputs for SCUBE application is probably the activity which requires the greatest effort: for this purpose it is necessary to interview an executive or top manager and collect all the material available including documents and power point presentation about how a company makes business. Firstly it's necessary to discover Desired Results of a company (a Desired Result is an End that is a state or target that the enterprise intends to maintain or sustain) by asking the interviewee questions such as "*What is your Vision?"* and "*What is the target state you want to reach*?". Secondly it's necessary to point out the Courses of Action of the company, which include Strategies and Tactics, it represents the basic elements of a general plan or overall solution; in other words, an overall approach that the enterprise will take to achieve its Desired Results. In particular we decided to focus on an accurate identification of strategies and the key questions to be asked are "*What are the strategies you think are able to realize the Desired results just identified?*" and "*What actions are you putting in place to reach your mission?*". Eventually to complete the input definition the most time consuming and committing part is surely related with the identification of all the Influencers, intended as described

in the BMM model. This stage is critical because we need to make all the External and Internal Influencers explicit and we need to be sure to share with the interviewee the same definitions for all the Influencers, thus for some internal Influencers such as Management Prerogative, Assumptions or Resource we provide the interviewee the BMM definitions along with examples developed by our research team belonging to another company. The identification of the Input for SCUBE, viz. Desired Results, Strategies and Influencers concludes the first part of the interview. Before starting with the second round of interviewee, that would deal with the real application of SCUBE, the research team should perform an analysis of which influencers or combination of influencers would possibly be considered of sources of SCA and would like to test against the four characteristics of SCA. That means to perform a preliminary selection of those influencers or combinations of Influencers and exclude those one which clearly would fail in one of the four tests.

Step 1 is the first stage of the second round of interview and consists of testing the preliminary selected influencers against the four attributes of SCA, parameterized with accurate questions. Within this step the research team need to challenge the executive and make her prove the value of the influencer by demonstrating its ability to enhance the quality of the service (or product) provided by the company. Subsequently we need to verify rareness: in this case the task is mainly performed by the research team that must verify whether competitors or not possess this Influencer, the opinion of the interviewee has to be taken in consideration by might be biased by her position. Then it comes the test against non-substitutability: also for this test is absolutely necessary that the research team verifies if in other companies the same strategy is realized by a different Influencer or not and moreover the questions to ask the interviewee is "*Does a one-to-one correspondence between an influencer (or combination) and a particular strategy exist?"*. Eventually regarding non-imitability the idea is to explore if the Influencer cannot be imitable by competitors due to historical reasons, causal ambiguity or social complexity, therefore the questions to be asked the interviewee are "*Is the considered influencer (or combination) directly dependent on a socially complex phenomenon?*", "*Does the company know how the influencer (or combination) generates a SCA or this link is tacit and implicit?"* and *"Is the influencer directly dependent on some particular historical reason?*". Influencers or combinations successfully responded to these for criteria are selected for Step 2.

Step 2 requires a deep commitment from the executive interviewee: it's necessary she describes in details the strategies on which the selected Influencers have their impact, what kind of impact they have and how that strategy can be linked to a Sustainable Competitive Advantage for the company.

Step 3–6 should be less critical and more straightforward: in Step 3 the interviewee has to answer the question "*Which are the goals that can be achieved by the selected SCA-generating strategies, and what's their relation with the company's vision?"*

Step 4 requires the presence of a manager that has a clear visibility on the target that the specific processes of a company has to reach. He is asked to translate the

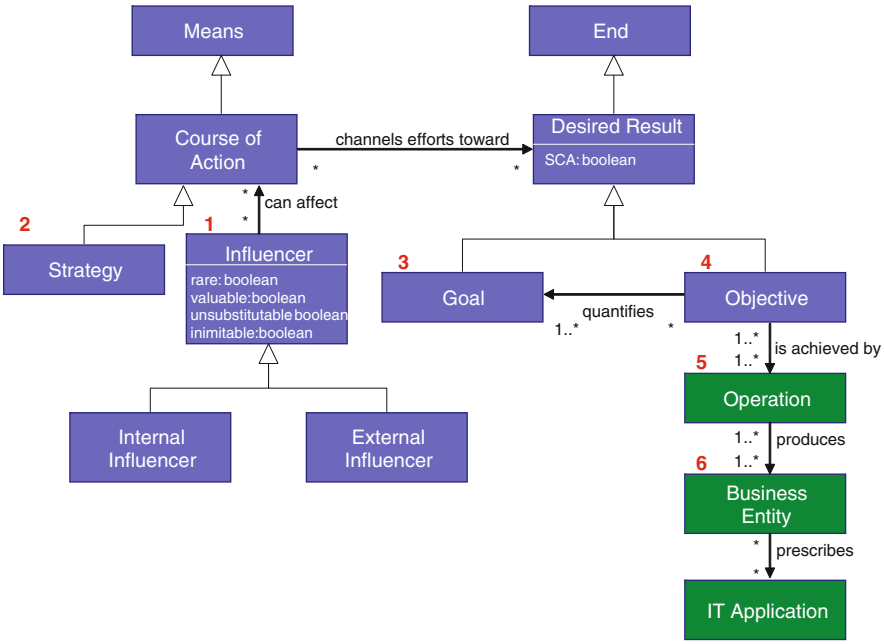

Fig. 1 Modified BMM class diagram with SCUBE methodology

goals explicated by the executives in specific objectives containing a measure and a target value for that measure.

Step 5 involves always a managerial or operative role, he's asked to identify all the operations that concur to the achievement of the specific objective, in particular he has to answer the question "*Which are the processes, information, roles and systems that contribute to the realization of the specific objective?*"

Step 6 finally should come very straightforward: the research team should be able to define from Step 5 which are the Business Entities are involved in each operation and subsequently responsible for SCA.

Figure 1 shows the main steps of the SCUBE methodology. This figure extends from BMM model by adding additional elements, SCA, Operation, and Business Entity.

4 Conclusion and Future Work

In this paper we propose a new methodology for achieving Sustained Competitive Advantage synthesizing and evolving concepts from Resource Based View of the firm, Business Motivation Model and MDBT. We illustrate the protocol for the application of the methodology that is currently being tested in real engagements.

We have a body of evidence that the MDBT framework and thinking has resulted in improving the operations of businesses significantly. The SCUBE

method described here provides the formal linkage to strategy that has been lacking in MDBT; the expected pay-off of course is business agility. A remarkable aspect of the proposed methodology is that it is very concrete in the sense that we propose a practical way that would allow any company to achieve business agility with a set of formalized steps. None of the other paradigms or models mentioned within the paper possesses this characteristic, as BMM is in fact just a model of a company's business and SCA is a principle that drove our work. Our method, properly integrated with MDBT can practically help organization in developing business solutions from strategy; development of business solutions from technological innovation is not the focus of our method.

We are aware that the methodology we proposed has some limits and needs to be tested in real applications. A first issue to investigate is the applicability domain of the SCUBE methodology. Moreover, the methodology should include a definition of a performance measurement system. A monitoring system should be put in place to provide executives with up-to-date information about the strategic impact of the initiatives performed on the business entities and the software applications that support them. This final stage of the methodology has not been defined yet.

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Financing Public e-Services in Europe: A Regional Perspective

Luigi Reggi and Sergio Scicchitano

Abstract EU Structural Funds represent by far the main source of funding for innovation in general and for Public e-services in particular in the lagging regions of Europe classified into the "Convergence" objective. The paper explores for the first time the amount of resources dedicated to public e-Services and Information Society by elaborating European Commission data on programmed resources for the 2007–13 period. Our analysis highlighted a strong heterogeneity in the level of commitment towards e-services development both between and within countries. Such heterogeneity depends not only upon the total amount of resources available, which is connected to the degree of development of the various territories, but also upon different regional strategies.

1 Introduction

The role of Information and Communication Technologies (ICTs) in fostering productivity and growth has been highlighted by a growing body of literature (see for example [1] and [2]). Moreover, the Digital Agenda [3] of the European Union, one of the key component of Europe 2020 strategy, considers Structural Funds – the main arm of European Regional policy – as a key source of funding to foster citizens' digital literacy, public agencies' interoperability and coordination, and broadband penetration among households and individuals [10].

Regional policies co-financed by EU Structural Funds represents an ideal context to quantify the amount of financial resources dedicated to Public e-services and IS. European Cohesion Policy (a) is the main – or the only in many cases – source of funding for investment in innovation in the lagging regions of Convergence objective [4] and (b) forces EU Regions to share the same rules and

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regulations when programming and implementing actions, which implies that funding is allocated and classified through common categories and definitions. In the lagging areas classified into the Convergence objective, the amount of Structural Funds allocated to IS and e-services policies represents a good indicator of the level of commitment of EU Regions to public services transformation in particular and to ICT diffusion in general.

Therefore, the aim of this paper is provide a detailed view of the available resources for e-services and IS by comparing the amount of Structural Funds that EU regions dedicate to these topics at regional level through a cluster analysis. The analysis is conducted with respect to the programming period 2007–13 and is based on an official dataset provided by the European Commission – DG Regional Policy in July 2009.

2 Regional Policies for Innovation and ICT

European regions are becoming increasingly important in the implementation of innovation and ICT policies. Even though their institutional competences and innovation leadership vary significantly across Europe [5], their institutional powers and role have increased in the last two decades in several countries. Likewise, regional innovation and technology policies gained momentum and legitimation: "the region is increasingly the level at which innovation is produced through regional networks of innovators, local clusters and the cross-fertilizing effects of research institutions" [6]. Many relevant arguments have been added by the economic literature to explain the main rationales for the regional dimension in innovation policies [4]. The line of research that investigates the Regional Innovation Systems (RIS) is the most relevant here.The concept of RIS has been introduced since the early '90s [7], [8], [9] as an extension of the concept of National Innovation System (NIS) [10] and [11] and it is well known both in regional economics and economics of innovation. Three different types of RISs have been identified [12]. The territorially embedded regional innovation systems (TERIS), where firms (primarily those employing synthetic knowledge) base their innovation activity mainly on localized learning processes stimulated by geographical, social and cultural proximity, without any strong interaction with knowledge organizations. The second type is the regionally networked innovation system (RNeIS), where firms and organizations are still implanted in a specific region and characterized by localized, interactive learning. The third type is the regionalized national innovation system (RNaIS) where the innovation activity takes place mostly in cooperation with actors outside the region at a both national and international level.

Taking into consideration the policies for IS and public e-Services development, European regions can play a pivotal role. The region can act as an intermediating agent between EU and national top-down initiatives (e.g. on interoperability, standard setting, e-ID, etc.) and the bottom-up efforts of local administrations

[13]. For example, the implementation of interoperable e-government networks requires a high level of inter-agency coordination and cooperation which is more easily manageable at the regional level. The promotion of re-use practices avoid costly duplication of software development, while the transfer of experiences from advanced administrations to less advanced ones – even when promoted by national authorities – needs to be managed in a decentralized way.

3 Data Source

The analysis is based on the official dataset on EU Structural Funds programmed resources for the period 2007–13. The dataset is provided by the European Commission – DG Regional Policy and includes data on the amount of financial resources by Operational Programme (OP) and by category of expenditure. The OPs that were formally approved in July 2009 were taken into account.

Since the OPs show different territorial scope, namely regional, national and multiregional, a matching with the Eurostat database of EU Regions (NUTS2 level) has been performed in order to estimate the programmed amount of resources at regional level. In particular, the total amount of national and multiregional OPs has been equally assigned to all regions directly involved in each OP. Consequently, the amount of Structural Funds assigned to each region is calculated as the sum of: (a) the amount of resources allocated by the regional OPs (typically, the ERDF regional OP plus the ESF regional OP) and (b) the share of national or multiregional OPs that involve that specific region.

According to the Council Regulation No. 1083/2006 of 11 July 2006, the contribution of Structural Funds to each policy priority (research and innovation, human capital, transport, energy, environmental protection, culture, etc.) has to be classified into "categories of expenditure", otherwise named "priority themes". In particular, six categories (from no. 10 to no. 15) are dedicated to the IS in general, while no. 13 is explicitly devoted to public e-Services development and diffusion.

4 Structural Funds Allocated to Public e-Services and Information Society

European Cohesion Policy covers more than one third of the European budget and amounts to almost 344 billion euros. 281 billion euros were allocated to the Convergence objective (CONV), 56 to the "Regional Competitiveness and Employment" objective (COMP) and 7 to the "European territorial cooperation" objective. With respect to the main instrument, the ERDF is the most relevant fund (with almost 278 billion euros), while the ESF amounts to 76 billions.

In particular, 15.2 billion euros are allocated to the IS, while more than 5.2 billions to public e-Services (Table 1), one third of the total. The fact that the

Table 1 Categories of expenditure dedicated to IS and public e-Services and financial resources allocated in both CONV and COMP objectives

N.	Name	A.V.	%
10	Broadband networks	2,257,722,464	15%
11 + 12	Information and communication technologies (interoperability, security, etc.)	4,121,115,554	27%
13	Services and applications for citizens	5,225,072,351	34%
14	Services and applications for SMEs	2,144,358,160	14%
15	Other measures for improving use of ICT by SMEs	1,537,162,147	10%
	Total	15,285,430,676	100%

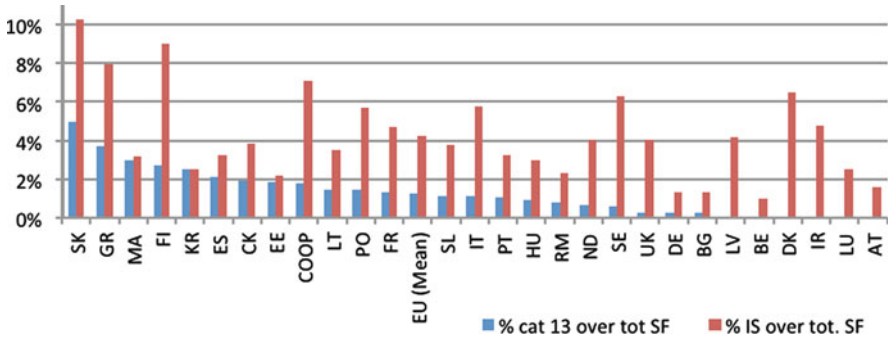
e-Services category is prevailing among the policy options available to EU regions confirms the long-standing trend in EU policy to invest in e-government, in order not only to obtain efficiency and effectiveness gains in the provision of public services, but also to improve role of governmental bodies in public procurement of advanced technology [14].

According to Council Regulation No. 1080/2006 of 5 July 2006, the Regional Development Fund (ERDF) co-finances a large spectrum of actions aimed at fostering Information Society, including: the development of electronic communications infrastructure; the development of advanced content, services and applications, the improvement of secure access to and development of on-line public services; aid and services to SMEs to adopt and effectively use information and communication technologies (ICTs) or to exploit new ideas. Thus, the large majority of financial resources for IS (15 billion euros) and e-services (5) comes from the ERDF, while the ESF – which is competent for the dissemination of information and communication technologies and e-learning, as from the Council Regulation No. 1081/2006 of 5 July 2006 – allocates respectively 128 and 90 million euros.

As already reported, CONV Objective absorbs the majority of Structural Funds. Regions belonging to CONV objective planned to invest almost 12.5 billion euros for the IS (almost 4, 5 for the public e-service). The expected investment by COMP regions is about six times lower than those of CONV Objective. It is interesting to note that, while the financial effort from COMP Objective is limited in absolute values, they show the highest value in relative terms.

4.1 Financial Resources at the National Level

Figure 1 shows the amount of Structural Funds allocated to IS and e-Services (category no. 13) by the EU Regions and aggregated at a national level.The Slovak Republic shows the highest values with respect to both e-services and IS resources over the total amount of Structural Funds available. Greece and Finland also show relatively high values, while Poland, which is the Member State that received the largest amount of Structural Funds in 2007–13 period, is now just over the European average.



CAT 13: Resources dedicated to public e-Services; I.S.: Total resources dedicated to Information Society development; S.F.: Structural Funds

Fig. 1 Financial resources allocated by Member State, in %

Data shows a significant variation in the amount of resources dedicated to e-services actions, especially if compared to the resources dedicated to other IS themes. For example, in Countries such as Spain, Estonia, Malta or Slovak Republic e-services investment represents more than the half of IS total investment. Other Countries, such as Sweden, Denmark or Italy, seem to focus on other priorities classified into the remaining IS categories of expenditure (10, 11, 12, 14, 15).

4.2 Financial Resources at the Regional Level: a Cluster Analysis

In order to explore the allocation of Structural Fund in each single EU Region, we performed a univariate cluster analyses and classified the European Regions into homogeneous classes based upon the allocation of funds e-Services (category no. 13).

The Jenks optimization method, also known as the goodness of variance fit (GVF) was applied [15, 16]. The method assigns the highest values observed to the first cluster, and the lowest to the fifth cluster, while the remaining values are classified into intermediate classes by minimizing the squared deviations of the class means.

This technique first orders the values from low to high. As a second step, it calculates the sum of squared difference (SSD) for the possible first breaks, calculating the SSD for every possible break. It then finds the SSD for each of the next possible breaks, as if a previous break had already happened. It determines the SSDs for all of the requested breaks, and then it chooses the best last break from the last list of SSDs, the best second to last break from the second to last list, etc. This provides the best set of breaks from the entire list of possible breaks:

$$SSD_{i..j} = \sum_{n=i}^{j} \left(A[n] - mean_{i..j}\right)^2 \tag{1}$$

which can be substituted to

$$SSD_{i..j} = \sum_{n=i}^{j} A[n]^2 - \frac{\left(\sum_{n=i}^{j} A[n]\right)^2}{j - i + 1}$$

where:

- A is the set of values that have been ordered from 1 to N.
- $1 \leq i < j < N$
- Mean i..j is the mean of the class bounded by i and j

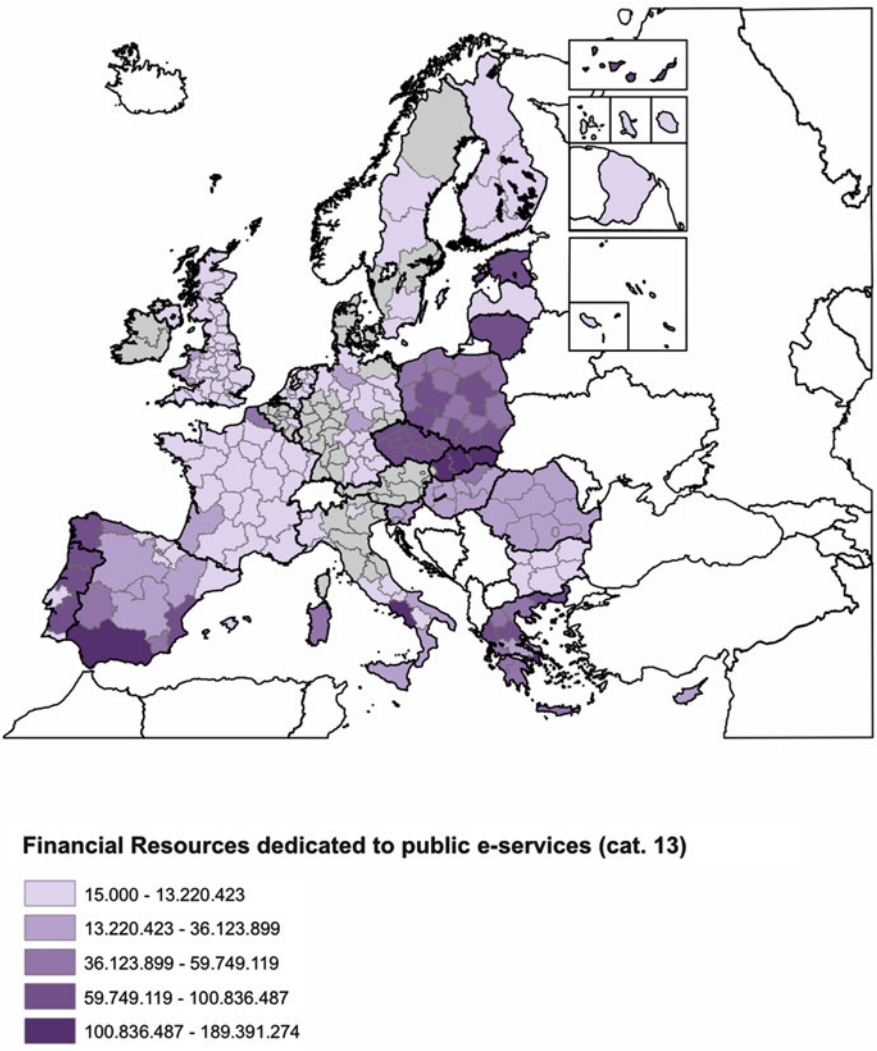


Fig. 2 Structural funds dedicated to public e-services development in 2007–13 period

Table 2 Financial resources dedicated to public e-services by cluster, average values

Cluster	Average amount of resources (€)
Cluster 1	164,164,097
Cluster 2	73,442,227
Cluster 3	50,298,301
Cluster 4	24,043,678
Cluster 5	2,716,310

With regard to the planned funds for e-services (Fig. 2), all the regions in Slovack Republic except Bratislavsky have planned high investments in e-Services (more than 189 million euros). Campania (147,5 milion of euros), Andalucia (Spain) and Attiki (Greece) are positioned in the first cluster. Sardinia in Italy plus three Spanish, seven Greek and ten Polack regions, Pas-de-Calais (France), Észak-Magyarország (Hungary) belong to the second cluster.

As highlighted in Table 2, the analysis makes clear a strong heterogeneity in the total amount of resources dedicated to e-services by EU regions. Such heterogeneity between regions depends not only on the total amount of structural funds at their disposal, which is linked to the degree of territories' development, but also on different regional strategies, as explained before.

5 Conclusions

In this paper we explored the contribution of European Regional Policy to public e-services development and diffusion across Europe by using evidence on Structural Funds allocated to Information Society by all European regions. We provided key figures at European, national and regional level showing the amount of programmed funding dedicated to this topic by Fund, objective, Member State and region (NUTS2). Such a detailed picture is provided for the first time and may also represent a useful tool for benchmarking purposes at regional level.

In particular, in the case of the regions of Convergence objective (mainly located in Southern and Eastern Europe), the amount of EU Structural Funds dedicated to these topics represents a good proxy of the total amount of resources actually available for public and private sector to finance ICT projects.

Our analysis highlighted a strong heterogeneity in the level of commitment towards e-services development both between and within countries. Such heterogeneity depends not only upon the total amount of resources available, which is connected to the degree of development of the various territories, but also upon different regional strategies. For example, the analysis at national level showed that in some cases e-services represent the core of the whole IS strategy, while in other cases the regional priorities are focused on other themes connected to the IS development (such as broadband diffusion or ICT among enterprises).

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About the Relevance of eDemocracy in Italian Regional Websites

Mario Bochicchio and Antonella Longo

Abstract This paper explores the diffusion of eDemocracy and eParticipation services provided by institutional websites of Italian Regions in 2010. By using content analysis methodology, we examined eGovernment services, functions, and features of Italian Regional portals in relation to broader and more active citizens' participation in public activities. The investigation instrument is established upon the Italian legal framework, user interaction theories, e-government sophistication models, and comprehensive literature review. The research reveals that most of eParticipation efforts at Regional level are limited at information provision and one-way interaction services. Most Regions perceive the importance of social networks and have a presence on it, even if their posts are not frequent and are not used for official eParticipation services. Some advanced eParticipation experiments exist, but they are occasional (e.g. a specific regional law, a specific eParticipation initiative, ...) and not scaled-up to become stable practices for regional eDemocracy services.

1 Introduction

In Italy local government is comprised of three levels: regions, provinces and municipalities. According to the strategic framework and laws defined by the Central Government, regions can autonomously define their own policies, laws and finances, and provide important services related to health, education, transportation, welfare, local development, employment and environment. In performing their local administration duties, elected regional presidents are chief officers of local governments. Executive power is exercised by the regional government (*giunte regionali* in Italian) while the legislative power is vested in the regional

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councils (*consigli regionali*). As so, regional governments are accountable for successes and failures of local eGovernment and eDemocracy policies and processes. In recent years Italian regions have made visible progresses in ICT infrastructure and in some sectors of eGovernment. However they are far from exploiting the full potential of the Information Society. This is evident in the low diffusion of the Internet among the population, although Italian enterprises, despite their small size, have made remarkable progress in using ICT as a business tool. With the e-Government 2012 national plan, the central Italian Government aims to modernize the Public Administration (PA) and the relationship between PA and citizens in terms of transparency, effectiveness, efficiency and user focalization. In terms of infrastructure, broadband population penetration (53% of households have an internet connection in 2010) is lower than the EU average, while DSL coverage (74%) is somewhat above, but 12% of the population has no or insufficient connectivity. To reduce the digital divide, the Broadband National Plan (*Piano Nazionale Banda Larga* in Italian) defines how to provide at least 2 Mbps across the country. For enterprises the scenario is better: penetration is 84%, above the EU average of 83% [1]. Overall Italy remains an average performer on most eGovernment indicators. The availability of public services for citizens and enterprises has been constant since 2007, at 58% for individuals and 88% for enterprises. Take-up is relatively good for enterprises but quite low for citizens (around 17%). Italy has embarked on a comprehensive and ambitious strategy of administrative reform, putting eGovernment at its core. In setting its strategies, Italy is aligned with EU policy frameworks such as i2010, being active contributor to EU projects and programs in this area. Notwithstanding these shortcomings, Italy ranks 38th in the UN e-Government readiness index globally (it ranked 27th in 2008) [2].

The legal framework where the digitalization of Italian PA poses its root is the Code of Digital Administration (Law n. 82/2005 and its modification with law n. 235/2010). Its aim is to provide Public Administrations and Public clerks with ICT based tools to improve efficiency and effectiveness of the whole public system, simplifying administrative procedures and enhancing them with ICT. The law introduces the legal value of digital registers and digital files, enables digital payments and digital services, and digital exchange of data between Public Administration and enterprises, enriches contents published on institutional web sites with transparency.

In order to promote transparency, accountability and improve access to information in Public Administration portals, the Italian Minister of Public Administration and Innovation (MiPAI) stated Directive 8/2009's guidelines [12], where minimal contents each Public Administration must present are listed. They are about organizational structure (i.e. information about public managers, their CVs and salaries, the list of certified emails for interacting with citizens and enterprises), Administration's rules and public bids. Moreover some guidelines for assessing web portal quality are described, based on the identification of a radar with six axis (Participation 2.0, openness, accessibility and usability, legal and technical requirements, services, contents).

Starting from the Italian directive and research references about eGovernment and eDemocracy evaluation, in this paper a scheme for evaluating local government websites is proposed and an attempt is made to assess the performance of Italian Regional websites against this scheme, with particular attention to eParticipation services. The proposed scheme contributes toward the development of a worldwide evaluation scheme that would measure the quality and sophistication of e-government websites. The paper is structured as followed. Section 2 describes the methodology, Sect. 3 shows results, while Sect. 4 is for conclusions and future works.

2 Evaluation Method

This research investigates the status of Italian Regional e-Government and the relevance of e-Participation and e-Democracy practices using content analysis methodology. Content analysis is a research technique for the objective, systematic, and quantitative description of the manifest content of communicator [3, 4]. It has been intensively applied in research of consumer behaviour, public communcations, and media analysis. Recently, it has been frequently used to investigate the Internet usage, e.g., Website content and structure [5]. For government services and functions are delivered via the Internet media, content analysis presents an effective methodology of evaluating e-government practice. Based on the online sophistication model developed by the European Commission, which defines five stages of e-government service maturity [7], we establish a research instrument in which the measures of eGovernment functions are organized into five stages: information, one-way interaction (downloadable forms), two-way interaction (electronic forms), transaction (full electronic case handling) and personalisation (pro-active, automated). Content topics and functions were structured either according to services areas Italian Regions must deliver to citizens and enterprises, or required by Central Public Administration (i.e. the Minister of Public Administration and Innovation) for transparency and accountability and stated in Directive 8/2009's guidelines [12]. We identified 13 services areas which we crossed with sophistication stages. In eDemocracy areas we mapped sophistication services according to the classification described in [10] and defined in Demo-Net project [11].

On the other hand, we analyzed the overall use of interactive and social media in Regional portals, in order to investigate the Italian Regional attention to the latest ICT trends (push, pull technologies, social networks, multimedia tools). At first we scouted all Regional portals, once we had identified all tools, we scored each portal against the others.

Regional social and economic factors, such as population, education infrastructures, ICT society (domestic broadband, domestic internet, Internet users, etc.) and income factors are gleaned to support analysis.

The unit of analysis is the Regional's e-government portal. An e-government portal is as an official entry website that contains information about and links to the

services provided by all regional departments and agencies. A portal is created from the idea of "onestop service centers" [6, 8].

An e-government portal is an umbrella website where services of different administrative levels, departments, agencies are organized together. Italian Regions are relatively stable administrative units; and a Region' mission, tasks, and scope of services are well defined.

Therefore, an investigation of Italian Regions' official e-government portals can effectively help us understand the status of local governments' adoption of eParticipation and eDemocracy.

Italian Regions are 20 territorial entities with their own statutes, legislative power and functions. Five of them have self-governing special statute and one of them (Trentino-Alto Adige/Südtirol) is made up of two autonomous provinces, owning legislative powers similar to Regional ones.

In Italian juridical law a Region is autonomous in several areas, self-sufficient in several administrative areas (like education, health, mobility, etc.). Regional legislative and financial autonomy has been considerably enlarged by the constitutional reform in 2001, even if it is still not active.

All regional e-government websites were coded and analyzed. Regional URIs (Unified Resource Identifier) are coded according to the following rule: http://www.regione.<region's name> .it. Actually according to the Directive 8/2009 all Italian Public Administrations must belong to ".gov.it" domain, but this rule is not still used by Regions. Regions with composite names, like Emilia Romagna, Friuli Venezia Giulia, use special domain characters, like www.regione.emilia-romagna.it, or abbreviations, like www.regione.fvg.it.

Totally 20 domains were found, verified and analyzed by the time of data collection. All regional websites were double checked to make sure they were official Regional portals. Several Regions have developed thematic websites (often for touristic and welfare services) out of their main domain, but they were filtered out, limiting the analysis to the main domain.

Social and economic factors such as a regional population, education, income etc. were collected from Eurostat, Italian Tagliacarne Institute websites.

Totally, there are 28 social and economic factors in the list.

Three trained, independent students examined and coded regional e-government portals from January to July 2010.

As suggested by Kolbe and Burnett [9], the authors did not participate in the data collection to ensure objectivity and avoid any potential bias..

3 Key Findings

Assessment highlights only two main categories of user types: citizens and enterprises. In the analyzed domain we didn't find any orientation to more specialized taxonomy (i.e. tourists, unemployed, etc.).

eDemocracy and eParticipation services are still at its early stages. More specifically information provisioning about political activities (i.e. repositories of Regional

laws and regulations and official acts, Council calendars, Regional Commissions calendars, law proposal procedures), are wide spread, even with advanced multimedia features (i.e. multimedia archives of meetings), but two ways interactions and transaction stages' services are still in infancy.

Some Regions (i.e. Emilia Romagna, Lazio,) promote surveys and forums but usually a few citizens participate and enliven forums and discussions.

An excellent example among eDemocracy initiatives is the Sicilian eDemocracy portal (www.ars.sicilia.it), which integrates consultation, dialogue, information provisioning services in a well designed multimedia portal. Alas citizens are little active in forums and surveys.

In general despite the sophistication of eParticipation and eDemocracy services, citizens are little present and active.

Transparency, according to minimal contents stated by the Italian Law, is still low. Figure 1 shows the level of each Region, showing generally a mean around 50%.

The main current requirements are related to Administrative transparency, which means the list of concourses and request for proposals, the list of clerks' email and certified emails, the regional organizational structure, the list of online services, information about the Regional one stop shop, employees' salaries and absences rates.

Some information is only present in some portals, like the legal exposure, the variable part of clerks' salary for achieving performances. It is interesting to notice that only one region (Apulia Region) is able to drill down the list of instances processed in each office with final deadlines, organizational structure and manager's name.

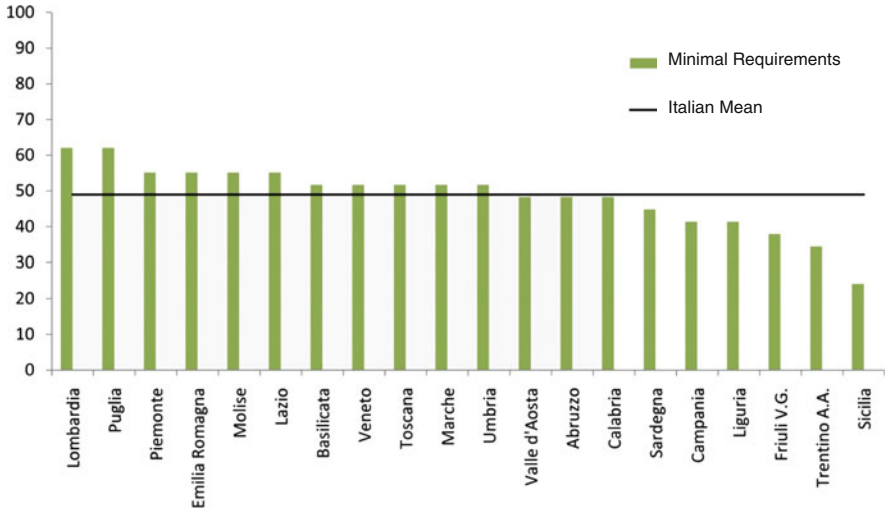

Fig. 1 Coverage of Italian minimal transparency contents

Some contents totally lack, like the list of services to be activated in the future, the 3-years plans of transparency and integrity.

3.1 Interaction, Collaboration and Web 2.0 Tools

Interaction and collaboration are present on Regional portals. Figure 2 shows the main tools present in Regional portals.

The most diffused tool is the newsletter (95%), sometimes focused on specific topics and distinguished between citizens and businesses.

Contact forms are also present for sending requests and communications from the institutional portal. Citizen sends his/her comment but it doesn't receive back a request id, which could easily enhance transparency and accountability in communication processes. Further enhancements would impact back office procedures, like sending the requester the clerk's name processing the request, or sending the requester the state of the communication if it is processed by different officers until the final answer.

Discussion forums are also common about public infrastructures and welfare.

Information provisioning about public meetings is even sophisticated: 70% of Regions publish live video streaming of public meetings even if the user experience in multimedia archives searches needs improvement in terms precision and recall.

The diffusion of Web 2.0 is still at its early stages. Less than 50% of Regions link the main social networks (i.e. YouTube, Facebook, Twitter) from their institutional portal (Fig. 3).

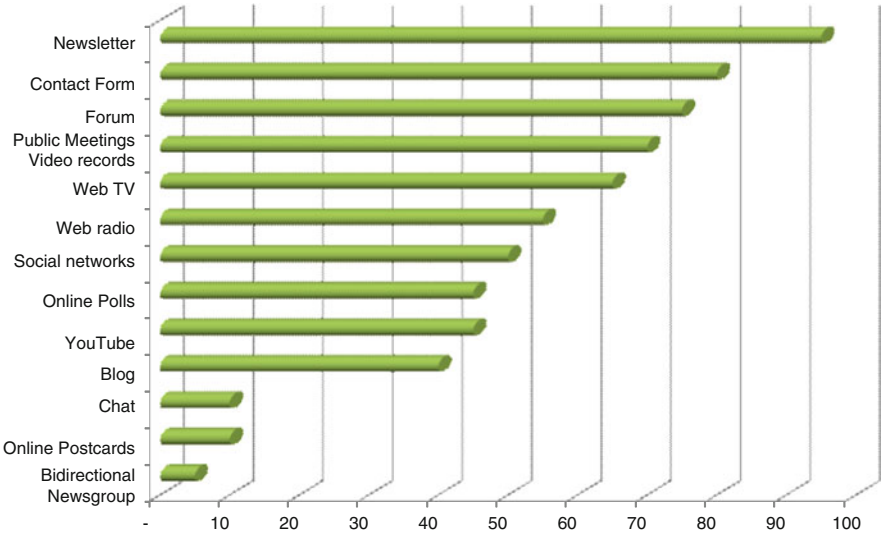

Fig. 2 Coverage of interaction tools present on Regional Portals

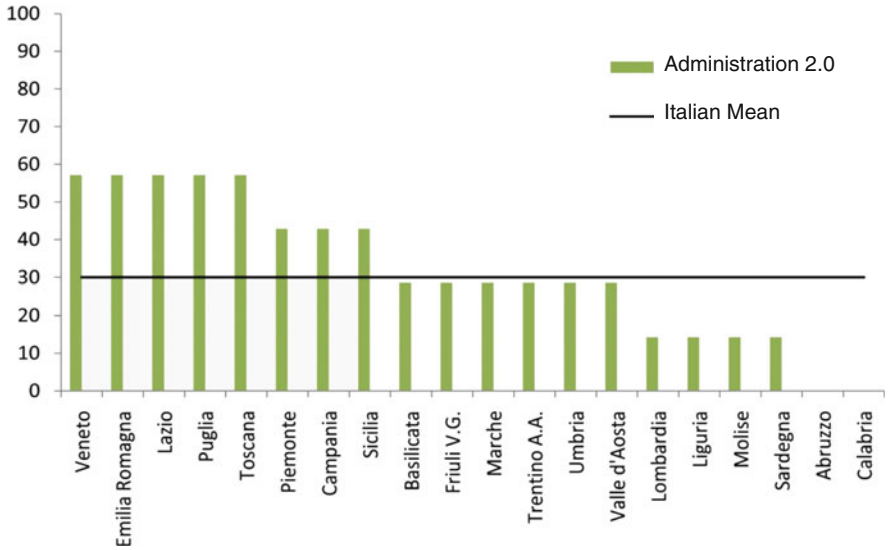

Fig. 3 Administration 2.0 in Regional Portals

Blogs and bidirectional newsgroups for sharing comments about Regional actions and activities are rare. Currently these tools are still very expensive in the management because they require human moderators for effective filtering and we foresee they will spread when semantic web will be more matures. We found only one example of bi directional newsgroup: ioPartecipo (I participate in English), the Emilia Romagna's eParticipation portal. In general Regions with the

If we consider the coverage of collaboration and interaction tools in Regional portals (Fig. 3), the most numerous are Veneto, Emilia Romagna, Puglia, Lazio and Toscana, while only a few Regions (Veneto and Piemonte) use YouTube and Flickr for sharing video and pictures.

4 Conclusions and Further Works

We have presented the results of a survey about the state of eDemocracy and eParticipation in Italian Regional Portals.

Even if current eParticipation and eDemocracy research topics are advanced, like l'eVoting, eConsulation, services delivered by Local Public Administrations in Italy are very far from the research state of art and usually eDemocracy services little weigh on overall eGovernment.

Multimedia contents (WebTV, WebRadio, interviews, pictures galleries, ...), push (i.e. newsletter) and asynchronous (i.e. forums) information services are widespread, but the communication model is usually one way (from Administration to users, from the Regional President to citizens, ...). User Generated Contents (UGC), like YouTube, are rare.

Because of the shortage or lack of laws, regulations, directions and procedures which bind Administrations to take into account input coming from the Net, today eParticipation is still an experimental arena more than a systematic and structured approach of regional stakeholders' involvement.

Rephrasing the statement that "every policy initiative becomes sooner or later an ICT project" [7], it seems emerging a picture where new opportunities enabled by ICT generate eParticipation initiatives with potentially relevant political impact.

The debate on efficacy, costs, organization aspects, human resources, methods and tools necessary to support these initiatives are still to be investigated.

In order to enrich the present work about eDemocracy, further investigation will extend the sample of local Public Administrations currently included in the survey with provinces and municipalities with specific focus on value one Public Administration exchange with stakeholders, in order to link performance and perceived value.

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Collective Intelligence and Social Computing: A Literature Review

Luca Cremona and Aurelio Ravarini

Abstract In recent years the rise of 2.0 applications and platforms, commonly known as "social software", has been promising to provide firms and organizations with new ways of communicating internally and externally. The main characteristics of these solutions are to improve information flows at many levels and between different actors. Its most credited potential lies in the support to team work and project management where people, by exchanging information and knowledge, can act – collectively – more intelligently than the sum of single individuals, producing what is referred to as *collective intelligence*. This emerging concept – as such still under definition – can be described according two different perspectives: at a conceptual level it is the intelligence emerging from the distance collaboration of a multitude of individuals based on on-line software systems and, at the IT level it is the bunch of user-centric applications often addressed as *social computing* that enhance an high degree of community formation and exchange of information. This research paper aims at defining a comprehensive framework of social computing and collective intelligence to draw a coherent and non-redundant picture of this rapidly growing domain. Through a multidisciplinary approach we identified about 160 articles, published after 1990 on conference proceedings and journals in the fields of information systems, knowledge management, organization science and innovation management. Within this set 60 relevant articles were reviewed in order to infer a limited set of n aggregated definitions and identify the related most promising areas for future research.

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1 Introduction

The need for improving and exploiting internal communication between members of an organization has always been critical for the organization itself. Since the rise of communities of practice (CoP) the idea of providing better information to professionals about a set of specific topics contributed to the development of virtual communities of people (VCoP) [1]. In particular having a domain, i.e. "a social fabric of a learning organization", where professionals can share insights or best practices about specific processes or the organization, has fostered a knowledge creation process that the community can share and keep a long time [2]. The extensive use of IT – combined with face to face meetings – contributed to the development of CoP and VCoP where knowledge could be harnessed and supported by professionals of an organization [3]. During the last 10 years, advances in information technology led to the introduction of new ways of creating and managing information. Content management systems, emails, presentations and electronic documents and spreadsheets were the main stereotypes for many years and led to information fragmentation. In this light, a demand for better collaboration and information sharing, specifically among project teams, led to the birth of new products and technologies that could grant flexibility in operation and cost reduction.

The need for aggregating information and facilitating communication within an organization and the members of a team, found in web 2.0 applications and platforms its natural evolution. The idea of letting people participate proactively in the creation and sharing of knowledge has totally reversed the usual information flow: from top-down to bottom-up. The architecture of Web 2.0 is nowadays well-known, because many important contributions have been carried on. These technologies made possible the production and transfer of knowledge.

This growing phenomenon, often referred to as *Social Computing* (SC), has great potential for social and business impact. Individuals are enabled and empowered to express their own creativity, to contribute in decision making problems, to share knowledge, to locate experts. Social computing represents a new research frontier for information systems because it places the user at the centre of the creation of information [4]. By transforming individual processes of interaction and knowledge creation, people can interact in many different ways. At the enterprise-wide level, social computing leads to transform corporations into social organizations "where people contribute their knowledge when they perceive that it enhances their professional reputations, when they have the experience to share, and when they are structurally embedded in the network". Corporation boundaries begin to include new players, for example consumers, entitled to influence internal decisions.

Harnessing the power given by their interchange of ideas, thoughts and replies to questions delivered via the Internet, the so-called "wisdom of the crowds" emerges [5]. This capacity of human groups to collaborate on creating, inventing and innovating, both on small and big scale is referred to as *Collective Intelligence* (CI) of groups [6]. As social computing tools enable and enrich the exploitation of

human collectives, the collective intelligence concept is gaining momentum both in literature and professionals communities.

The aim of this research paper is to define a comprehensive framework of social computing and collective intelligence in order to draw a coherent and non-redundant picture of this rapidly growing domain.

The remainder of this paper is organized as follows. Section 2 presents an overview of the terms social computing and collective intelligence, whose semantics is very blurred. Section 3 presents the methodology applied for the review of the scientific literature related to these terms and Sect. 4 discusses research issues in the interaction of social computing and collective intelligence. Section 5 concludes and identifies areas for future research.

2 Overview

In this section we present a review of the definitions of the main terms used to describe this phenomenon.

2.1 Social Computing

While a lot of literature describes what Social Computing can do, there is no specific agreement about its nature. Definitions of Social Computing overlap, most of the times, with the definitions of collective intelligence, making this research field characterized by blurred boundaries.

Under the broad definition of Social Computing are a large number of web 2.0 applications or platforms, such as: blogs, wikis, social bookmarking platforms, peer-to-peer networks, open source community platforms, photo and video sharing community platforms, and online business network platforms. Many of them have had a fast growing pace granted by new IT systems that enable data aggregation and information sharing. In particular, the growing of data connections bandwidth on the IT side, and the proliferation of online communities on the organizational side, paved the way for the rise of Social computing. With regards to the latter, important drivers are represented by the need to capture and share tacit knowledge, to find and engage experts, to attract and retain young talent, to increase organizational productivity. The evolution of Social Computing must take into account context and consistency for information works, governance and visibility for the business, manageability and integration for IT, extensibility and scalability for the future [7]. Contrary to previous communities built on traditional, centralized architectures, social computing architecture is decentralized and loosely defined, resulting in communities more dynamic and with highly transient members. Their fluid boundaries overlap with other communities and give place to a dissemination of structure and peer influence mechanisms that produce a high level of scalability [8].

2.2 Collective Intelligence

Collective intelligence is broadly defined as "groups of individuals doing things collectively that seem intelligent" [9]. It involves groups of individuals collaborating to create synergy, "something greater than each individual part" [10]. Collective intelligence is considered a determining factor in competitiveness, creativity and human development in a knowledge based economy. The collaboration of people within an organization is enhanced by the usage of technologies and applications that improve the efficiency and effectiveness of information collection and sharing [11]. Under these conditions the topic of collective intelligence gains importance and still represents an emerging research area [12].

As underlined above, Social Computing and Collective Intelligence are terms only recently introduced and have very similar definitions, so that it is an issue even to make a clear distinction between them. The aim of this work is to carry out a literature review to identify prominent clusters to describe the phenomenon these two terms represent. Taking into account the broadness of the definitions, the literature review covers a broad range of disciplines: information systems, knowledge management, organization science and innovation management. Thus, the research question is: which are the concepts behind the terms Collective Intelligence and Social Computing that characterize this phenomenon as relevant and innovative within the Information System research field.

3 Methodology

The literature review is organized around a comprehensive framework that explicitly aims at defining the characteristics of both Social Computing and Collective Intelligence. This section outlines the methodology followed to identify and evaluate relevant literature for review. As a first step EBSCO, Springer and Google Scholar were queried using the following search terms: collective intelligence, social computing, knowledge management, knowledge transfer, web 2.0, crowdsourcing, online communities, remote collaboration, organizational learning, organizational memory, innovation, human computation, strategy. We considered multiple sources: primarily books, journals, and articles using keyword searches. The literature review was primarily based on journals and books, that were accessed to examine current trends and concepts. Each source was evaluated against specific criteria, such as peer reviews, to ensure its relevance and quality. We identified about 160 articles, published after 1990 on conference proceedings and journals. For each article we evaluated both the title and abstract. The 60 articles containing the highest number of occurrences of the keywords (listed above) were then analyzed in the full text. Every article was codified in a table to collect in detail all relevant information such as: title, year, source, authors, keywords, underlying theory, possible empirical domain investigated.

4 Research Results

The literature review focused on two areas (a) definitions and applications of social computing, (b) definitions and applications of collective intelligence. Once the 60 identified papers were analytically described in the table, the evaluation of (a) the similarities in the research subjects, (b) the possible empirical domains and (c) the semantic overlaps in the definitions led to the emergence of three dimensions of analysis (or perspectives). In the following we present such dimensions and discuss how the papers deal with them.

A first relevant dimension of analysis is the academic discipline in which each paper is mainly focused: Strategic Information Systems (SIS), Business Process Management (BPM), Knowledge Management (KM) and Computer Science (CS). The articles were distributed as follows: 10% presented applications or research within SIS, 30% for BPM, 43% for KM, 17% for CS.

A second dimension is represented by the finalization of the innovative initiatives under investigation in the papers, being it called "social computing" or "collective intelligence". We identified 14 different aims driving the decision to carry out such initiatives (Fig. 1).

The third dimension is the scope of the initiatives. Two main categories emerged: in some cases SC/CI is meant as an innovation to improve the business processes of an organization, otherwise it is exploited as the cornerstone of new businesses. Figure 1 shows the distribution of the number of papers dealing with the second dimension of analysis (finalization) and the third one (scope).

Besides the most renowned case histories of start-ups building an instant success upon a social network, it is relevant to observe a number of empirical studies about

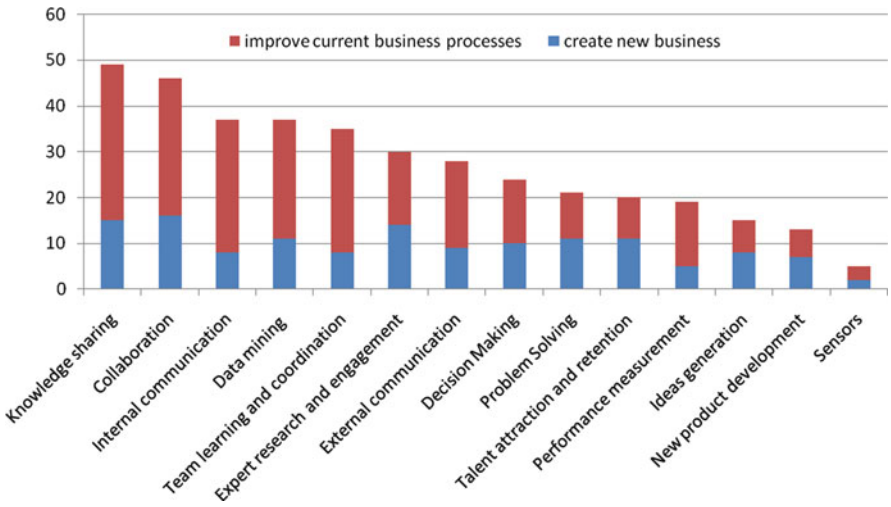

Fig. 1 Literature analysis according to the finalization (x axes) and the scope (stacks of each column) of the SC/CI initiative

business applications of SC/CI focused on a specific business process. In this latter – less frequently mentioned in the reviewed literature – the impact of the innovation may appear limited, because its scope is within a limited organizational area, but the lessons learned in these cases have – in principle – a much wider domain of application compared to the cases of Wikipedia or Facebook.

Within the investigated set of papers, the most frequent finalization are: knowledge sharing, collaboration, internal communication, data mining, team learning and coordination [13–15]. Notably, a limited number of papers dealt with applications of crowdsourcing used to capture talent and experts via the Internet in order to solve problems or generate new ideas for products development [16–18].

With the aim to define relevant research streams, a new analysis of the results drawn by the literature review and still ongoing, has been carried on. In particular we identified some variables describing the environment where the application of CI/SC was carried out: size of the organization (big, medium, small), type of financial resources (high, medium, low), type of firm (services, manufacturing). A second set of variables deal with the organizational aspects of CI/SC: group size (small, mass collaboration), extension of collaboration (internal, external), business processes involved (commercial, sales, project management and communication, research and development, . . .). A third set of variables relate to the technological aspects of CI/SC: interaction (real time, non real time), solution development (internal, external), type of system (integrated, distributed).

5 Discussion and Conclusions

The phenomenon of social computing and its organizational impact is still far from being clear. Many web-based applications labeled as *social computing* are available for professionals and organizations, but the plethora of software alternatives creates a sense of "watchful confusion" as business managers try to understand how to adopt and utilize technologies that continue to mutate rapidly.

Recent academic research attempted to enlist and describe the main characteristics and implications of social computing by collecting relevant applications, that usually respond to the need of people in a team to share knowledge and collaborate in a better way. This augmented information among team members fosters what is usually called Collective Intelligence. Through the literature review has been identified that definitions and applications of this topic are still under development.

The aim of this paper, once identified this literature gap, is to try to analyze the two phenomenon and identify future fields of study. This research, still in progress, showed that Knowledge Management and Business Process Management are the two main impacted area within an organization. In particular, from the literature examples, Social Computing and Collective Intelligence show their main benefits on people's activities and task in a complex and, usually, international organization. The main finalizations of these methodologies and applications are related to

improve the knowledge sharing and the internal communication within a group of people collaborating by extracting information in an easier and effective way.

Further research will address the of identification of the streams of research about this phenomenon that will emerge from the detailed literature review. Next, we will select a research stream to carry out an empirical research within the context of small and medium-size organizations.

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E-Marketplaces for Professional e-Services: Trust, Reputation and Performance

Alberto Francesconi and Claudia Dossena

Abstract Currently, Professional Service Firms (PSFs) are becoming more and more important in a 'knowledge-worker based' society. This trend is supported by the development and diffusion of web-based technologies, encouraging firms to outsource a wider variety of business functions, especially those not included in the company's core competencies. Many web-based platforms offering services for contractor management in the field of professional e-services emerged in these years. Reputation mechanisms are arising as key components for them because they help to build trust and to favour cooperation among loosely connected and geographically dispersed economic agents. In this work, we aim at exploring the relationship between online reputation of professionals (individuals, groups or PSFs, in brief PSFs) and their performance. We exploit one of the most widely used Web platforms for professional e-services and contractor management in the world, Elance. We try to reduce the research gap due to the fact that few previous works focused on e-marketplaces where rated and tested PSFs offer their e-services.

1 Introduction and Research Aim

Different definitions of e-services can be found in literature [1]. Nevertheless, it can be argued that they all agree about the role of IT in facilitating the delivery of services. Internet is arising as the main channel of e-service delivery.

Currently, PSFs are becoming more and more important in a 'knowledge-worker based' society. Many firms need for professional services – such as accounting, law,

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software development, engineering, etc. – due to the temporary or permanent lack in specific knowledge or being some specialized functions peripheral to a company's core competencies. PSFs typically provide customized solutions to new or complex problems [2] but they frequently offer standardized solutions too, i.e. in accounting or software development, well supported by e-services. Many e-marketplaces for contractor management in the field of professionals e-services emerged in these years, where transactions are conducted as 'reverse auctions'. Firms and individual actors can find, buy, manage and pay external professionals services and contractors from a lot of suppliers across the world. Most important, buyers and sellers are gathered together into online trading communities, reducing search costs even further. At the same time, complex issues arise such as the quality evaluation of services proposed, their heterogeneity and the information asymmetry in the exchange process [3]. A number of e-marketplaces for goods, such as Amazon and eBay, base their business model on reputation mechanisms as the primary method for encouraging honest behaviour and for reducing information asymmetry among strangers [4–6]. In a similar way, reputation mechanisms are arising as key components for 'professional e-services' because they help to build trust and to favour cooperation among loosely connected and geographically dispersed actors [5, 7, 8]. Since few works focused on e-marketplaces where rated and tested professionals offer their e-services, we aim at exploring the relationships between online reputation of professionals, trust and their performance (in terms of earnings), based on the exploitation of Elance case, one of the most widely used Web platforms in the world for professional e-services and contractor management.

2 Theoretical Framework

PSFs may very well be looked at as what Whitley calls 'reputational work organizations' [9] due to the fact that commercial considerations are increasing also for them [10].

Previous research on the role of information and reputation within e-marketplaces has focused on the quality of sellers of goods rather than services (e.g., 500 MHz processors [11], US$5 coin [12] and Pentium III [13]). Mostly based on eBay and Amazon.com experiences, previous empirical studies suggested a positive relationship between price and seller reputation [14, 15], documented the impact of reputation on sellers' bidding [4, 12, 13] and buyers' willingness to pay [13]. Apart this contributions, few works focused on e-marketplaces where rated and tested professionals offer their e-services. Our work aims at giving some explorative insights on this issue. From the customer perspective, a key issue is the potential variability of service providers in terms of service quality, skills, and honest behaviours. The marketing research literature, for example, identifies at least two distinct dimensions of service quality [16, 17]: the provider's technical skills, as evidenced by educational and professional qualifications and certification,

that increase the likelihood of a high quality service outcome; and the provider's functional ability in interacting and communicating with customers, in understanding and being responsive to their needs, being a factor able to enhance the overall service experience. Moreover, to determine the quality of professional e-services, information on their past performance as well as the aggregation of different quality signals are important to infer the service provider's quality. Most e-marketplaces have developed quality disclosure and monitoring systems, such as business specific qualification-check systems, service providers' self-advertisement (i.e.disclosures of their education and certification), summary reports and feedbacks on past works, to filter out low-quality professionals. Because entering into a transaction entails a certain level of uncertainty regarding a provider's ability or intentions, reputation assists customers in making choices. Following the literature on signalling [18], whereby social actors rely on proxies to serve as a basis for judgment of a candidate's future performance, a market participant's reputation can act to bolster or undermine their future opportunities [19, 20]. In online markets, reputation has been shown to garner a higher price as well as a greater likelihood of transaction closure [4] because reputation can also be seen as a proxy for quality or reliability. Moreover, reputation is strongly related with trust because reputation enables trust. In fact, the creation of trust can be rooted either in an anticipation that something will be forthcoming [21], or on common past satisfactory experiences [22]. Thus, being reputation a representation of a collective opinion of a certain community, professionals' reputation can be conceived as an input to a heuristic (rule of thumb/intuitive) decision about trustability, a scalable way to evaluate relationship/transaction risks within an extended community of professionals. The assertion that a good reputation is perceived as a mark that guarantees professionalism and competencies favouring trust among actors is true also, and maybe above all, on the Web, where professionals are strangers for customers. The huge number of players makes less probable repeated interaction between the same set of players, thus reducing the incentives for players to cooperate (only) on the basis of hoping to develop a profitable relationship. Because of these Internet peculiarities, many traditional trust-building mechanisms, such as repeated interactions, tend to be less effective in large-scale online environments [23]. On the contrary, online reputation mechanisms, also known as 'reputation systems' [7], artificially engineer large-scale word-of-mouth networks in online environments through aggregated feedbacks on service providers, posted and publicly available.

3 Empirical Setting, Method and Hypothesis

We focused our inquiry in the context of a professional e-service marketplace, Elance. Elance counts more than 130,000 registered PSFs (March 2010) that operate in more than 50 services categories grouped in eight major domains: Web & Programming, Design & Multimedia, Writing & Translation, Administrative Support, Sales & Marketing, Finance & Management, Legal, Engineering &

Table 1 Our dataset and basic statistics

Business area	PSFs subscribed	PSFs analyzed	Tot. earnings ($)	Tot. num. of projects	Num. of projects (AVG)	Earnings per project ($) (AVG)[a]
Web & Progr.	26,989	2,000	19,348,214	21,022	13.97	920
Design & Multim.	19,433	2,312	4,057,356	19,183	8.30	212
Finance & Mgt.	3,742	221	152,697	721	3.26	212
Engin. & Mfg.	2,592	202	330,191	571	2.83	578
Legal	950	110	200,081	715	6.50	280

[a] We divided total earnings by the total number of projects

Manufacturing. Elance works as a 'reverse auction'. It provides a venue for providers ('freelancers') and customers (buyers of services) to post jobs. Essentially, it's a 'Request for Bids' or 'Request for Proposals' platform. Upon delivery of the completed service, the customer can provide feedbacks on the provider's performance. Feedbacks on providers past projects give a signal on the intrinsic ability or quality of them. In this website a customer can choose the service provider through a lot of information about it, such as self-rated skills or rated by Elance (through standard tests), the overall activity, the description of previous projects. Within the profile it is also possible to check the provider qualification for Premier status. The Premier Provider Program is a merit-based membership for qualifying providers that meet key performance criteria. We collected data from five business areas[1]; we excluded all providers with no earnings, thus reducing dataset from about 100,000 to about 4,800 providers (Table 1).[2]

In our study, we referred to online professional performance as the provider's cumulative earnings gained in the last 6 months through Elance. Then, we used the feedback rating in the provider profile, arising from project history of the last 6 months, as a main indicator of provider online reputation. Each project is scored by a weighted average of six evaluations, on a rating scale from 1 (very negative evaluation) to 5 (very positive), made by customers in terms of: quality of work (the most important, weighted 0.3); responsiveness (weighted 0.2); expertise and professionalism (weighted 0.15); adherence to costs and schedule (though more objective, they are considered less important and weighted 0.1). The provider feedback rating represents an average rating of all projects the provider have done in the last 6 months. We used also another component of a service provider profile, 'being a premium provider status', arguing this is potentially able to affect earnings. Due to the fact in literature traditional 'core' trust-building mechanisms (such as 'repeated interactions') are considered to be less effective in large-scale

[1] Data are collected in January 2010.

[2] For four business area (Legal, Engineering. & Mfg., Finance & Mgt., Design & Multimedia) we considered all providers that have gained at least $1 in the website. Instead, due to the huge number of providers in the "Web & Programming" area (more than 4,100 providers), we considered only 1,000 providers with highest earnings (that gained from US$3,760 to US$513,443 in the last 6 month through Elance) and 1,000 with lowest earnings (that gained from US$1 to US$250).

online environments [23], we verified if reputation mechanisms could better explain provider's performance rather than repeated interactions. We measured the latter as the percentage of provider's customers that deals for more than one project with the same provider. Repeated interactions can increase trust between actors, though we suggest that in large-scale online environments traditional trust-building mechanisms such as repeated interactions are less effective rather than online reputation. In order to consider possible differences, we split the analysis among different Elance business areas. Finally, we defined three hypothesis:

Hp 1) providers with higher feedback ratings gain greater earnings
Hp 2) premier providers gain greater earnings
Hp 3) traditional trust-building mechanism ('repeated interactions') is less effective in large-scale online environments rather than online reputation

4 Results and Discussion

For Hp1 we verified the correlation between earnings and feedback ratings (Table 2).

Our Hp1 seems not to be sufficiently supported by data. This counterintuitive result could be explained by the limited scale adopted for feedback system and the resulting low variability of this indicator within dataset. The negative relationship between feedback ratings and earnings in some business areas can be explained by the high number of providers that have done only one or few projects (and consequently gained lower earnings) and have a high feedback rating: about 40% of providers has a feedback rating of 5 and most of them (about 48%) have only one review. Therefore, to take into account both the feedback ratings and the number of

Table 2 Correlation between earnings feedback rating and reputation index

			Feedback rating	Reputation index
Tot. earnings (last 6 months)	Legal	Spearman's rho	−.192	.794**
		Sig. (2-code)	.081	.000
		N	83	83
	Engineering & Mfg	Spearman's rho	.022	.624**
		Sig. (2-code)	.776	.000
		N	171	171
	Finance & Mgt.	Spearman's rho	.299**	.630**
		Sig. (2-code)	.000	.000
		N	155	155
	Web & Programming	Spearman's rho	−.171**	.744**
		Sig. (2-code)	.000	.000
		N	1,600	1,600
	Design & Multimedia	Spearman's rho	−.131**	.744**
		Sig. (2-code)	.000	.000
		N	1,998	1,998

** Correlation is significant at the 0.01 level (2-tailed)

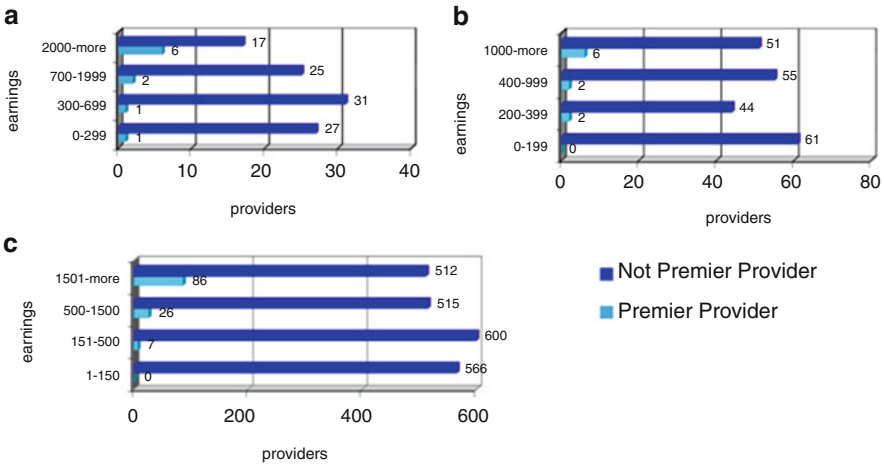

Fig. 1 Number of premier providers in each class of earnings

reviews left for each provider, we construct another variable, named 'reputation index in the website', multiplying the feedback rating per the number of reviews. After this, we found a very strong correlation between the two variables (Table 2). We can conclude that, though the feedback rating cannot explain the course of earnings, it is well explained by the combination of feedback ratings and the number of reviews. Thus, our Hp1 cannot be confirmed if we take into account only the feedback ratings (value shared in the website), but it is confirmed if we consider the feedback rating and the number of reviews jointly.

To text our Hp2 ('*Premier providers gain greater earnings*') in Fig. 1 we represent the number of Premier providers "Legal"(a), "Finance & Mgt."(b) and "Design & Multim."(c). For each business area we created four classes of earnings. For "Web & Programming" area we divided our dataset in two classes: 1,000 providers with higher earnings and 1,000 providers with lowest earnings. Due to the fact that in the first group (providers with lowest earnings) we found only three Premier Providers and in the second group (providers with highest earnings) we found 254 Premier providers, we can conclude that there is a sort of relationship between earnings and Premier Provider status. The high number of Premier provider in the "Design & Multimedia" area allowed us to use Pearson's chi-square text, confirming our Hp2 (sig. = 2.07125E−33).

Finally, as suggested by many authors, also in our case study we found a statistically significant correlation between trust and reputation (Table 3). However, though reputation and trust are related, we suggest that in Elance case reputation mechanisms better explain provider's earnings rather than trust-building mechanisms. Therefore, in Table 3 we reported also the correlation between trust and earnings. From our data, a correlation between the two variables arises, though it is lower than the correlation between the 'reputation index' and earnings (see Table 2).

Table 3 Correlation between trust, reputation index and earnings

			Reputation index	Earnings
Trust (% repeated clients)	Legal	Spearman's rho	.456**	.397**
		Sig. (2-code)	.000	.000
		N	83	110
	Engineering & Mfg	Spearman's rho	.302**	.261**
		Sig. (2-code)	.000	.000
		N	171	202
	Finance & Mgt.	Spearman's rho	.320**	.288**
		Sig. (2-code)	.000	.000
		N	155	221
	Web & Programming	Spearman's rho	.403**	.407**
		Sig. (2-code)	.000	.000
		N	1,998	2,311
	Design & Multimedia	Spearman's rho	.403**	.407**
		Sig. (2-code)	.000	.000
		N	1,998	2,311

** Correlation is significant at the 0.01 level (2-tailed)

5 Conclusions

In this work, we aimed at exploring the relationship between trust, online reputation of professionals and their performance based on the Elance case. Online professional reputation is firstly represented by the provider's feedback rating. Nevertheless, our analysis showed that the mere possession of a high feedback rating does not guarantee higher earnings. Customers does not fully recognize the reliability of this indicator on Elance. Thus, the feedback rating can become more informative if joined with the number of reviews. Therefore, we constructed a new variable, 'reputation index', combining both feedback ratings and number of reviews. This new variable is strongly correlated within provider's earnings. Another indicator of provider reputation, significantly associated with higher earnings, is the status of being a Premier Provider. Elance rewards with this status the most virtuous providers, thus representing a guarantee of their goodness. Finally, we found that trust and reputation are related and that there is also a correlation between trust and earnings. However the latter is weaker than the correlation between the 'reputation index' and earnings. Some important insights, though explorative and to be deepen in other professional e-marketplaces and from a theoretical point of view, are offered. Other suggestions for further research arise too. Firstly, we need to answer questions such as: how is the problem of gaining the first customers solved by successful PSFs? Why are there so many providers with no customers and no incomes? It could be also interesting to identify some differences, due to providers location (i.e. country or region), in terms of feedback rating relevance. Finally, the high dynamism of data in the website suggests to take into account this aspect in data collection.

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Part II
Organizational Change and the Impact of ICT in Public and Private Sectors

The Evolution of Information Systems Strategic Models: From IT Management to IT Governance. The FIAT Case

Renata Paola Dameri

Abstract This paper aims to analyse the evolution of Information Systems strategic models during the latest 10 years, pointing out the passage from a management paradigm to a governance paradigm. The paper is divided into three parts. In the first part, the author compares the two paradigms – IT management and IT governance – finding evidences for this evolution in academic literature, professional standards and business implementation. In the second part, drivers for IT governance implementation and IT governance strategic models are analysed, trying to understand the main reasons for the evolution from the first paradigm to the latter and introducing a typical model for IT governance in business. In the third part, an empirical business case is studied, that is, IT governance strategic model in FIAT Group Automobiles, to support with concrete evidence the theoretical framework introduced in the previous two parts.

1 From IT Management to IT Governance

During the latest 10 years, Information Systems (IS) strategic models have been deeply changing; if we examine this change, we can note that there is an evolution from IT management models to IT governance models [6]. Several large companies all over the world have been introducing in their IS department a unit called "IS governance", or have been developing IT governance policies to be applied all over their business units. Generally, it does not mean that IT management is disappeared, but that IT management is included in a larger, superior activity called IT governance. Indeed, to manage something or to govern something are very different each others [3].

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IT management means to manage a given technology, that is, to have well working IT all over the company. IT management focuses on business processes and especially on the better alignment between business processes and IT architecture and applications. Lean organization, fast and efficient processes are critical success factors for global business, and IT is a crucial driver for this business model. In the meantime, however, IT applications like ERP, SCM or CRM, mainly designed on business processes, require business process reengineering to reach their better results. Therefore, efficient, effective and well working business processes and IT applications are the main focus for information systems; IT is managed aiming to reach the better performance at the lower cost. Key Performance Indicators are the measure used to evaluate the impact of IT in business.

IT governance means to govern IT, that is, to pursue a virtuous behaviour including: IS strategic vision, consequent decisions and prioritization regarding IT investments, IT value measurement, responsibility and accountability [1]. We could say that IT governance is an higher activity respect to IT management, because it involves personal responsibility and it considers information systems part of the strategic success or failure of a business. To understand how IT governance really should be implemented in company, we could consider three key aspects [4]: alignment, evaluation, decisions.

- In IT management, IT operational alignment is pursued, aiming to process efficiency and effectiveness. In IT governance, IT strategic alignment is needed, therefore, IS should have its own strategic vision and mission, obviously in accordance with corporate vision and mission.
- To support this more important and strategic role of IS, also evaluation methods should be different. In IT governance paradigm IT is not only an operational instrument, but also a strategic weapon, able to contribute to value creation. Therefore, IT evaluation should consider return on investments and not only operational performance measurements such as KPIs.
- To obtain better results from IT investments and from IT governance, optimised human behaviours should be induced, to pursue the better alignment between corporate aims and IT investments, realising good IS functioning; accountability and personal responsibility are the main instruments to support this strategic intent regarding IT governance.

The passage from IT management to IT governance is therefore not simple, because it requires a deep change not only in business practices, but especially in behaviours, business culture and values regarding IS. Indeed, the shift from IT management paradigm to IT governance paradigm has been lasting for more than 10 years. We can find several evidences of this change in three sources: academic literature, professional standards and best practices, and finally business implementations.

Academic literature survey shows that IT governance has been an interesting topic till the end of XX century. In 90s, strategic alignment between business and IT has been one of the main topics in academic journals. Not only researchers in IS, but also economic "guru" wrote about IT and strategy, such as Porter [9,10].

Venkatraman [13] explicitly considers IT governance and strategic IT alignment like key success factors both for IS and for companies. But only in 2004 the more important and organic works about IT governance and IT compliance are published [2,12,14]. After 2004, IT governance has become one of the main topics in academic literature, and its definition is already mature.

Also around the middle of 2000 years, we can find mature professional standards regarding IT governance. The IT Governance Institute was settled in 90s. Its main aim is to study how to effectively implement IT governance in business, suggesting best practices and standards to be easily applied. CobIT is the most known professional standard regarding IT governance processes [8]. It was first published in 1996, but in 2005 the fourth release was published, that is, the most complete one. We can therefore argue that in this period, the theoretical study was mature and IT Governance became a major issue for both academics and also practitioners.

IT governance implementation in companies has been less fast [7]. Global surveys carried out by the most important research and advisory firms in IT, such as Gartener, Forrester, ISACA and the IT Governance Institute show that IT governance implementation has been starting only at the beginning of XXI century and that the main driver for IT governance has often been the compliance needs. However, large companies are interested in IT governance practices and are changing their IS strategic model to join IT governance, considered most suitable for supporting good decisions about IT investments in a global and high competitive economy.

All this sources clearly point out that IT governance is nowadays the emerging organizational paradigm for IS. Therefore, it is now important to understand why IT governance is the emerging strategic model and which is the framework – if it does exist – for the better IT governance implementation.

2 IT Governance Drivers and Models

Examining both literature and professional practices, as well as IT governance implementation in large companies all over the world, we could note three main drivers for this important change: technological, business, contextual.

The technological driver, that is virtualization, is a trend that permits to separate the technological layer of IS and the application one. Several technological paradigms and solutions are nowadays available, to permit to companies the outsourcing of their IT facilities, both to gain cost savings and to move to the outsourcers the management of IT common infrastructure, focusing on their own core IT solutions. From IAAS (Infrastructure AS A Service) to Cloud computing, to Service Oriented Architecture (this one far from to be implemented till now), all these technical solutions meet one well defined need: to externalise non-core IT and to maintain inside the company what is really important for each business. Obviously, to obtain benefits and to gain success from outsourcing and virtualisation, it is necessary to both understand what is really crucial and core for the company,

externalising the rest, and to be able to keep under control: relationships with outsourcers, service levels, IT architecture performance and alignment between the IT infrastructure and the real needs of the business. It requires technical performance indicators aligned with business strategies, accountability for the success or failure of externalisation, control of behaviours: in a word, it requires governance of the relationship with external suppliers and IT facilities.

The business driver is here summarised in a word, specification; however, this word hides a complex idea, regarding the business strategic value of IT solutions. In 2003 Carr [4] wrote that the strategic role of IT in business was out, because IT has been becoming a commodity, that is: a resource *must have*, if you don't want to fail, but nothing able to create a strategic advantage respect to competitors. Several researchers answered to Carr, trying to explain why IT is not so trivialised to be unable to play a strategic role in business. The most of papers regarding the strategic value of IT focus on the same idea: it is not the technology itself able to create strategic advantage, but the specific use of the technology in each combination with business, people, knowledge and specific organization of technology, processes and ideas. Analysing the evolution of IT eras, we could argue that new technological solutions are subject to two different paths, depending on their specific use into the business (Fig. 1):

- Trivialisation, that is, the IT solution is used without specific adjustment or enrichment from a company; in a short time (ever shorter time) it becomes a commodity *must have* to carry out the daily operations of the company, without any competitive value; the aim of the company is to control or reduce the cost of this IT solution and perhaps to externalise it to an outsourcer;
- Specification, that is, thanks to the continuous adjustment of the IT solution, its better alignment with specific business needs, its updating with the evolution of the business strategic goals and its enrichment with company's knowledge, the value of this IT solution for the company increases and it becomes a distinctive resource, able to make the difference respect to competitors; the aims of the company in this case is to defend this resource against competitors, to maintain it up-to-date and to prevent its obsolescence investing for its renewal.

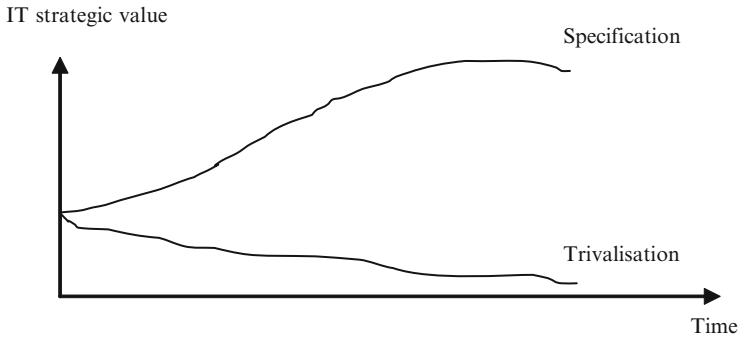

Fig. 1 Trivialisation and specification of IT solutions

To gain the better results from specific IT solutions, companies should govern their own strategic IT investments, implementing positive behaviours such as: IT investments prioritisation in accordance with IS and corporate vision and mission; measurement of the impact of IT strategic applications on value creation; personal accountability for obtained results.

The context driver is represented by compliance. At the beginning of XXI century several financial scandals regarded large companies and their false financial disclosure. To improve the affordability of financial data, severe internal and external financial auditing have been required by specific laws and rules, both by Governments and by Stock Exchange Regulations Boards (like SEC for example). The most known rule regarding affordability, auditing and financial disclosure is the US Sarbanes-Oxley Act. These rules impact also on IS. Indeed, all business data and information regarding financial disclosure should be carefully controlled; companies and their Board should grant that data processing producing financial reporting are sure and checked by monitored processes and that IS is affordable and failures prevented. To realise a so high security level for IS, a governance framework is required, both to formalise all processes regarding IT management, and to assign specific responsibility and accountability to persons who have IS in charge.

Even if compliance needs have been the key driver to IT governance implementation, because companies (especially large companies and listed ones) were forced to adopt IT compliance, this driver is only the occurrence that discovered the importance of IT governance to CIOs and top management awareness. During IT governance and compliance implementation, companies had the opportunity to understand that to govern IT was necessary to face the more and more difficult challenges of a global, more competitive environment and a complex, flexible and fast to change technology.

IT governance changes the IS strategic model. Indeed, IT governance gives more importance to the difference between decisions about IS and concrete actions regarding IS. Moreover, virtualisation and outsourcing practices separate the IT service supply from IT facilities used to produce them. The result is a three layers IS strategic model (Fig. 2), giving more importance to the relations between the different actors in the model: IT and business managers, IT workers, outsourcers and IT vendors, IT service internal and external customers. This model brings out the need to govern relations in IS, aiming at the best behaviours.

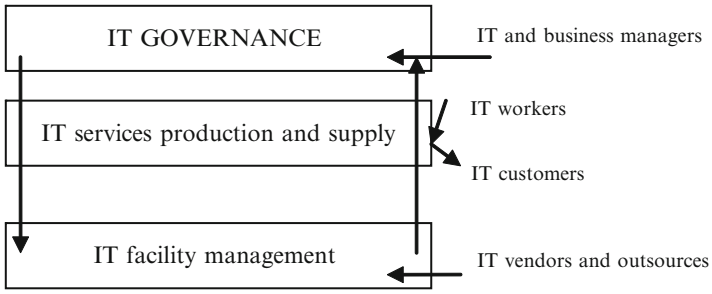

Fig. 2 The three level IS strategic model

3 The FIAT Business Case

Fiat is a global group with a clear focus in the automobile sector. Through its various businesses, it designs, produces and sells automobiles and related components and production systems. Fiat was one of the founders of the European car industry and today, as a result of its partnership with Chrysler, has a manufacturing and commercial base of sufficient scale to compete as a global automaker (www.fiatspa.com).

Fiat is a very big corporation, with a complex value chain and organization. It has several international presences and global alliances, such as the most recent with Chrysler. Its products portfolio includes several brands and the company is organised in several business units. It requires a strong commitment also in IS to govern and control a complex IT infrastructure.

The IS mission in Fiat is focused on three main aspects: quality, agility and decision support. These three main streams drive IS to pursue the excellence not only in daily operations, but mainly in business transformation and in globalisation support. To realise its IS strategic goals, Fiat decided to gradually shift towards an IS strategic model based on full outsourcing, IT architecture flexibility and high focus on specific business needs. This strategy permits to Fiat to reach high quality IT services in specific aspects regarding its own business and to be able in the meantime to change its IS organisation, in accordance with the continuous evolution of corporate boundaries all over the world.

To implement this IS strategic vision, strongly aligned with corporate strategic goals – excellence, globalisation, and business continuous changement – IT governance is really needed, to govern all the relationships between several actors involved in IS all over the world, both internal or external to the company.

This vision is summarised in Fig. 3; we can see that the more important aspect in Fiat IS strategic model is to govern ICT strategy. In Fiat ICT is a governance

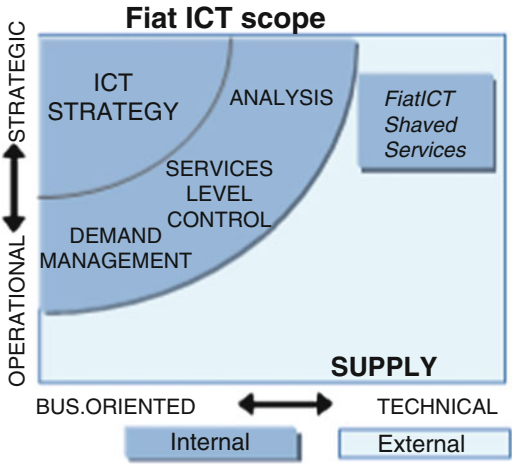

Fig. 3 The Fiat IS strategic model impementation.

structure that manages the relationship with business and outsourcers; it is based on an IT management model that implements full outsourcing strategy. All ICT operational activities are outsourced to external providers and local ICT units are allocated to countries and plants. To govern a so complex architecture, IT governance is strongly centralised. To realise both strategic and operational excellence, there is a strong commitment in governance and control activities such as Demand management, Service level management and Business requirements analysis. All these activities are internal to Fiat, because they are considered strategic and business oriented. On the contrary, all the technical, operational activities regarding IS are outsourced.

In Fig. 3 we can also verify the different weight of four IS activities on Fiat IS department. As we can note, the three levels model appears also in Fiat. The higher level, Governance, is full internal to the company; the second level, to define ICT needs and to project the IS development is more internal than external, whereas the operational and technical aspects such as Maintenance and Infrastructure are mainly externalised.

4 Conclusions and Lessons Learned

Fiat is an useful business case, to understand why and how IT governance has been becoming the leading IS strategic model. Indeed, Fiat is a real global company, in which IS is important both at operational level, and at strategic level, and finally at executive level. At operational level, IT supports operational efficiency and excellence; at strategic level, IS supports integration and harmonisation of a global business and the continuous changement in the corporation's boundaries deriving from M&A; at executive level, a strong and centralised IT governance permits to monitor and control a complex IS, composed by different subsystems, reaching a homogeneous quality of IT all over the world.

To realise these IS goals, the centralised IT governance model is the best solution, together with the full externalisation of non-core IT facilities. In this way, Fiat can concentrate its efforts on the strategic definition of IS, governing the relationships with its vendors and sourcers of technological solutions, asking them not "what" IT but "how" IT should work, that is, with excellence and in accordance with the specific strategic goals of the corporation. IT doesn't matter for itself, but IT governance matters!

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Organizational Factors as Determinants of SaaS Adoption

Antonella Ferrari, Cecilia Rossignoli, and Lapo Mola

Abstract The present study investigates outsourcing according to a Software as a Service (SaaS) model, with reference to transaction cost theory and the resource-based view. Specifically, this research determines the key organizational factors that influence decision making about SaaS adoption, including people, operative processes, and providers. Economic and technological aspects further enable SaaS adoption. In turn, the innovative choice of SaaS on a strategic level makes operating processes more efficient and reduces time to market. The choice of SaaS provider depends on its expertise related to the client's business processes, its reliability, and the strength of its relationship with the client.

1 Introduction

Any make-or-buy decision affects the structures and organizational processes of the company making the decision, which implies that decision making necessitates the determination of the most efficient organizational assets. This study extends traditional research into the connection between organizational projects and information systems to investigate how companies can outsource services efficiently, even if those strategic services previously have been developed exclusively within the company. New information and communication technologies (ICT) entail increasingly advanced connectivity and virtualization, which prompts managers to reconsider their organizational boundaries. In response, changing processes lead to more agile and flexible companies. For example, the emergent SaaS (Software as a

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Service) phenomenon offers a means for ICT providers to supply services through web-based platforms. This study employs existing theory, including transaction costs (TCT) and the resource-based view (RBV) to analyze potential outsourcing forms that are based on an SaaS model [2]. In particular, this research outlines the key organizational factors that affect decision making about SaaS adoption, with an emphasis on people, processes, and providers. Moreover, costs and technology can help enable SaaS adoption. The results confirm the importance of choosing SaaS strategically: It can make operational processes more efficient and reduce the time to market.

After this short introduction, the next section explicates SaaS adoption theoretically according to key elements of TCT [3, 13–15] and the RBV [1, 7, 11, 12]. After explaining the guiding framework and research setting, this article details the multiple case study methodology adopted, which features 16 medium- to large-sized Italian companies. Finally, the results, presented together with a discussion, lead to several conclusions.

2 SaaS Adoption: A Theoretical Framework

The Software as a Service model, which has existed in ICT for nearly 10 years, refers mainly to software for distribution and development. It aims to substitute a product-provision concept with service provision by offering a wide set of virtual resources that are easily accessible and usable (e.g., hardware, development and/or service platforms), dynamically resettable for optimal use, and provided with a pay-per-use model [9]. Although these strategies are focused in ICT, their theoretical basis derives from organizational theories, including the RBV and TCT, which attempt to specify the SaaS adoption decision according to the strategic values it involves.

In particular, the RBV considers the impact of choosing SaaS on human resources and the internal operations of adopting firms. The RBV assumes that strategic resources get distributed among organizations heterogeneously, which is a permanent characteristic [5, 7, 11, 12]. Transaction cost theory [3, 4, 13–15] instead represents the organization as the result of all relevant contracts and transactions, such that it regulates the acquisition of supportive resources to enable internal activities. This model features structural organizational alternatives that depend on the decision between two extreme possibilities: hierarchy or market. The latter is a form of outsourcing. Therefore, to analyze sourcing decisions, it is appropriate to focus on the transactions that derive from an SaaS approach. If the goal of such decisions is to optimize operational processes, such as facilitating cost-effective internal transactions or making external relationships more efficient, then it also is necessary to define adequate levels of service. Estimating the transaction costs then is a function of three critical variables [15]:

– *Investment specificity*. In the case of SaaS, specificity refers to the software package intended to support the product and/or services demanded.
– *Environmental uncertainty*. This variable, in the field of IT outsourcing, reflects a combination of uncertainty about business and technology [6], expressed in terms of unpredictability in business development (e.g., pricing, processes, services levels) and modifications of technical characteristics and functions over time.
– *Transaction frequency* between parties.

3 Guiding Framework

On the basis of the RBV and TCT, the focal research question for this study emerges: What key organizational factors determine SaaS adoption? In turn, the analysis involves five separate but related perspectives:

1. Processes. Which factors determine the choice of operational processes, and what expectations do companies have about process improvements through SaaS?
2. People. Can an internal orientation or practical experience be considered discriminating factors for SaaS adoption?
3. Provider. How is the provider perceived, and what requirements must it have to be considered reliable by the client company? What distinctive features appear in the offered services?
4. Economics. What is the investment approach, and how does SaaS meet the particular needs of the clients? What influence is exerted by an analysis of costs, cost controls, or related opportunities for economies of scale?
5. Technology. How mature is the SaaS technology, and how well does it match the companies' processes and business, such that it can optimize firm performance? Do complementarities exist between the SaaS model and the internal structure and human resources of the firm, and if so, can the model support the organization correctly and efficiently?

4 Research Setting and Method

Using a multiple case study method [8, 10, 16], this research analyzes 16 Italian companies. The data collection involved direct observations, informal conversations, recorded interviews based on a semi-structured questionnaire, and focus group interviews. The direct observations and informal conversations clarified the study context, prepared the researchers for the interviews, and provided ideas for extending or revising the analysis. All interviews were recorded, to enable the close examination of all considered elements that have an influence in this research and to provide a common basis for all 16 case studies. Thus it becomes possible to structure the comparative analysis of the results according to the proposed model. The interviews,

based on the semi-structured questionnaire, involved the IT managers of 13 large to medium-sized companies, in three economic sectors: 7 industry, 5 services and 4 financial.

Considering the size the interviewed companies are:

10 with more than 1,000 employees
2 in the range of 501–1,000 employees
1 in the range of 251–500 employees
1 in the range of 100–250 employees
2 in the range of 20–99 employees

The software packages span various types, which allows for a more comprehensive analysis, including customer relationship management systems (25%), enterprise resource planning (25%), ad hoc systems (25%), document management systems (6%), accounting (13%), and business intelligence (6%).

5 Results and Discussion

Across the 16 relatively large companies, the software uses mainly focus on support for core processes and rely on heterogeneous supply models. For example, in a simple supplemental model, the vendor coordinates with the SaaS provider; in another, more sophisticated model, the client company becomes an SaaS provider for its own clients. Still other models suggest systems integration, such that specific services offered in software packages combine with existing systems.

The operational processes perspective, as perceived through the RBV, implies that optimizing processes constitutes a strong motivation for SaaS adoption. For example, in some study companies, relevant software packages enabled processes that previously were nonexistent, such that they resolved a fundamental lack at the organizational level. Because SaaS software packages are considered very "customizable," they encourage varying personalization levels. Even in its standard version, without any modification, SaaS can provide operational support. In these cases, the supported processes are core to the firm. The conventional wisdom that SaaS cannot make critical processes more efficient thus finds no basis in the studied cases; on the contrary, it improves cost monitoring, mitigates operational risk, avoids technical slowdowns, enhances efficiency, and demands performance and service continuity guarantees from the provider. Thus the strategic consideration of SaaS is critical, especially if the company believes its internally managed or licensed software does not contribute sufficiently to its processes.

The people perspective recognizes the key resources of the firm and considers how SaaS can help those human resources learn and improve their different skills and abilities, especially in connection with new physical or organizational resources. From an empirical standpoint, the case study informants confirm the widespread belief that SaaS represents innovation and the future. The IT staff is involved and motivated, which suggest little concern regarding negative reactions

or a loss of identification with the company. Managers' proactive attitudes represent strategic decisions; involvement by the IT staff allows for movements of skills and internal knowledge to address any contractual or control aspects. No resources or skills get abandoned; rather, skills are converted to be more oriented toward the relationship with the provider, which ensures the fulfillment of business needs. However, one indirect negative element emerges, namely, IT skills that are not fully exploited but also cannot be converted to support different activities. Yet even this element does not represent a significant deterrent. On the contrary, if the obsolescence of some internal skills make core operational processes more efficient, then the strategic value of the decision increases through improved performance.

From the supplier perspective, a strict and specific relationship is preferable, because it creates a sort of dependence. Investment specificity offers incentives for SaaS adoption, whereas uncertainty lessens this incentive. Client confidence must be strong initially, or else the contract negotiations become overly complex and expensive as the partners attempt to dictate flexibility margins and other terms. A closer partnership than appears in traditional supplier–client settings is preferred.

The technology perspective is significant in terms of the service, scalability, and security. In particular, uncertainty has negative effects according to the preceding perspectives, yet it is never easy to define ex ante the appropriate service flexibility levels that will ensure the advantage and protection of the company. Therefore, relational support exerts a positive effect, both on the initial collaboration and during the progression of the relationship (e.g., monitoring, control). However, it has negative effects during contract definition, when uncertainty plays an important role. Overall, the contract formulation and drafting phase remains very challenging.

Finally, in line with TCT, the economic perspective offers confirmation of the promise of SaaS, though cost rarely emerges as the focal decision-making variable. Without speed or operational efficiency, cost benefits offer little value. Therefore, the study informants refer particularly to their appreciation of solution flexibility, dynamism, and speed, which in turn support superior operational efficiency. This final consideration links this perspective to the process perspective and its related strategy. From a transactional point of view, costs diminish in the short-term; the optimization of processes allows them to remain low over time, due to improved efficiency and stronger economies of scale. Cost advantages on an infrastructural level and in terms of installation time also arise, especially in comparison with traditional supplements, which provide another strong motivation for SaaS adoption.

6 Conclusions

The development of software on demand has arisen due to the potential to create strategic alliances between clients and providers, which helps mitigate the contractual risks that firms normally perceive. A conscious, correct definition of the adequate levels of service protects client organizations from the uncertainties often associated with technological and business development.

Companies therefore consider SaaS, which can give them a software package that supports their core business (e.g., customer relationship management, enterprise resource planning). Growing demand focuses on guarantees of adequate service to make processes more efficient. This feature represents a core challenge for providers. Furthermore, clients must develop the internal skills to achieve distinctive performance and thereby obtain competitive and sustainable advantages while also undertaking an efficient process for the architectural restructuring of their internal IT.

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Exploring the Impact of Innovation Policies in Economic Environments with Self-Regulating Agents in Multi-level Complex Systems

Francesco Niglia, Dimitri Gagliardi, and Cinzia Battistella

Abstract This work aims at exploring the possibilities offered by agent-base modelling techniques in explaining the mechanisms underlying the outreaching effects of policy measures and a platform in support of policy evaluation. This aim is accomplished by modelling and simulating the organisations' and systems' reactions through the implementation of alternative strategies. In order to validate and showcase the application of agent-based modelling as a policy impact assessment tool, the team has concentrated its effort on the agro-food domain of the Puglia Region of Italy. This paper provides a first evaluation of the application of a legal framework fostering organic products and reducing the OGM goods.

1 Introduction

The evaluation of the impact of innovation policies on economic systems has been at the centre of the research policy debates for several decades. While several approaches emerged, these can be traced back to the classical view of economics and political sciences. The rationale assumed by these views has often been that of market failure (corrective policy actions and subsequent evaluation against the failure). Instruments and techniques used to carry out innovation policy impact

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studies have also been those of classical econometrics and qualitative analysis [8,19]. These approaches have based their impact assessment "exercises" on the application of linear (or quasi- linear) theory in deterministic environments, thus greatly limiting the possibility to evaluate the non-linear consequences of the additional synergies brought by the innovation itself (feedback) or on the qualitative analyses of cases where a number of methodologies are followed to assess the direct and indirect impact of a policy [7]. These two main methods are continuously developing and great advances are consistently published in the field of econometrics (i.e. endogenous growth theory and computational modelling) and in the qualitative and semi-qualitative assessment research field (i.e. social network analysis and behavioural additionality). Alternative rationales for policy making are only beginning to emerge, for example the system's failure approach [15,17] or the approaches of complexity and networks (Santa Fe institute, [2,4,6,10,11,16]). However, given the complexity of the object under scrutiny, the research team concentrated its effort on the development of a methodological approach to policy evaluation that is gaining popularity in theoretical studies and has proved to be equally grounded in the general economic theory and in the principles of political economy: agent–based modelling in complex systems. This paper is the first output of the research undertaken in this area by the research team and the aim of this work is to explore further the possibilities offered by the agent-base modelling in explaining the mechanisms underlying the outreaching effects of policy measures. This aim is accomplished by modelling and simulating the organisations' and systems' reactions through the implementation of alternative strategies without compromising on the statistical properties of econometric modelling techniques or the realism of qualitative evaluation yet probing further into the non linear characteristics typical of complex economic systems. In order to validate and showcase the application of our agent-based model as a policy impact assessment tool, the team has concentrated its effort on the agro-food domain in the Puglia Region. This case has been selected as representative of an economic domain in which innovation policy can be determinant in driving regional development.

2 Theoretical Background

Agent-based modelling is the generic designation of a family of computational techniques used in the simulation of the behaviour of a number of agents acting as decision-makers in a given environment [9,13]. The agents are the key elements of the theory; they represent those actors that, during simulation, interact in a given environment. The behaviour of such agents is usually typified in terms of learning/adaptive rules and simple behaviours (mostly reactive); their interactions "create" complex dynamics along hinged structures. This is often referred to a self-organization process: given the learning and behavioural rules, the agents organise spontaneously and autonomously, without external intervention, nor any central structure [1,5,12,14]. Moreover, the advancement of computational techniques pushed these

models to an even higher level of complexity. Regarding the theoretical foundation, the most interesting and widespread agent architecture is the Belief-Desire-Intention (BDI) architecture, introduced by Bratman as a philosophical model for describing rational agents [3]. It consists of the concept of belief, desire and intention as mental attitudes, to mimic human actions. Beliefs capture informational attitudes, desires motivational attitudes, and intentions deliberative attitudes of agents. Rao and Georgeff [18] have adopted this conceptualisation, built their formal theory and an execution model for software agents based on the notion of beliefs, goals, and plans. EXAMPLE is based on JADEX technology employed to facilitates the use of BDI models in the context of mainstream programming. It does so by introducing beliefs, goals and plans as first class objects; these can be created and manipulated "inside" the agent. This framework bypasses the problems related to occurrences like multiple equilibria and temporal irreversibility. In fact, the evolution of a system of interrelated agents involves non-predictable dynamics without top-down planning and therefore, increases the analytical power of the model when an emergent phenomenon is unexpected and not-predictable. That is why agent-based modelling can provide an experimental platform enabling the application of complexity theory for policy evaluation: it can be an effective tool to study complex systems and processes of emergence and self-organization.

3 Methodology: The Agro-Food System in Puglia Region

In the Puglia Region of Italy there are some 245 thousand companies and organisations, mostly SMEs, engaged in the agro-food industry constituting the 15% of the total national agro-food sector (ISTAT, 2010 – Data 2007). In 2007, the value of production was of €3.4 billion; of these, 39% came from arboreal cultures, mainly olives and grapes. Potatoes and other vegetables constitute the 37% of the total value. The remnant 24% of the sector's value is given by agricultural services (14%), meat (9%) and feedstock (1%). The Puglia Region is relatively important nationwide for the production of durum wheat, olives and grapes. Also the region is one of the national leader in the production of tomatoes for industrial use (1.7 million tons) and olives (1.1 million tons) both supplying the 35% of the national production. Grapes, with a production of 993 thousand tons, provide 68% of the total national production and durum wheat, with 817 thousand tons, covers 21% of the total. The regional agro-food system has been modelled on the actual data available from official databases (i.e. Eurostat and ISTAT). This formalisation has been used to evaluate the variables pertaining to each agent and to collate the time series against which we benchmarked our simulations. In doing so we were able to provide the metrics that are then used to define statistically the agents and fine-tuning the simulation.

3.1 The Characteristic of the Model and Relation Among Agents' Categories

The authors identified 18 agents in the system; each agent represents a different category of actors in the agro-food sector, including the final consumer. A "buffer" agent whose role is to complement the results obtained in the simulation with the expected ones has also been introduced. Figure 1 describes the actors of the agro-food system and their inter-relations. The level of disaggregation is such that each product of the agro-food value chain and relative supply chain is identified. The model constitutes a representation of each agro-food good and its specific supply chain, thus preserving the scalability on each product and enabling the analysis of the impact on single or agro-food categories. In more details, the agro-food model for the Puglia Region is defined by a three-layer category of agents: the "producers", the "manufacturers" and the "sellers". A further class of agents, representing the final consumers has been added to complete the value chain and un-modelled exogenous factors, complete the system. The relations among the agro-food categories (agents) are listed as: (1) exchange of goods; (2) exchange of money; (3) definition of contracts and (4) communication/branding on the supply chain. The system dynamics has been analysed and transferred in software routines. The scheme deployed for the Puglia Region agro-food consists of 18 active agents that are so classified:

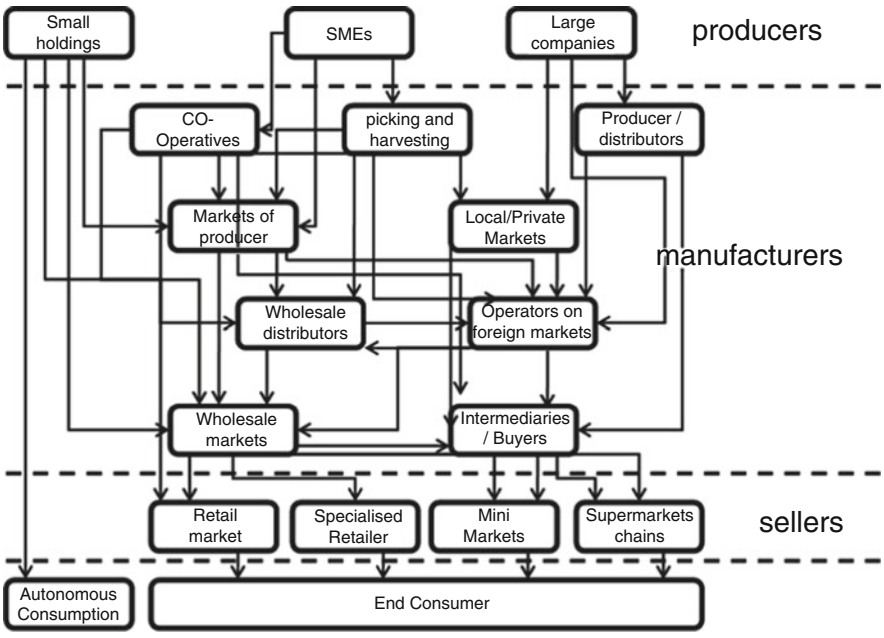

Fig. 1 Interaction among agents in the adopted model for Puglia Region

- *3 "producer" agents;*
- *9 "manufacturers and manufacturing services" agents;*
- *4 "sellers" agents;*
- *2 "final consumer" agent enabling the dynamics of the final step of the market;*

Each agent identifies a category of economic actor in the model; each arrow indicates the connections and the direction of the exchange of goods. The dynamics in the model is ruled by the behaviours of all agents. The behaviours are extrapolated from the data analysis.

3.2 The Selected Indicators for the System

The indicators offer different views on the evolution of the variables and the system's dynamics at each step of the simulation. Four indicators reflect the main factors characterising the agro-food environment, i.e.: goods (M), total revenue (R), number of companies (Q), and employment in the sector (Na); and a fifth indicator has been added to ascertain the sustainability of the system. The five indicators are:

- *I1 "total revenue" = the sum of the revenues of all the agents in the system.*
- *I2 "total stock" = the sum of the stock value of all the agents in the system.*
- *I3 "total number of companies" = the sum of the number of companies belonging to all the agent categories in the system.*
- *I4 "total number of workers" = the sum of the personnel employed in all the agent categories in the system.*
- *I5 "sustainability" = the capability of the system to preserve companies and work-places defined as a function of the distributions of I3 and I4.*

Each indicator is normalised to the value of 1 against its initial value and it is always positive.

3.3 The Dynamics of the System

3.3.1 The Agent Reasoning: Agent's Learning Patterns and Behaviour Routines

EXAMPLE is based on native JADEX routines customised to our purposes. Our original algorithm "I/O goods trading" works as follows: each agent gathers up-to-date information about the status of the system's indicators and the endogenous variables and uses them for creating its belief-base. All agents use the same behavioural routines traceable to the actions of selling and buying. To these, we included a third routine describing a more complex behaviour deriving from the

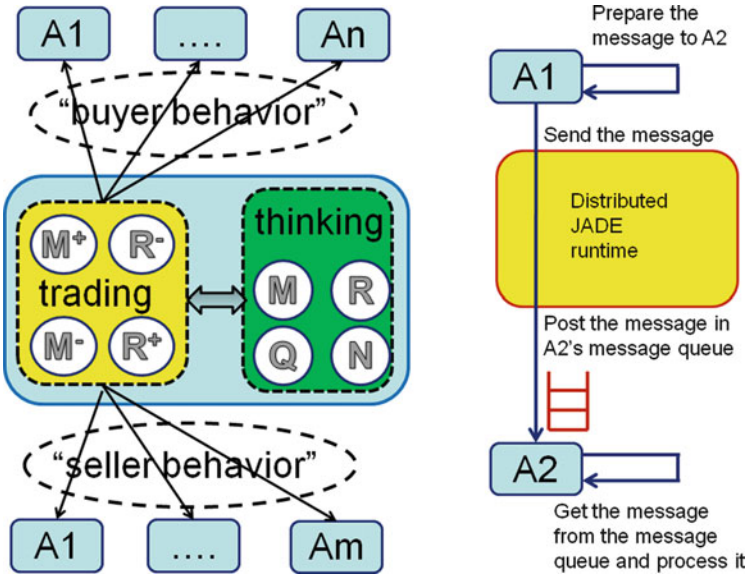

Fig. 2 Scheme of a mixed behaviour for applied agents

fact that some agents perform the roles of buyers and sellers in the supply chain. The schema of the "I/O goods trading" algorithm is described in Fig. 2.

The 18-model system is represented by 3 "seller" agents, 13 "buyer-seller" agents and 2 "buyer" agents. Each agent is engaged in selling its products and purchasing products from other agents at the best economic conditions basing its decisions on the level of its own stocks. If more than one seller agent provides an offer, the buyer agent accepts the best one (i.e. the lowest price, quality of the produces, characteristics of the suppliers etc.). In order to guarantee a certain stability of the model and introduce a more realistic dynamics in the price/quantity relations, we have introduced the working hypothesis that prices and quantities are somehow sticky. In other words, the variance of these variables is kept within a certain range. The market dynamics is based on a set of procedures taking into account the evolution of the independent variables (Q, Na) as well as the dynamics of direct variables (M, R) as described in Fig. 2. All operations are based on the concept that the simulation is carried out through steps and it ends when the system has found a stable configuration. To this end the system's control operates on two levels: (1) evaluation of each single step of simulation and (2) evaluation of the system's configuration. Each simulation step terminates when a satisfactory solution in buying-selling is found for all agents or, if such solution is not reached, the system adopts a hierarchical rule to terminate the step. The independent variables are calculated as empirical expression of the dependant variables collated from ISTAT (2011, Conti Economici Regionali, 1995–2009). The model works with the discrete percentage variations of the variables calculated as $\Delta = (X_t - X_{t-1})/X_{t-1}$ where X is the variable at hand. EXAMPLE uses the following:

$$\Delta Q = f\ (\text{coeff.}\,\Delta M,\ \text{coeff.}\,\Delta R) + \text{Error} \tag{1}$$

$$\Delta \text{Na} = f(\text{coeff.}\,\Delta M,\ \text{coeff}\,\Delta R,\ \text{coeff}\,\Delta I) + \text{Error} \tag{2}$$

Where Δ I represents the gross investment undertaken by the agents.

Once each step of the simulation is considered achieved, the control shifts to the "system" layer. This latter layer provides information about the five system's indicators, updated at the step of reference, and includes a check about the system stability that is evaluated against the stability of indicators themselves as a case of dynamic equilibrium. Here, "dynamic equilibrium" is a minimal condition imposed on the system: the system does not behave uncontrollably or the variables become meaningless.

3.3.2 The "Buffer Agent"

The buffer or "ghost" agent has been introduced to "smooth" the differences between the modelled (calculated) system and the real economic dynamics that occur in such environments. The buffer agent is the result of an empirical survey that takes into account the responses of the system to a solicitation and the expected results evaluated against official data sources.

The adopted approach, at a macro-level, is the following

$$\text{Result(simulation)} + \text{Result(buffer agent)} = \text{Result (expected)} \tag{3}$$

$$\text{Result(buffer agent)} = \text{Result(official)} - \text{Result(simulation)} \tag{4}$$

In particular, the role of the Buffer agent is that of minimise the difference between Result (expected) and Result (official). At the micro-level, the buffer agent operates accordingly to the logic described by (3) and (4) involving every single variable of each agent and the system's indicators. To this end, the buffer agent is defined through a linear polynomial equation:

N = **V**ariables (i *as index*)
M = **I**ndicators (j *as index*)
A, B = normalisation coefficients

$$\text{Agent}_{\text{BUFFER}} = \sum_{(i=1,N)} A_i * \mathbf{V}_i + \sum_{(j=1,M)} B_j * \mathbf{I}_j \tag{5}$$

The linear polynomial equation is recursive, a consistent vector of A and B characterises each solution of [A, B]BUFFER. Also, this approach allows evaluating different "stresses" to the system.

4 Findings and Conclusions

This paper has the ambitious objective of proposing an additional, yet complementary, tool for policy evaluation. It comprises the elements of a complex economic system: variety of actors, complexity of relations, regulatory framework and organisational dynamics. It comprises a set of rules: adaptive and reactive behaviours that the agents of the system follow in their decision making process; and an IT platform where individual agent's "priorities" are the drivers of the systems and the system's dynamics do endogenously play out. The results obtained are presented in such a way that step-by-step analyses can be carried out and the interpretation of the effects can be ensured through a set of system's and agents' indicators while accounting for the contribution to the system's performance of those variables that cannot be endogenized. This provides an easy-to-use platform onto which engage in the evaluation of alternative scenarios. While the application of such modelling techniques is still at its inception, the model has given encouraging preliminary results. It is in fact appropriate to describe and analyse non-deterministic dynamics of complex systems yet conserving those statistical properties of econometric models relating to the explicative capacity of the model and the statistical significance of the results. Moreover, the structural stability of the model is assessed throughout its operations and fine-tuned through the "buffer" agent. In fact, basing our evaluation on some performance indicators, the impact of exogenous variables on the model can be evaluated as a percentage of influence on the system dynamics and monitored at each simulation "step". Preliminary findings are described in Fig. 3.

The findings show how the system reacts to the application of a legal framework aiming at strengthening the production of organic produces and decreasing the production of OGM produces. The introduction of the new policy framework causes the system to react, in the first instance, by exerting a positive effect on the Revenue, thus reducing the overall Sustainability. Subsequently, once the transition phase is over, the system stabilises at a higher level of revenue

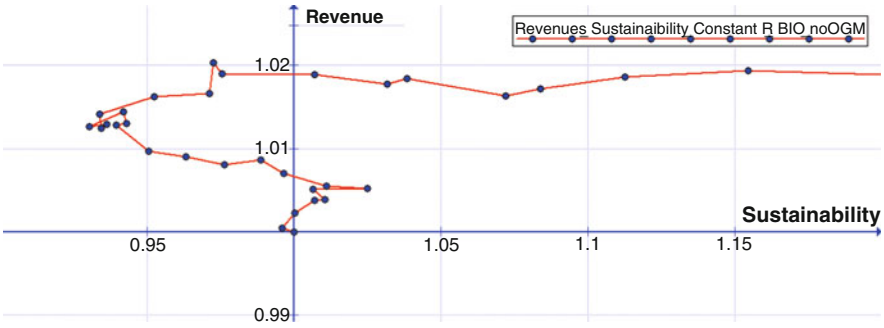

Fig. 3 The sustainability of the agro-food environment and related revenue level after the application of a legal framework targeting to organic and non-OGM productions

(I1 = 1,02 limit) while the sustainability indicators increase (I5 = 1,2 limit). The practical implications of our study are manifold but primarily they can be established in the domain of policy evaluation. In particular, once the model is validated and assessed against historical data, the impact of innovation policies can be assessed against its systemic objectives and evaluated at a more disaggregated level, for example at the agent level (a group of enterprises or a single production value chains) without requiring further modelling. At the same time, the forecasting capabilities of our model are such that to match or rival econometrics simulations by means of integrating into a statistically sound structural model the possibility of analysing alternative scenarios. As a consequence, the study is mainly directed at policy makers, research and development funding institutions and organisations by providing a further evaluative tool in their decision making process. Compared to traditional tools, this model offers analogous statistical properties and an indicator-based summary, making its employment relatively free from interpretation issues.

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Managerial and Organizational Impact of ERP Systems in Public Sector Organizations. A Case Study

Alessandro Spano and Benedetta Bellò

Abstract Drawing on a questionnaire survey conducted in an Italian Regional Government organization, the paper presents an in-depth analysis of the organizational issues linked to the introduction of an Enterprise Resource Planning system. The results of the second part of the research based on the results of the first qualitative part where a Focus Groups (FGs) analysis was used, are provided. A structured questionnaire, made specifically for this study by operationalizing the variables raised in the previous phase in ten types of questions, has been used. The sample is composed of 775 employees and managers users of the ERP system. Results show that, broadly speaking, employees believe that organizational rather than technical aspects are the main obstacle to fully utilizing the ERP system, that knowledge of the system did not spread through structured or programmed actions (e.g. training). Limitation and future research perspectives are also discussed.

1 Introduction

The role of information systems is crucial to provide data and information needed to manage any kind of organization, and public sector organizations have been investing heavily on Information Technology (IT) and Information Systems (ISs). Markus suggests that IT alone is not enough to improve organizational performance, but it needs to go together with organizational changes in order to produce "technochange", with potentially great impacts on people, processes and organizational performance [8]. One of the main reasons why public administrations have been investing in ERP systems is to help them provide better services at a lower cost and additional studies on information technology in the public sector [5] and on ERP in particular [10] are necessary to increase their effectiveness. However, the

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introduction of a new IS is, sometimes, a difficult if not traumatic event, which needs to be handled with caution. Most pieces of research on ERP systems focused on the implementation phase, analysing the main critical success factors for a successful installation [12], even though success may have different meanings, according to the different perspectives taken (ERP vendors, consultants, project manager, or with a company-based perspective, [9]). Some researches found out that users acceptance and organizational issues are of particular relevance. As regards the first aspect, the successful implementation of a new technology requires, among other aspects, that the intended level of usage is achieved, as system usage is a measure of its acceptance by the users [2]. Users' acceptance is a critical success factor for ERP systems implementation [7]. As regards the organizational issues, the implementation of ERP systems, in particular, has an impact on several aspects, such as the individual working behavior and organizational processes [9,14]. Sedera et al. [11] measured the organizational impact of an ERP system implementation with five variables: organizational costs, staff requirements, overall productivity, product/service quality, business process change. Somers and Nelson [13], in a survey of 86 organizations that introduced an ERP system, found out that support of senior management, redesign of business processes to "fit" what the software will support, investment in user training, avoidance of customization, and use of "business analysts" are success factors for an ERP implementation. Other research found out that management attributes associated with the successful implementation of the ERP in the public sector are top management's knowledge of the system, top management's preparedness to support the project team's efforts to manage change generated by the ERP system implementation and to support the implementation process [4].

Allen et al. [1] consider the organizational culture a factor that influences the success of an ERP implementation. Holland and Light [6] state that organizational aspects and individual perceptions are, together with the technical aspects, the main reasons for ERP systems implementation problems. One of the key issues for a successful ERP implementation is the organizational fit of the ERP [7].

While the implementation phase and the related critical success factors have been relatively widely investigated, less attention has been devoted to the post-implementation phase, when the decision to introduce an ERP system is irreversible and it is important to understand its long-range impact. In fact, the effects of an ERP system unfold also after the implementation phase, and it is necessary to understand what they are and how to cope with them for the whole ERP life cycle [3]. However, there is a lack of attention for the post-implementation impact of ERP systems throughout ERP life cycle. Some of the problems experienced in the post implementation phases originated in the earlier phases, and often remain unnoticed or unsolved, and the measure of success may be different in different moments [9].

ERP systems are critical to organizational performance and survival [9] as they represent the most advanced solution for providing public sector organizations with effective ISs. For this reason we believe that investigating the effects of their introduction and use on the organizational processes and individual working

behaviour is a particulary relevant issue in order to understand what are the main reasons for resistance to them.

This paper focuses on the managerial and organizational implications of an ERP system in a public sector organization, by analysing a case study related to an Italian regional council, after 4 years from the system kick-off. Two questions guided this research. First, what are the organizational effects of using an ERP system? Second, what are the main causes of resistance against a full use of the ERP system (individual working behavior)? Even though it is an explorative research whereas no specific hypotheses or models are tested, according to the literature and the results of the qualitative phase [14], the strong effects an ERP system generates on internal business/individual processes and resistances to the system caused by organizational and cultural issues more than technical ones, are expected to be found.

2 Methodology

The paper illustrates the results of the second part of the research carried out through a structured questionnaire. The questionnaire was built based on the literature review and by operationalizing the results of the first qualitative part where a Focus Groups (FGs) analysis was used (for further details on the qualitative part see [14]). The aim of the quantitative part is to provide an understanding of what organizational aspects, problems and aspects related to the introduction phase of an ERP system, are more meaningful and relevant to describe the impact of this kind of systems on organizational processes and individual working behaviour for a larger sample of ERP users (for this part means and standard deviations have been calculated). Moreover, using a correlation and a regression analysis, the paper underlines some organizational effects and some plausible causes of resistance generated by an ERP system. Data from the questionnaires have been analyzed by SPSS software.

2.1 Measures, Procedure and Sample

Being part of an exploratory research, carried out through a qualitative analysis in order to deepen comprehension concerning the introduction of an ERP system into a public sector organization, which, in the Italian context, can be considered as a “new phenomenon” [15], in the second phase, the most important constructs emerged were analyzed with a quantitative methodology. In fact, a structured questionnaire, made specifically for this study by operationalizing the variables raised in the previous phase in ten types of questions, has been used. Questions are related to different dimensions as: (1) general social background, personal and

professional data (questions on sex, age, level of education, department, specific organizational unit, area of employment and category, organizational temporary task/role covered); (2) preliminary aspects (questions concerning daily use of time, modules used, typology of users, task/role covered related to the introduction/development of the ERP system, level of knowledge and ability in using the different modules); (3) introduction phase; an inventory of 17 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates how the system had been introduced, the training organised, problems, etc.; (4) problems: an inventory of 10 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates technical and organizational problem in using the system; (5) positive aspects: an inventory of 17 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates positive aspects and effects in using the system; (6) reasons for resistance: an inventory of 12 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates why people refuses to use the system; (7) training: one question on participation in training activity related to the ERP; an inventory of 12 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates the quality/quantity of training provided; (8) suggestions: an inventory of 9 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates users' suggestions in order to implement the system; (9) organizational aspects: an inventory of 14 items on a 5 point scale from 1 = totally disagree to 5 = totally agree; it investigates organizational aspect that can affect the proper use of the system; (10) level of satisfaction (one question on the general level of satisfaction with the ERP system). The quantitative methodology (structured questionnaire) allows to involve a larger sample, useful for the results' generalizability to the regional administration; it had been sent to the entire population of ERP users that have the license to use at least one of its modules. The final sample is composed of 775 employees and managers (around 36% of the population); it is 57% female; 23% under 35 years old; 6% between 36 and 40 years old; 12% between 41 and 45 years old; 18% between 46 and 50 years old; 16% between 51 and 55 years old, and 25% over 55 years old. 6% belonging to category A, 12% to B, 27% to C, 50% to D (in Italian regional governments employees belong to categories based on salary level and education; from A to D listed in increasing order) and the remaining 5% are managers; 36% of the sample is composed of SB users (SB = Basic System – document and work flow management), 25% of HR users (HR = Human resource) and 16% of SCI users (Integrated Accounting System – Financial); the remaining participants state that they use a combination of two modules or all three modules.

3 Results

Results from a descriptive analysis (means and standard deviations) show that, about the way in which the ERP system has been introduced, participants agree that its knowledge did not spread through structured or programmed actions

(M = 3.26), but through the support of colleagues (M = 3.32) and/or self-training and self-learning (M = 3.51). Moreover, there were high expectations related to the introduction of this kind of integrated system (M = 3.23) but its introduction was traumatic for employees and managers because of the sudden switch from old, well tested and well known systems to the new ERP system (M = 3.22); finally, they agreed on that the tests conducted before the introduction phase were insufficient (M = 3.17). Moreover, users agreed that there was no widespread training to disclose knowledge of the new system (M = 3.36) and that its introduction required new training methods (e.g. informatics knowledge, managerial competencies, etc.) to be met with new training activities (M = 3.18).

The main problems seem to be the customizations, believed to be necessary to adapt the ERP system to the individual organization where it was introduced (M = 3.39) and the use of software programs other than the one chosen to compensate its limits; in particular, employees use spreadsheets to check different kinds of calculations (M = 3.06). Other problems are related to the organizational aspects; in fact, participants believe that the introduction of the ERP system produced negative effects on internal processes and these effects had been underestimated during the new system planning phase (M = 2.86); this aspect can be observed together with the reported negative effects on individual activities (M = 2.83).

Among the positive aspects, the untapped potential of the ERP (M = 3.55), the guarantee that data are not ambiguous (M = 3.32) and easy access to data and information (M = 3.29) have the highest means.

Finally, there are several reasons for resistance to the new system: (1) technical, (2) related to involvement and (3) cultural. The first refers to the rigidity in the sequence of activities required to use the system (M = 3.32), the system's slowness (M = 3.21) and the difficulty in using the system (M = 3.16). The second refers to the lack of involvement and an inability to impart to employees the reasons behind a decision to implement an ERP system (M = 3.31), and to the fact that the new system has not been designed according to the actual needs of the Regional Government (M = 3.03). The third refers to the lack of managerial support in using the system (M = 3.00), an inherent cultural problem of not readily accepting innovation (M = 3.00) against a natural tendency to be attracted by information technology innovation and this seems to have had a positive effect on the new system's acceptance (M = 2.95). In fact, they suggested to implement and develop the new system for the future: moving the switch from one screenshot to another (M = 3.81) should be easier and that the system should be faster (M = 3.79); moreover, they recommended that training activities correlate to specific training needs (M = 3.64), that the system's potential should be made known (M = 3.61), that the integration of the three modules should be completed early on (M = 3.57), and that an internal helpdesk is necessary (M = 3.42). All nine suggestions mentioned in the inventory reported a high mean (over 3.21).

3.1 Correlations and Regressions

With the aim to foster the comprehension of the organizational effects and, also, the plausible causes to resistance to the new system and to provide suggestions to increase the system' use in the future, the paper presents correlations between some variables of the scales presented and some regressions. The reported correlations are those higher than .300 and the variables involved are those with a mean higher than 2.5. We found correlations between some reasons for resistance to the introduction of the ERP system and organizational aspects. In particular, two items related to the organizational aspects (the introduction of the ERP system produced negative effects on internal processes and on individual activities and these effects had been underestimated during the new system planning phase) are correlated with (1) the lack of employees' involvement in the decision to introduce the system and in the planning phase (.372, and .398 respectively); (2) the awareness that the ERP system was not properly designed according to the administration's needs (.489 e .490 respectively); (3) some technical reasons for resistance, such as its rigidity (.396 and .405 respectively); (4) the perception that the new system causes an higher workload (.347 and .397 respectively).

We found correlations between some reasons for resistance to the introduction of the ERP system and the way in which the new system has been introduced. In particular, (1) the lack of employees' involvement in the decision to introduce the system and in the planning phase; (2) the awareness that the ERP system was not properly projected for the administration's needs; (3) some technical reasons for resistance, such as the system's slowness, and its rigidity are correlated with the item of the scale related to the introduction phase: "The tests conducted before the introduction phase were insufficient" "The group that participated to the analysis before the introduction of the new system was composed by people that didn't know the problems" "The introduction of the new system was not properly planned".

We found correlations between some reasons for resistance to the introduction of the ERP system and problems. In particular, the awareness that the ERP system was not properly projected for the administration's needs; some technical reasons (rigidity) are correlated with problems related to the language and glossary used in the new system compared to those usually used in the past. Also, the lack of employees' involvement in the decision to introduce the system and in the planning phase and some technical reasons for resistance, such as the difficulty in using the systems, the system's slowness, and its rigidity are correlated with the lack of an initial training phase when the new system was introduced.

Regression analyses were conducted in order to deepen the comprehension of the relationships between some variables, to underline, for instance, some plausible causes for resistance to the new system.

For example, results of the regression analyses conducted considering some organizational aspects as predictors (R square =.189), and the resistance to the system caused by a lack of managerial support in using it as the dependent variable, show that this resistance is determined especially by the variables "the introduction

of the new system produced negative effects on internal processes and these effects have been underestimated" ($\beta = .241$; $p = .000$) and "the limits to the proper use of the system are organizational more than technical" ($\beta = .166$; $p = .000$).

Results of the regression analyses conducted considering some organizational aspects as predictors (R square = .252), and the cause of resistance "the system was not designed according to the actual needs of the Regional Government" as the dependent variable, show that this resistance is determined especially by the variables "the introduction of the new system produced negative effects on internal processes and these effects have been underestimate" ($\beta = .254$; $p = .000$) and "the introduction of the new system produced negative effects on individual activities and these effects have been underestimated" ($\beta = .263$; $p = .000$).

Results of the regression analyses conducted considering some organizational aspects and some aspects related to the introduction phase as predictors (R square = .154), and the "not proper distribution of licence" as the dependent variable, show that this problem is determined especially by the variables "the introduction of the new system was not properly planned" ($\beta = .366$; $p = .000$) and "the limits to the proper use of the system are organizational more than technical limits" ($\beta = .138$; $p = .001$).

4 Discussion and Conclusions

The statistical analysis of the questionnaire data provide some food for thought and are consistent with the literature. For example, we found that the resistance to the system caused by a lack of managerial support in using it [4,13], is determined by the fact that introduction of the new system produced negative effects on internal processes and these effects have been underestimated. In other words, ERP users believe that a lack in the introduction and design phase determined and still determines a resistance caused by a lack of support by managers. Also, regression analysis highlights that the underestimation of the possible negative effects that the new ERP would have generated on individual activities, determined a lack during the design phase and, as a result, the ERP system was not designed according to the actual needs of the Regional Government. Another interesting result of the regression analysis is that the perception of the presence of untapped potentials determines a resistance caused by a lack of managerial support. This can be explained by a managers' belief that the actual system's features are not fully capable to produce the results expected by managers. Also, regressions show that a lack in the planning phase determined a problem in the licences distribution coupled with the conviction that the most serious obstacles to the proper use of the system are organizational more that technical. Despite these considerations, higher means were reported in the suggestions section of the questionnaire, and this may be interpreted as a general optimistic feeling towards the future implementation of the system.

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IT Helps the Italian Army to Implement a Performance Management System

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Abstract Over the last years, Italian public administrations have been involved in a long-term reform process with the aim of "reinventing" the public sector in accordance with new public management principles. The Italian Army, along with other public organizations, has been engaged in the implementation of a performance management system as stated by Italian law 150/2009. Information Technology (IT) has played an invaluable role during this process. The Italian Army is still developing a business intelligence tool to support its strategic activities. This article investigates on how Italian Army strategies can contribute to the success of implementing an effective performance management systems.

1 Introduction

Over the last 20 years, public sectors of many developed countries have initiated long-term processes of reform in line with the new public management (NPM). The aim has been to improve efficiency and effectiveness of the public administration management. The NPM is a worldwide paradigm, which focuses upon the introduction of managerial techniques taken from the private sector to obtain better results in the public field [1] in terms of managerial efficiency and effectiveness. The NPM has also affected the Italian public administration through enacting a number of laws as a variety of pillars of the NPM [2]. One of the principal "levers", used to promote the organizational change of the public sector, has been the

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introduction of the performance measurement and evaluation, which are both emphasized by the NPM as governmental management tools [3], and used to promote the organizational change of the public sector. From a temporal point of view, law 150/2009 is only the last reform[1] enacted by the Italian Government. This law focuses upon the role of performance in the public sector and introduces performance cycle in the public administration. Law 150/2009 states also that performance cycle is the basis of strategic planning, measurement, control, and evaluation.

The Ministry of Defense together with other public administrations adopted this performance cycle. The Italian Army (IA) set out to introduce the adoption of a PMS through the implementation of a strategic decision support system (SDSS). The implementation of a SDSS has required different steps [4] such as introducing monitoring and control's office, defining and mapping organizational objectives, identifying and developing key performance indicator and key performance area, identifying and adopting advanced instruments as for development and implementation of software solutions. The IA has already instituted a monitoring and control organization (MCO), directed by an executive officer, and in charge of all activities related to the burden stated by the law 150/2009. In particular, the MCO identified analytically the operative objectives of the Army, stating metrics and indicators for each of them. The complete set of metrics, indicators, algorithms and rules constitute what the IA calls a "Performance Management Model", which is another way of calling a Performance Management Systems (PMS). PMS is a conceptual model that allows evaluating both organizational and individual performances though an analytical measurement framework. The importance of defining a PMS is to make easier and more transparent all steps related to the evaluation process. However, such an analytic model is usually considered as a different area from planning, control and evaluation by a holistic performance management approach [3, 5]. The approach to deriving metrics and indicators of the PMS is based upon an adaptation of the Goal-Question-Metrics (GQM) approach [6]. Based on the defined PMS, the IA has already started developing advanced information system solutions with the aim of better supporting the stated PMS. As Eccles stated [7], any PMS effort requires a new information system to support the new information needs. Furthermore Bringall and Ballantine [8] argued that "effective ISs are vital to the success" of PMSs, because only information systems can support organizational learning and strategic processes. As Kaplan and Norton [9] claimed, an unresponsive information system can be the Achilles' heel of PMSs. Information Technology offers a whole foundation for the PMS, supporting all related processes. In this work we focus upon the role that IT and ISs have played for the success of the implementation of the IA's PMS. Our research question is: How did the IT contribute to the implementation of an effective PMS in the IA?

[1] Previous reforms were: law 29/93 (Cassese's reform), law 286/99 (Bassanini's reform).

This article is structured as follows: (1) description of theoretical background; (2) presentation of the research methodology, (3) analysis of the PMS's implementation, and conclusions.

2 Theoretical Background

Over the last 20 years, performance and evaluation have been the main concern of the public sector reform of the most developed countries. "Governments have growing interest in the measurement of performance in the public sector" [10] to improve efficiency and effectiveness of the public sector's organizations [11, 12]. To promote the implementation and use of strategic performance measurement systems, governments all over the world have carried out a number of initiatives For instance US Government Performance and Results Act in 1993, to improve the governmental EEE (triple E) – economy, efficiency and effectiveness – by increasing the quality of public service and reinforcing the accountability of public managers [13, 14]. This is one of the major ideas of the NPM "using performance information to increase performance by holding managers accountable for clearly specified goals" [15].

The NPM maintains that Weberian bureaucratic public organizations are obsolete and then proposes introducing performance measurement, performance evaluation, and personnel management as ways of reaching successful management innovation initiatives. The NPM is constituted by a set of assumptions and principles on how public organizations should be organized and managed [16]. The main idea of the NPM is to make public structures and servants more similar to what private organizations have. This means that public organizations should be more "business-like" and "market-oriented", where efficiency, effectiveness, performance measurement, and evaluation are crucial to the success of an organization [17]. The way of evaluating efficiency and effectiveness should be analytically defined so that the evaluation on results would be undisputable. However, it is important to note that the NPM theory is still one of the most debated matters in academia; criticism against the NPS is still controversial insofar as some articles have even decreed its death [18]. Behind this criticism, the NPM is still a paradigm of strong influence, internationally [19, 20]. For instance Kulmann [20] considers the NPM local government reform in Germany as the trigger of "a number of positive effects".

3 Methodology and Data

In order to investigate our research question and evaluate the correctness of the theoretical referential framework, we looked into the organizational structure of the Italian Army during the implementation of the PMS. The methodology used for our research is the one introduced by the Action-Research [21]. During the process

we decided to use the technique called Multiview2 [22]. The crux of this approach is to put the theoretical model (IA performance model) in the context of the organization, so that, the model can follow a dynamic and integrated process. The point is that, the theoretical preconfigured model should be put in the context and tested, within the socio-economic environment. According to the indication of the Action-Research a theoretical model should be put in relationship with the real model. To do so, we tried to adapt our theoretical framework to the reality in a iterative way. In other words, we modified our theoretical framework in a recursive way until the gap between the model and reality seemed acceptable. This is the reason why, in the study, during the "as-is" step, we proceeded with a top-down approach.

In this article we analyze the theoretical framework elaborated for the good functioning of a performance management system and observe the first results obtained through the implementation of the model. According to the Action-Research we are now at the first steps of the analysis as the model should be reiterated and validated in order to make the theoretical framework compliant with the "real" environment (level of compliance greater than 98%) so that it could be accepted. To analyze the PMS theoretical model, we elaborated data and information gathered from the IA internal documents and Information Systems obtained by the Monitoring and Control Office (UCIG).

To come up with a relevant analysis of the theoretical framework in comparison with the reality, we conducted a series of semi-structured interviews with the personnel belonging to the IA Monitoring and Control Office (UCIG). The second step was to test the model analytically and then we evaluated the deviation gap between the theoretical framework and the reality which completed the first cycle of the process defined by the Action-Research.

4 The Introduction of the PMS in the Italian Army

4.1 Scenary

The IA is a hierarchical organization which is composed of about 500 spending sub-organizations.[2] Those sub-organizations, called UORs, perform heterogeneous activities, use different resources and competences, and pursue specific goals. For instance, a UOR may carry on the task of managing either a military hospital or a special forces' operation. To that aim they need different competences, procedures and resources. Lately, the public sector has been facing chronic lack of financial resources because of the strict policy of the Italian Ministry of Economy and Finance [22]. Since 2004, the national financial situation has imposed relevant limitations to the defense budget. Ordinary resources assigned to the IA turned

[2] All this information is publicly available as published by the Italian Parliament.

from €1,028.00 million in 2004 to €307.90 million in 2011, with a reduction of 70% [23, 24]. In this respect, the only viable strategy was to better manage assigned resources, avoiding any waste and cost duplications.

4.2 Current Situation and Development of Business Intelligence Solution

Since 2010, the IA has been engaged in the development of a performance management system. Until 2009 the management control activity was mainly based upon financial performance model, i.e. allocated versus used resources. Currently, the IA uses a predictive model called "what if analysis" which is able to evaluate expected versus actual productivity. Additionally, the model allows operating some decisional simulations, providing the rate of performance obtainable by the whole organization for each volume of allotted resources. The system implementing the evaluation model permits drill-down operations, as well. The idea is to highlight ex ante those areas which may result in organizational failures in terms of low performance, e.g. deviation between expected and actual productivity. The expected performance is actually a sort of benchmark, which identifies the target (called threshold of goodness) for each area of business.

The IA elaborates its strategy based upon objectives that the Ministry of Defense and the Defense Chief of Staff define on a yearly/triennial basis. Strategic objectives, operative programs and targets are derived from the objectives stated upward. Each objective possesses an analytical part which allows measuring the achievement of the objective during the monitoring stage when actual values are available. The performance model uses a percentage to evaluate the achievement of an objective. For instance, let 90% be the (target) performance on a specified objective. It means that, the organization achieved a (target) performance of 90% with respect to what the Director/Commandant of the organization was expected to do with the received resources. Together with the target value, each objective has another statistic called reference performance which measures the achievement of an objective with respect to what an organization should have produced apart from the resources that the Director/Commandant of the organization received. Therefore, the former (e.g., target performance) evaluates people (executives and eventually individuals) while the latter (e.g., reference performance) evaluates organizations. The IA has already integrated the strategic and financial planning by using two different software systems: SIEFIN for the financial planning and SIAPS + for the strategic programming. The integration of strategic and financial planning processes creates the essential link between organizational priorities and resources (Fig. 1).

This integration allows saving time and money because the resources are assigned to processes, projects and operations that are in line with IA strategic objectives. As a consequence of this integration, activities that are more relevant for the achievement of strategic objectives of the IA are funded while those that are not

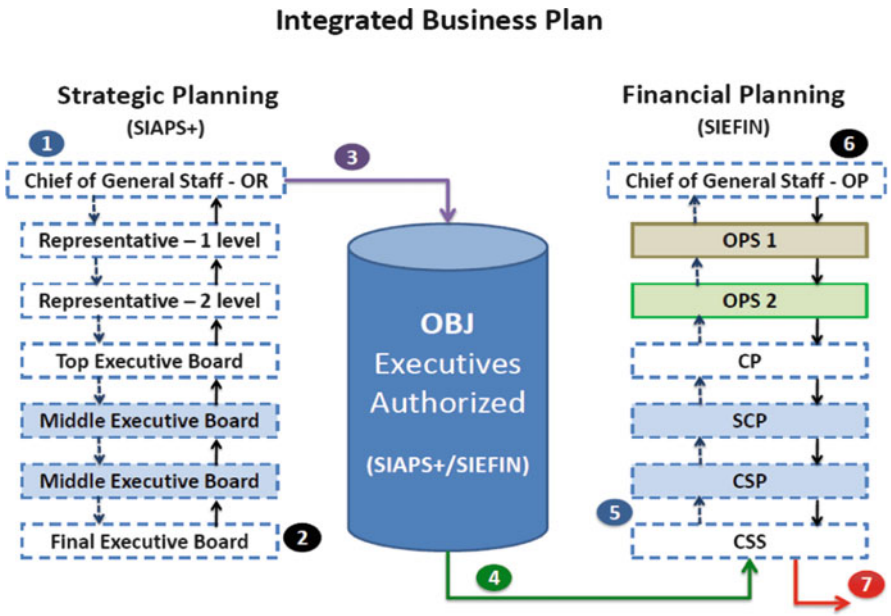

Fig. 1 Integrated strategic-financial planning

relevant cannot be funded. This avoids allocating resources to activities that have less or no "strategic" impact on the Army's strategy.

Currently, the IA is engaged in developing and testing an advanced IT solutions that support strategic activities such as planning, programming, performance budgeting, performance monitoring, measuring, assessing and reporting. These solutions are based upon open source applications which lying on the field of business intelligence. These tools can:

1. Support integrated strategic and financial planning activities through a top-down approach. In the past, there were two different processes conducted with different approaches (top down for the strategic stage and bottom-up for the financial stage) and even using two distinct IT solutions (before the integration of SIAPS + and SIEFIN);
2. Manage all processes (planning, budgeting, monitoring) from the top of the Organization (Army General Staff) to the operational units (Regiments/battalion). Previously, that was limited to the top levels of the IA organization (Directive branches);
3. Create specific dashboards for each level of the hierarchy, in order to have relevant monitoring, measuring and reporting activities.

Moreover, the integrated system (SIAPS + and SIEFIN) uses an open source data mining suite with the aim of performing optimizations when using and allocating resources. The IA will use the new application starting from the new financial year.

Presently, the integrated system is in real use with the majority of its functions. However, the system is not fully operational because some components need to be further tested before being deployed. In summary, the integrated system is a "powerful tool" that provides essential information to all organization levels (e.g., military hierarchy) about their goals, targets and assigned funds. The novelty is that now, through the integrated system, each organization receives upward and assigns downward analytical objectives and resources to achieve those objectives. This integrated system is, then, the core element of the IA strategy to aligning those organizational objectives that derive from the objective of "assuring a land component with an appropriate level of readiness".

5 Conclusion

The introduction of a PMS in the IA can be classified as a changing management process. It has positively affected the whole organization in terms of efficiency and effectiveness. The tangible results that reduced and even eliminated "auto-referentiality" are: better resources allocation through the financial-strategic planning, previous determination of the organizational critical areas through the what-if analysis, and the organizational alignment with IA strategic goals.

The Italian Army is still working on developing its PMS. The IA is now testing the new advanced applications of the integrated system with the aim of using it for the upcoming financial year. The adopted integrated system allows performing strategic and financial planning, performance measurement, and monitoring and control activities at every level of the military hierarchy, from the very top of the organization down to the regimental/battalion level. Data mining is part of the system and aims at performing risk and preventive analyses. The integrated system turns the IA into a learning organization which may eventually improve organizational performance over time. The system is a powerful means that increases the velocity and quality of the decision-making processes, as well. To support more informed decisions, the system manages all possible steps of the decision-making process assisting and supporting decision makers at every level of the hierarchy. The system also provides additional and relevant information to decision makers especially due to the intensive use of predictive tools such as machines learning and neural networks. Such an information system provides the IA managers with an effective decision support system as a performance driver, since "one can't manage what one can't measure" [25].

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Part III
Information and Knowledge Management

Semantics-Enriched Web APIs Selection for Enterprise Mashup Development

Devis Bianchini, Valeria De Antonellis, and Michele Melchiori

Abstract Collaboration inside and among enterprises often relies on mashup as a new development style for non-mission-critical Web applications, which are created to satisfy a business need and that often are used only for short periods of time, while the need exists. Examples of such Web applications are enterprise dashboards, that are used to improve decision making and locating contents. Mashup applications are built from independently developed software components, called Web APIs, collected in suitable registries or catalogs and linked through programmatic coupling. Ideally, mashups require a lower development effort with respect to traditional applications. To this purpose, we propose Web API selection patterns that are able to assist a mashup designer in selecting and aggregating Web APIs and we discuss their application to mashup development in enterprises. A prototype implementation of a Graphical User Interface to support Web API selection patterns is also described.

1 Introduction

Nowadays, enterprises are beginning to realize the benefits provided by enterprise mashup, a new development style for non-mission-critical Web applications which are created to satisfy a business need with a limited development effort. Often, the applications are short-lived, being intended to satisfy a specific short-term business situation. Examples of such Web applications are enterprise dashboards, which are used in an enterprise context to improve decision making and locating contents

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allowing users for getting and consolidating information and managing tasks to support their activities [1]. Generally speaking, mashup applications are built exploiting existing data, UI widgets and functionalities to create new applications and software artifacts that could be also reused as components in other mashups. Often mashup components are made available as Web APIs that are linked (through programmatic coupling) to enable the application logics. In particular, Web APIs are software interfaces to content and functionalities, adopting the architectural style and therefore accessible through standard Web protocols. In the enterprise context, mashups can be implemented by using either components developed internally at the enterprise, for instance to access customer data, or third party components as geo-coding services. These components are typically made available by means of searchable catalogs within the enterprise (e.g., IBM Mashup Catalog) or are selected from public Web registries (e.g., www.programmableweb.com). A general problem is therefore allowing a developer to explore and understand the space of available APIs and their relationships. This is usually a difficult task because of: (1) the dynamicity of this space and the large number of available APIs, (2) the limited time usually allocated for the development of a mashup application; (3) the limited skills/expertise of the mashup designer, who should develop a new application by looking for suitable Web APIs according to an exploratory perspective, without a wide knowledge about the available Web APIs and how their linkage can be performed.

With reference to these specific requirements, we propose in this paper a semantics-enabled framework implementing Web API selection patterns to proactively assist a mashup application designer during the development process.

Related work. Several efforts have been devoted to the design of tools which support mashup development [2]. In [3], a faceted classification of unstructured Web APIs and a ranking algorithm have been applied to the ProgrammableWeb repository to improve the search mechanism. The classification and searching solution is still based on Information Retrieval techniques. The MatchUp system described in [4] addresses the problem of suggestion of patterns to link mashups components: when the designer selects a set of components, the system suggests code patterns to connect these components on the basis of recurrent patterns in the component repository. A Web-based interface which supports mashup of semantic-enriched Web APIs is proposed in sMash [5]. Possible mashups are shown as graphs, where each vertex represents an API and an edge between two APIs means that they are mashupable, that is, they can be used together in a mashup.

With respect to these approaches, we performed an empirical study of possible selection patterns followed by the designer during Web application development. Therefore, we implemented selection strategies, providing browsing facilities for available APIs during application design. In the following section, we discuss our proposal with reference to the mashup developing process in the enterprise context and, later on, we illustrate the proposed selection patterns. Finally, we describe a prototype tool.

2 Enterprise Mashup Development Scenario

In the enterprise context, mashups have been adopted as a development approach both by business functions and IT departments. On one hand, business functions get advantage from them because they experience more control in addressing their needs. In fact, they can implement mashups to satisfy situational enterprise needs in a shorter time with respect to traditional applications and with a certain independence from the IT department. On the other hand, the IT departments can implement non-mission critical applications as mashups because their development requires lower effort, and less programming skills and time. Moreover, they provide support to the users that are not able to fully develop their own mashup applications. According to [6], the main reasons to adopt mashups in enterprises and organizations include: (1) reducing uncertainly and compressing timeline in projects; (2) creating a virtuous cycle of reuse; (3) enabling quick assembling of applications for new situations. In particular, the presence of an effective cycle of reuse (Fig. 1, adapted from [6]) in the developing process creates the conditions for compressing the length of the development time.

However, developing a mashup requires the ability of solving problems and making choices at different abstraction levels of the design process: the kind of technology, content authentication and privacy policies, selection of the most suitable components and functionalities, choice of component integration at server or client side.

Specifically, our proposal focuses, as we told, on the problem of selecting and integrating APIs and functionalities. To briefly illustrate this problem, we take the perspective of John who has been charged to design a Web application to illustrate the geographical distribution of the people accessing the web site of his company. John knows that single functionalities of the application he has in mind could be already available: to obtain the list of IP addresses he can use a Web API of the company Web site; to convert an IP address to a geographical address and to locate

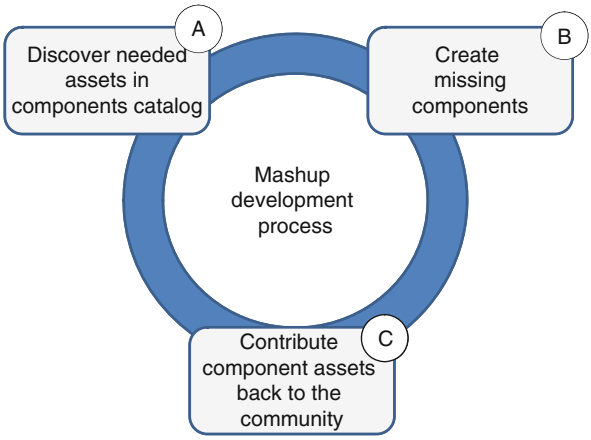

Fig. 1 Cycle of reuse in the mashup development process

points on a map, he can get such functionalities from Web APIs published on the Web. The problem is therefore to locate the suitable APIs and to integrate them in an application.

3 Selection Patterns

With reference to the development process of a mashup M (Fig. 1) we identify three possible Web APIs selection patterns:

- *Search*, to suggest a set of Web APIs that match a given Web API specification W_τ;
- *Completion*, to suggest a list of Web APIs that can be integrated with a given Web API W_τ belonging to M.
- *Substitution*, to suggest a list of Web APIs that can be substituted to the Web API W_τ belonging to M;

Formally, a *selection pattern* is defined $<W_\tau, m_\tau, \delta_\tau, \leq_\tau>$ where τ is the target of the selection pattern, i.e., *Search*, *Completion*, *Substitution*.

The metric m_τ is used to evaluate, the degree of matching if the pattern is *Search*, the degree of coupling if the pattern is *Completion*, the similarity between each suggested Web API and W_τ if the pattern is *Substitution*, respectively. The threshold δ_τ is used to filter out not relevant Web APIs. A Web API W_j is suggested to the designer if m_τ $(W_\tau, W_j) \geq \delta_\tau$. Finally, $\leq_\tau$ is a function to rank the suggested Web APIs.

With regard to their application to the development process, the selection patterns support the designer during the different phases of the mashup development and for implementing the practice of the reuse (see Fig. 2). With respect to the development phases, the *Search* and *Completion* patterns allow the designer to search for APIs matching a given specification and to search for APIs that can be integrated with a given one in the application, therefore allowing for extending it. The *Substitution* pattern allows for replacing APIs in the mashup with other functionally similar APIs under the constraint of minimizing the effort for implementing the substitution. The typical purpose of the substitution pattern is that of evolving the application by replacing those APIs no more available/

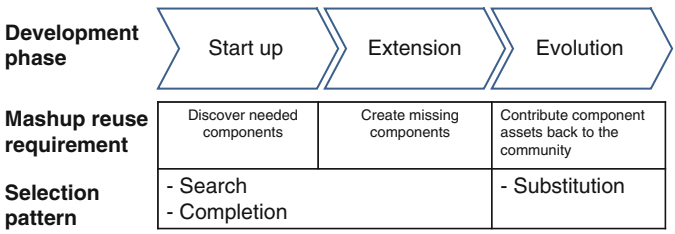

Fig. 2 Selection patterns used to support the mashup development phases

maintained or with low quality features. The proposed patterns contribute to stimulate the virtuous cycle of reuse highlighted in Fig. 1 by satisfying its requirements. For example, given that if the *Substitution* pattern is used to improve the quality of the mashup and to make it more stable, it favors the practice of sharing quality mashups within the users/developers community.

3.1 Semantic Descriptors for the APIs

Selection patterns are based on: (1) semantic annotation of Web API descriptions with respect to domain ontologies; (2) organization of Web APIs based on automated matching techniques apt to establish semantic links between them according to properly defined similarity and coupling criteria. In this section, we briefly discuss point (1) and in the next section we discuss point (2).

Semantic annotation of APIs in our framework is performed according to the steps suggested in the SWEET tool [7]: (a) identification of elements (that is, operations, events, inputs, outputs) in the unstructured HTML document which represents the API; (b) search for ontologies suitable for elements annotation and for taxonomies of categories for API classification; (c) annotation and classification of the API. The description of the API, is represented as a semantic descriptor.

We distinguish two cases in API semantic description: (1) the semantic characterization of an available API; (2) the semantic characterization of a requested API, as formulated by the designer, who is searching for a component.

Formally, we define a semantic descriptor W_i for a semantically annotated API as:

$$W_i = <CAT_i, OP_i, EV_i> \tag{1}$$

where CAT_i is a set of categories associated with the API, OP_i is a set of operations, EV_i is a set of events that the API can generate. Each operation $op_k \in OP_i$ is described by the operation name op_k, the operation inputs $IN(op_k)$ and the operation outputs $OUT(op_k)$. Each event $ev_h \in EV_i$ is described by a set of event arguments, used to represent the API state changes. Operation I/Os and event arguments are annotated with concepts taken from the reference domain ontologies.

The semantic characterization of a requested API is similar and defined as follows:

$$W_r = <CAT_r, opt_r> \tag{2}$$

where CAT_r is the set of categories featuring the request and $opt_r = <OP(W_r), IN(W_r), OUT(W_r)>$ are the sets of required operation names (resp., input names, output names). With respect to the definition (1), the descriptor W_r has a flattened structure, since the sets $IN(W_r)$ and $OUT(W_r)$ are specified independently from the

operation in $OP(W_r)$ they belong to. In fact, according to the exploratory search perspective, the designer could not have a precise idea about the structure of the descriptor to search for.

3.2 Semantic-Based Metrics for Selection Patterns

Implementation of selection patterns is based on the evaluation of similarity and coupling between Web API descriptors. The expressions for similarity and coupling coefficients are shown in Fig. 3 and have been addressed in our previous works. We define the functional similarity coefficient between two API semantic descriptors W_i and W_j, denoted as $Sim_{IO}(W_i, W_j)$, as a measure to quantify how much W_j provides at least the operations and outputs required in W_i; no matter if W_j provides additional operations and outputs.

The building block of this expression is the Dice coefficient, used in Information Retrieval and the computation of a concept affinity, *CAff()*, between pairs of, (1) operations, (2) I/Os parameters, (3) arguments of events and operation inputs, respectively. All these elements are in the semantic descriptors to be matched. The role of the coefficient $CAff \in [0.1]$ is to evaluate the similarity between two concepts. Here we simply state that *CAff* is based on both a terminological (domain-independent) matching based on the use of WordNet and a semantic (domain-dependent) matching based on ontology knowledge.

We define the coupling degree between the API semantic descriptors W_i and W_j, denoted as $Coupl_{IO}(W_i, W_j)$, as a measure obtained by computing values of event-operation coupling coefficients, $Coupl_{EvOp}(ev_i, op_j)$, evaluated as the average *CAff* between the arguments of $ev_i \in EV_i$ and the inputs of $op_j \in OP_j$. Actually, API integration in mashups often means integration of UIs (consider, for instance, the wide use of the GoogleMaps API, where the interactions with the user are modeled through UI events). Events raised by a Web API could be caught by operations

COUPLING DEGREE

$$Coupl_{EvOp}(ev_i, op_j) = \frac{\sum_{s,t} CAff(out_s, in_t)}{|OUT_{ev}(ev_i)|} \in [0..1]$$

$$Coupl_{IO}(W_i, W_j) = \frac{\sum_{s,t} Coupl_{EvOp}(ev_s, op_t)}{|EV(W_i)|} \in [0..1]$$

FUNCTION SIMILARITY DEGREE

$$Sim_{IO}(W_i, W_j) = \left[\frac{\sum_{s,t} CAff(in_s, in_t)}{|IN(W_j)|} + \frac{\sum_{s,t} CAff(out_s, out_t)}{|OUT(W_i)|} + \frac{\sum_{s,t} CAff(op_s, op_t)}{|OP(W_i)|} \right] / 3 \in [0..1]$$

Fig. 3 Coupling and functional similarity coefficients for the selection patterns

modeled on different APIs, which update their status accordingly. Therefore, the coupling evaluation aims at identifying associations between events and operations.

With respect to the definition of each selection pattern, if the pattern is *Search* and W_r is the specific requested Web API descriptor (that is, W_τ is set to W_r), the metric m_τ used to suggest candidate Web API descriptors W_i that match the request W_r is $Sim_{IO}(W_i, W_r,)$ if $CAT(W_i) \cap CAT(W_r)$ is not empty; otherwise, W_i is not included among the suggested descriptors.

If the pattern is *Completion* and W_c is a selected API descriptor already included in the mashup application and belonging to a category CAT_c the goal is now to identify API descriptors W_i that can be coupled to W_c. The metric m_τ used to suggest candidate descriptors W_i is defined as $Coupl_{IO}(W_C, W_i,)$ if $CAT(W_C) \cap CAT(W_i)$ is not empty; otherwise, W_i is not included among the suggested descriptors.

Finally, if the pattern is *Substitution* and W_S is a selected descriptor already included in mashup application under development, then m_τ used to suggest candidate descriptors W_j is the sum of three evaluations:

- the functional similarity between W_S and W_j, that is $Sim_{IO}(W_S, W_j,)$;
- the sum of the functional coupling degree between W_j and each W_K in the mashup application having $Coupl_{IO}(W_K, W_S) > 0$;
- the sum of the functional coupling degree between W_j and each W_H in the mashup application having $Coupl_{IO}(W_S, W_H) > 0$.

The rationale is to rank better those APIs having high similarity with the selected one and having high coupling with the other APIs in the mashup which were coupled with the API to be substituted.

Discussion – To speed up the computation of the $Sim_{IO}()$ and $Coupl_{IO}()$ coefficients, a semantics-enabled registry of API descriptors can be implemented, where functional similarity links are set between similar descriptors and functional coupling links are pre-computed and set between coupled descriptors.

4 A Design Environment Tool

In this section we briefly present a prototype of our framework to support mashup application development. The Web-based Graphical User Interface of the tool is shown in Fig. 4.

In the upper part, the Web interface implements the Search pattern by enabling the designer to specify the category, the operation name (Search By category and Search By Name) and/or I/O names. On the left, panels to browse the available Web APIs are shown. The selected descriptor W_i is highlighted as a circle in the center of the "Similarity links" panel (e.g., the ProductInformation API descriptor); all the descriptors W_j that are similar to W_i are displayed as circles around W_i; the size of each circle is proportional to the $Sim_{IO}(W_i, W_j)$ value. The selected descriptor W_i is also highlighted as a pentagon in the center of the "Coupling links" panel; other descriptors W_j coupled with W_i are shown as hexagons around the pentagon; the

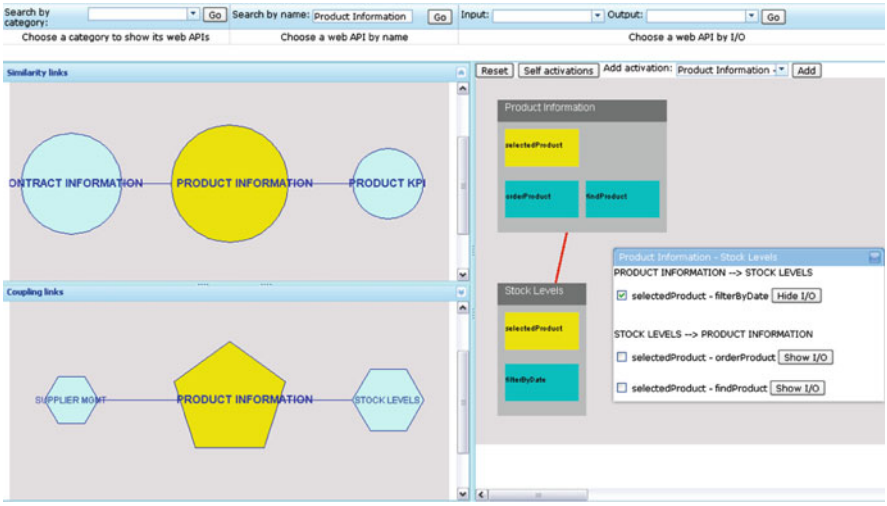

Fig. 4 Graphical user interface of the design framework

size of each hexagon is proportional to the $Coupl_{IO}(W_i, W_j,)$ value (see, for example, the StockLevels API descriptor). In the canvas on the right, the Web interface enables the designer to drag Web API descriptors and wire them to design the Web application. Each descriptor is represented as a rectangle containing the descriptor events and operations. Lines connecting the rectangles represent activations between Web APIs in the Web application. By pushing the "Self connections" button, the system suggests event-operation mappings between descriptors. Mappings are shown by double-clicking the activation links between Web API descriptors in the canvas.

5 Conclusions

In this paper, we proposed semantics-enabled patterns for Web API selection to support the enterprise mashup development process. Mashups are build from APIs semantically described and organized in a registry according to similarity and coupling criteria. A tool that implements these patterns has been designed. Future work includes testing the framework and the tool on real case scenarios. For this purpose we are studying applicability to selected mashups from the public ProgrammableWeb repository.

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A New Generation DMS for Supporting Social Sensemaking

Francesco Maria Barbini, Alessandro D'Atri, Laura Tarantino, and Stefano Za

Abstract Individuals and communities affected by disasters are exposed to massive material and immaterial trauma. While material (tangible) trauma are instantaneous and evident (and thus they are treated immediately by rescuers), immaterial (intangible) ones are subtle and mounting over the time. In particular, in the aftermath of the disaster, affected people lose their world of meaning and need to interact and to exchange information and experience to develop a new social sensemaking process. This paper describes EagleVox, an information system designed to support multidirectional (top-down, bottom-up, peer-to-peer) and multimodal communication within disaster-prone communities (involving citizens, rescuers, and institutions).

1 Introduction

Communities hit by large disasters have to face massive and evident material damages but also heavy psychological and social wounds [1–4]. These immaterial trauma are subtle, not immediately evident, and generally not addressed by first rescuers, who are seized by the material needs of the victims.

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First rescuers play a fundamental role in the relief process: they have to overcome contingencies (conveying medical assistance, shelters, emergency facilities, and primary goods) and to plan and coordinate their actions [5, 6] but they are not able to support the social needs of the affected individuals. On the other hand, in the aftermath of a disaster, the surge capabilities of local disaster-ready institutions are likely to be inhibited, while disaster-prone communities are usually exposed to the loss of their economic and social spaces (municipalities, public services, shops, meeting places, workplaces, etc.), thus experiencing the dissolution of their world of meanings [7]. Actually, as noted by Landau et al. [8], "the scope of the damage to family following mass trauma is often vastly underestimated. We tally the number of people killed or injured, number of homes lost, and dollars spent on emergency aid. Seldom do we measure the more subtle costs, such as an increase in depression and anxiety, substance abuse and addiction, risky sexual behavior, child abuse, and couple violence. And rarely do we mention the impact of those factors across extended families as their neighborhoods and urban setting suffer an increase in poverty, kidnapping, street and orphaned children, bank robberies, rapes, armed assaults, and car robberies".

The combination of material and immaterial losses, coupled with the unavoidable delays and inefficiencies of the relief process, is potentially able to trigger the suspension and the eventual rupture of the social ties that form the basis of the disaster-prone society. Since the adoption of strategies, techniques and tools to foster interaction between individuals is considered an effective approach for enabling an efficient process of social sensemaking [9], networked collaboration and information sharing may play a crucial role in the recovery process. It important to note that in this contribution sensemaking is intended as a form of social action; according to the classical definition proposed by Weber [10], "an action is social insofar as its subjective meaning takes account of the behavior of others and is thereby oriented in its course". This position is maintained also by Weick [11] who states that sensemaking is never pursued in solitude since the way people behave is always influenced by others. Hence, in the following, it will be not relevant to qualify sensemaking as an individual or as a collective process, as far as it is performed with respect to other people acting within the community.

In this paper, after a brief overview on Disaster Management Systems, we discuss, both from the social and the technical point of view, the main features of an ICT platform designed in the aftermath of the 2009 L'Aquila earthquake with the general goal of supporting information exchange among actors of a disaster aftermath (citizens, rescuers, institutions) in multidirectional communication channels (peer-to-peer, top-down, bottom-up, pull, push).

2 Disaster Management Systems

The recourse to Internet resources, and to virtual spaces, is to be expected in a situation in which human relationships cannot take place in their natural physical space. This is coherent with Levy's view of the cyberspace as a manifestation of the

knowledge space, the most recent anthropological space, after earth, territory, and commodity space. An anthropological space is defined by Lévy as "a system of proximity (space) unique to the world of humanity (anthropological), and thus dependent on human technologies, significations, language, culture, representations, and emotions" [12]. The first space, the earth, is characterized by language, technique and social organization; the second space, the territory, has the address (i.e., the belonging to a "recognized" locus) as identity marker; the third space, the commodity space, is characterized by the flow of energy, materials, merchandise, labor and information.

While a disaster impacts on earth, territory and commodity spaces, it spares the "knowledge space", which has the potential of promoting "the construction of intelligent communities in which our social and cognitive potential can be mutually developed and enhanced" [13]. This space can hence be exploited for the social sense-making process, provided that institutional, technical and conceptual tools that make information navigable are made available.

Actually, over the years, many ICT-enhanced support tools, categorized as Disaster Management Systems (DMSs), have been developed to provide the infrastructure that supports emergency management stakeholders [14]. A possible classification of DMSs is based on the disaster management phase(s) a system serves (it is generally agreed that the management process is a cyclic process with the four main phases of prevention and mitigation, preparedness, response, and recovery [15, 16]). Hence, besides systems useful also for prevention and mitigation (like Risk EOS or NHSS), we find DMSs focused on response and recovery: some of them are designed to support the management and the coordination of resources for the rescuers [17–19], while others try to offer citizens the possibility to participate in the reconstruction phase by sharing information (InSTEDD) [20]. Two of the most relevant examples of the second type are Sahana (www.sahana.lk [21]) and Ushahidi (www.ushahidi.com [20]). Sahana, used e.g., for the Asian tsunami, has the goal of coordinating rescuers activities and improving their efficiency. Ushahidi, born as a website during the 2008 Kenya electoral crisis, enables citizens and organizations to collect and visualize geo-referenced information. DMSs usually support real-time, categorized, geo-referenced data sharing, but they do not allow citizens to interact and exchange personal feelings to support the reconstruction of the social community.

3 The EagleVox Project

The experience of the 2009 L'Aquila earthquake highlighted the necessity of on-line services and multimodal forums able to support the social interaction of people not only during chaotic post-emergency situations, but also in the medium and long run, to allow them to be active agents in the redefinition of their social connections [22]. With the aim of designing and implementing a system able to offer services of this kind, the IASI-CNR (Institute for Systems Analysis and

Computer Science – Italian National Research Council), the Research Center on Information System (CeRSI) of the LUISS Guido Carli University and the Department of Electric and Information Engineering of the University of L'Aquila launched the EagleVox project, under the patronage of the Province of L'Aquila.

3.1 System Services Overview

The EagleVox project proposes to facilitate the emergence of a new community and to encourage collaboration spirit among citizens by a system that allows the creation of a social network connecting them on the base of common needs and discomforts, and that enables the sharing of information and mutual support necessary to reconstruct the social tissue.

The platform is conceived to be used both in the immediate aftermath of a disaster and in the long run. In the first phase, the need for interaction is high, but the only channels traditionally used for spreading information are television and radio, allowing to reach only people already rescued and accommodated in shelters of some kinds. Not only does this top-down communication prevent any form of citizen-to-citizen interaction, but it also does not offer any support to institutions for gathering requests and needs from the citizens. It has also to be observed that while citizens may find it difficult to have or to reach an Internet Connection Point, cellular phones are widely diffused and do not require particular technological skill. The use of SMSs in natural language then appears to be the most suitable way on which building an information channel.

Given these premises, the EagleVox platform offers citizens two kinds of access modes: by mobile phones (with a communication based on unstructured SMSs in natural language) and by web terminals (via the system web portal interface). To support the social sensemaking process, the IT platform is conceived as to provide several services of different nature, from rebuilding ties with relatives, business colleagues, friends or neighbours, to gathering information on relocation and opening hours of public offices and shops, or on special procedures issued to face the emergency. Furthermore, citizens may use the system to communicate to the institutions real needs, comments, suggestions and observations related to the social perception on reconstruction actions [23]. Institutions may in turn use the system not only to "listen" to citizens needs, but also to broadcast emergency related news. In the immediate aftermath of the disaster the EagleVox platform can also be used by rescuers and volunteers to communicate with citizens and institutions. The EagleVox enabled communication flows are depicted in Fig. 1.

The SMSs involved in this complex communication process may hence be focused on a variety of categories. So, after being collected by a central gathering point, they have to semantically analyzed, categorized and appropriately dispatched (to citizens or institutions, as requested).

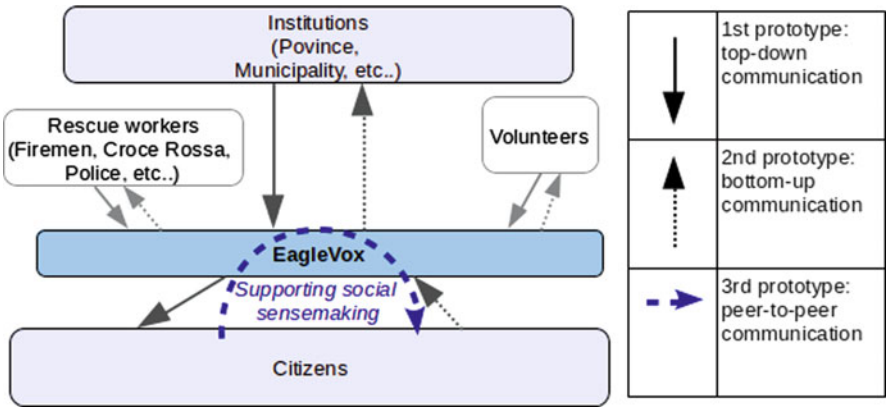

Fig. 1 Communication flows enabled by the EagleVox information system

3.2 Enabling Social Sensemaking

From a social point of view, EagleVox has two main objectives: (1) to allow citizens to actively participate in the monitoring of the territory and to contribute in all the phases of the disastrous event, from the prevention to the immediate intervention, to the reconstruction; (2) to help the population in recovering from the shock caused by the loss of public and private infrastructure, and to re-tie the broken social and business links.

EagleVox gives voice to citizens by collecting their messages about emergency related facts (e.g., people, office and shops displacement), as well as about real needs, expectations or fears, during the emergency and the reconstruction phases. In this way, it soon becomes a consistent and reliable source of information for the citizens, who can access this information in a very easy way through their personal cellular phones, Smartphones or computers (when available). The simple interaction is supported by the semantic engine of EagleVox that allows users to use natural language without having the burden of learning particular technical sentences. In this way, EagleVox allows the whole population (even the less technology-erudite) to access relevant information about disaster and post-disaster phases and to contribute to the enrichment of the EagleVox information repository.

People can first of all establish a virtual social network and then develop a social sensemaking process supported by the platform semantic analysis of exchanged information. It is worth highlighting that this process is driven by people, in a pure peer-to-peer approach (citizen-to-citizen) as shown in Fig. 1.

Furthermore the system, by semantic analysis, can periodically forward received information to the appropriate institutions allowing them to send messages to the system, hence supporting also top-down and bottom-up communication (citizen-to-institution, institution-to-citizen, institution-to-institution), along with the customary push and pull communication typical of SMS-based services. In this way it is

possible to avoid the proliferation of unqualified providers of information and as well as to monitor main community events that support the reconstruction of the social connective tissue. These functionalities are useful in supporting sensemaking since they allow affected individuals to efficiently develop new representations of the situation. By taking advantage of updated and reliable information, people can recreate their world of meanings, can delineate cause-effect relationships and identify future paths of recovery.

3.3 *EagleVox Technological Architecture*

From a technical point of view, EagleVox can be considered a web 3.0 platform that combines mobile ICT technologies (mobile computing), social web (Web 2.0) and semantic technologies (ontology, semantic annotation, natural language computing) [24]. People can send requests and communication to a single contact number to reach the platform that gathers, extracts, analyzes, categorizes and consequently stores received messages, according to the architecture depicted in Fig. 2.

SMSs handled by the *SMS gateway* and messages sent by the *web portal* are analyzed by the *Message Manager* to extract significant terms by means of natural language processing techniques. The extracted terms are then categorized by the *Semantic Analyzer* by means of semantic annotation techniques based on domain

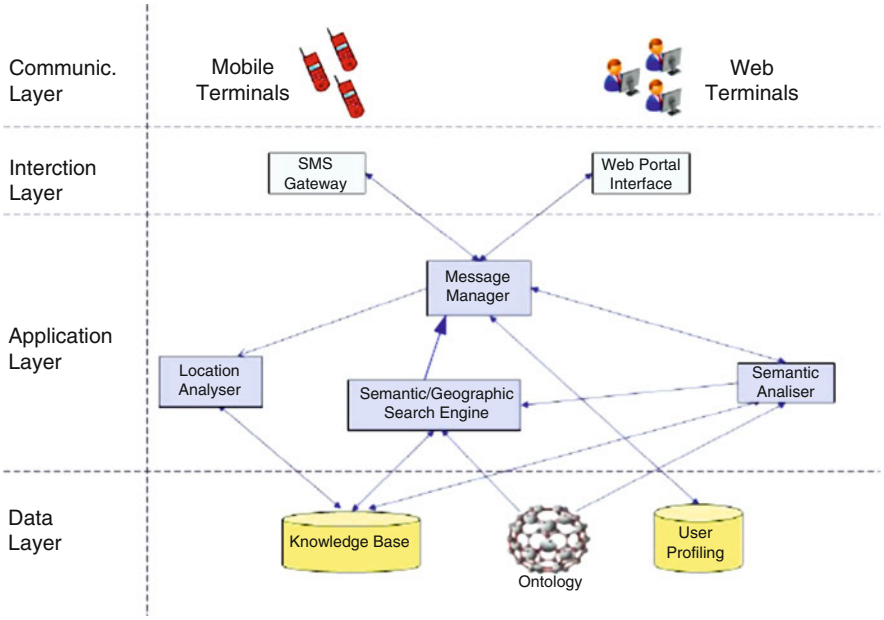

Fig. 2 The EagleVox architecture

ontologies to populate the *knowledge base* (a domain ontology is to be created for each sector involved in the reconstruction process). The *Location Analyzer* processes the portion of the message containing geo-referenced information to further enrich the *knowledge base*. Whenever the *Semantic analyzer* reveals a request in the message, the *Geographic/Semantic search engine* handles it by retrieving information from the *knowledge base* and sending the result to the user through the *Message Manager*, according to his/her profile stored in the *User profiling* module.

4 Conclusion and Further Research

The experience of the L'Aquila earthquake clearly shows how people affected by a disaster is forced to develop their sensemaking processes within communities to which they did not belong before the earthquake and how difficult is for them to keep their bonds with their traditional communities (usually, they find such relationships are hampered by physical and communicative distance). In particular, the lack of tools and technologies for interacting with their geographically-dispersed communities slows down the process of sensemaking.

With the objective of facilitating the interaction among individuals, EagleVox was designed so to act both as a support for the communication among citizens and as a support for the public administration for communicating in bidirectional way with the citizens. From the citizens' side, it allows to "dialog" in natural way with the institutions, lowering the bureaucratic barriers. On the other hand, institutions are enabled to collect a lot of information, warnings, and judgements provided by citizens. Furthermore, EagleVox support the participation of citizens to decision-making processes performed by local and national institutions. It is important to highlight that EagleVox does not impose points of view or the participation to social networks, and that supported social communities are open and not headed by official institutions. Thus, EagleVox will provide disaster-affected populations with consistent information and opportunities for voluntary interaction and resocialization, necessary prerequisite for social sensemaking and for the self-organization of disaster-prone communities.

The open architecture of the system is the basis for the implementation of the EagleVox services which will proceed in a series of steps. In particular with reference to communication flows of Fig. 1, the current prototype supports top-down communication, the second one will support bottom-up communication, and the third version will enable peer-to-peer communication.

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An Innovative Approach to the Governance of E-Government Knowledge Management Systems

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Abstract In this paper we describe an innovative approach to the governance of knowledge management systems and services, currently applied in the Italian Public Administrations domain, which could be easily replicated in other countries as well. This approach is being applied in the framework of Italia.gov.it, a governmental on-going project aimed to the establishment of a big knowledge management system and of vertical search services for Public Administrations' data. The Italia.gov.it project comes after a 3 years long period of studies and experimentations jointly performed by DigitPA and research teams from several Universities, with the aim to define an economically viable information system aimed to gather and manage the knowledge currently published in open data and over the Internet by public administrations on a national scale. We both summarize some lessons learned during such activities and describe the overall technical and organizational solutions being adopted for Italia.gov.it.

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1 Introduction

The development of effective information and search services to support citizens and business companies in finding information and e-services in the Public administrations' (PAs) websites is a very challenging organizational issue [2] in the whole e-government setting. Indeed, over the latest years the number of PAs digital services, mainly on the web channel, and of sources of e-government data increased at an impressive rate. By merely considering Italian Public administrations, there is an estimated number of 40,000 websites, with hundreds of thousands pages.

The Digital Public Administration can be defined as the view of public entities (and their services) in the virtual world (web, social networks, e-mail channels, mobile devices ..) and is the result of the work of thousands of autonomous (public) entities organised in a sort of *huge federated enterprise*.

In this scenario, many countries are facing the problem of providing Web portals to support citizens in finding the information they need within the Digital Public Administration.

The search.usa.gov site provides a notable example of this kind of portal: it provides an interface which allows to perform traditional keyword-based search queries with a simple and easy interface. Search.usa.gov integrates the web search service provided by means of a well-known public search service with other specialised search services, such as, for example, the recall search service, which makes it possible to find recall announcements (i.e. request returns of a product to the manufacturer, as for necessary repairs or adjustments) published on several governmental websites. Other relevant experiences have been made in Australia (see the AGIMO Australia.gov.au), in Austria, with the development of the "Digital Austria Explorer", in UK and in France. Other e-government portals adopt a web directory approach, that is an organised collection of URLs, classified on the basis of topics. Portals of this type usually play the role of well-organized indexes of contents of other PAs websites, as in the case of the Swedish e-government portal.[1] However, sometimes they also directly provide information for citizens, like the French portal.[2] In this case, an e-government portal relies on an editorial staff, in charge of collecting, classifying and updating the reported URLs and information. Some e-gov portals, such as the Spanish one,[3] try to involve citizens into the update of their contents by applying Web 2.0 techniques.

Our work aims to define an economically viable information system to manage the knowledge published over the Internet by public administrations on a national scale.

[1] http://www.sverigedirekt.se

[2] http://www.service-public.fr

[3] http://www.060.es

In Italy, the first official e-gov portal was established in 2002. The "E-citizen portal" was designed as a website for collecting and summarizing information already published in other PAs websites. Even if the portal was useful and attractive for e-citizens, the project was ended in 2009, mainly due to the high costs of maintenance.

The most relevant cost was due to the editorial staff needed to monitor the ever increasing collection of PAs websites and to produce, control and maintain the consistency between the information published on the portal and the one provided other e-gov sites. As a consequence, in the latest years, the portal has been no longer able to promptly and efficiently track the information to be processed and to convey it in a consistent and reliable manner. In 2010 the project has been restarted and a new approach has been adopted. In this paper, we introduce and briefly describe the italia.gov.it project, whose core objective is now the development of a Knowledge management system and a search engine, on which the new portal will be based. The italia.gov.it project comes after a 3 years period of studies and experimentations jointly performed by DigitPA[4] and research teams from several universities with the aim to define a technical and economically viable project able to provide a portal containing highly specialised search services to suit the citizens informative needs.

The project has been re-started in August 2010 and involves the Departments of the Ministry of Public Administration and Innovation. Its goal is to build-up a system able to collect, process, merge and update data and information gathered from PAs websites and from other PAs public data bases and archives. The key idea is that available state-of-the art technologies in the fields of information retrieval, natural language processing, semantic search, data/text mining and machine learning are now adequate to build a Knowledge Management System (KMS) able to collect and automatically manage big amounts of data and information with a level of quality (in terms of correctness and completeness) comparable or higher than the one provided by human teams. Such quality is guaranteed also by the involvement of a small team of "knowledge managers", in charge of validating only the data and information the system is not able to adequately manage by itself. All search services provided by Italia.gov.it rely on information stored in the KMS that has been extracted from raw data, either manually by the knowledge managers or automatically by the system. This is an innovative approach to the development of e-government portals, collecting and providing information gathered from a number of different, heterogeneous, independent sites in a consistent way. In fact, the mid-term goal of the project is to build a system able to automate, as much as possible, the process of data collection and update into the knowledge base of the Digital Public Administration: this would result into high scalability and economic

[4] DigitPA is the organization of the Italian Prime Minister that supports the Government by coordinating the development of large ICT projects and by designing and implementing e-gov policies. It also helps the Italian Public Administrations in ICT adoption.

sustainability. In the following section, we explain and motivate some strategic choices taken during the overall design of Italia.gov as a result of preliminary study of some information retrieval tools.

2 Strategic Choices for Italia.gov

The ICT Laboratory of DigitPA has performed an in-depth organizational, market and technical investigation in the Information retrieval (IR) and Knowledge Management (KM) fields. This activity included both market analysis and the testing of commercial and open-source tools. Market analysis has been conducted by meeting companies offering IR and KM software solutions and evaluating their products in terms of both functionalities and cost. The experimentation of IR and KM technologies has been performed jointly with research teams from academia, with the aim to assess the maturity of open-sources technologies and to acquire sensibility on open research problems in related scientific fields. Based on the results of that activity, we can summarize some conclusions concerning the benefit of IR and KM technologies to the development of large PA information systems [5].

The interaction with the user should be based on a "search only" approach instead of the classical "portal only" approach. Users are now familiar with widespread general purpose search engines like Google, Yahoo and Bing, and this is currently the best available way of accessing big data.

Existing general purpose search engines are generally not sufficient to satisfy the citizens' needs of accessing public information. A general purpose Internet search engine tries to index, by definition, all the Web. From the citizen point of view, this implies mixed result sets, containing both governmental and non-governmental URLs.

The quality of an e-government search service depends more on knowledge than on software. This conclusion is the result of our investigation and experiments. Even if many commercial enterprise search engines often provide advanced retrieval functionalities, they address general purpose search. What is really relevant is the capability of extending the search platforms, like in open-source software.

The maintenance of contents should be based on a "Knowledge management" approach rather than a "data management" approach. The information system should be designed to manage concepts, relationships and the cause-effect phenomena that drives the dynamics of the Digital Public Administration.

Technical scalability can be reached adopting big data management technologies. Building up a specific search engine[5] for Public Administrations is a challenging work also due to the large amount of data to crawl and index. In the latest few years a number of highly valued frameworks supporting data-intensive

[5] A vertical search engine, as distinct from a general web search engine, focuses on a specific segment of on-line content.

distributed applications have been developed and released by the open-source community. Among others, Hadoop [13] implements the map-reduce programming paradigm [5, 9] in order to enable data and time intensive tasks to be transparently executed on thousands of computing nodes. Many IR open-source systems already support Hadoop: Nutch [1], Solr [12] and Terrier [9, 10] already support highly scalable solutions for crawling, indexing and querying. The open-source community is also quite productive on Machine Learning (ML) and Text Mining (TM) tools. In the first case, frameworks such as LingPipe [8] (which requires a license in the highest-level configuration), Mahout [11], SVM-Light [7] allow to face a number of mining problems useful to support search services, such as clustering and classification. In the latter case, the analysis of unstructured contents such as texts, audios and videos, can be performed extending frameworks like UIMA [6] and GATE [3, 8]. Finally, in the latest years significant advances have been made in the development of NoSQL databases, useful to manage large and sparse data like the ones collected by Italia.gov.it.

Leveraging sources of structured data to set up the Knowledge management base. Sources of structured data are mainly registries, often instituted by law and maintained by national administration: Ministry of Interior, National Institute for Statistics, Ministry for Public administration. Structured data bases contains clear definitions of e-government concepts (administrations, web sites, e-mail communication channels, digital registries ..) and explicit semantic relations among them. Theoretically, they are sufficient to feed the Knowledge management base of the Digital Public Administration. Unfortunately, in many cases information about PA is not complete, not up-to-date and is replicated on several information sources. In order to build a consistent knowledge base, it is crucial to maintain these information sources as synchronized as possible. This is a tricky problem, especially when information sources are managed by different administrations in an autonomous way. This is the case, for example, of the Index of the Italian Public Administrations (IPA). IPA is a public e-Service[6] based on a centralized archive, where each Italian Public Administration publishes, by law, its institutional contacts (address, emails, phone numbers, etc.), together with some information concerning its organizational structure.

Leveraging institutional collaborations to improve the quality of the system while maintaining costs at an acceptable level. The quality of the knowledge base can be significantly improved through a suitable contribution of operators working in PAs' call centres. In fact, each call centre already has to manage a knowledge base to support its operators in dealing with inbound calls. Among others, Linea Amica's operators[7] are involved in the Italia.gov project. Such operators will highly profit from specialized search services, which will allow them to effectively improve the quality of their result-sets.

[6] http://www.indicepa.gov.it

[7] http://lineaamica.gov.it is the official call center of the Italian PAs provided by FormezPA.

3 Italia.gov.it: The Architectural Solution

Italia.gov.it is an information system including all hardware, software and data management components yielding support to the provision of a set of value added search services [14]. The logical architecture of the Italia.gov system is composed by the following subsystems:

- The ICT infrastructure is the middleware software performing the "sensory function" of the system (look, discover, search in content sources). It also includes the technical infrastructure (processing, storage and network) of the system.
- The knowledge base performs the "cognitive function" of the system (e.g. entity extraction, classification, update, entity representation);
- The learning system extracts the implicit knowledge of the human actors (knowledge operators, professionals, citizens) from their behaviour and interaction with the system and transforms it in explicit knowledge;
- The presentation layer performs the comprehension of the user needs and presents the results derived by the system.

The Presentation layer supports basic needs of information access to foreign speaking users and gathers feedbacks from final users about the quality of the services and the information provided. For what concerns communication channels, the subsystem, apart from the usual web application/web services interface, allows the development of client applications on mobile systems, tablet PCs, and, possibly, digital TV appliances. A most relevant task for the Front End module is the gathering of user feedback. Apart from explicit feedback, the one gathered through an explicit interaction with the user (such as, for example, question answering), the front-end module will provide mechanisms for implicit feedback collection (for example, through user click recording). Feedback analysis will be applied with different objectives, such as auditing, user profiling, suggestion techniques implementation, service improvement, and new services identification. At the functional level, the Front End module interacts with the Content Management module by exchanging contents to be published. The Content Management module allows the structured organization of Italia.gov.it contents, manages all processes related to data gathering, approval and publishing. It also manages all information relevant for user interface personalization. At the functional level, the Content Management module auto-feeds its content by interacting with the underlying Knowledge management subsystem.

The Knowledge Management subsystem is the core of Italia.gov.it, and is devoted to:

- Storing and managing all rules, both formal and heuristic, which influence the state and the evolution of the digital administration;
- Maintaining, indexing and storing the Knowledge base of the digital administrations, as obtained from gathering content from institutional sources, from public administrations web sites, from call centres reports and logs;

- Managing and making use of user feedback, as provided by the system for the management of Knowledge base contents, to update the Knowledge base;
- Implementing techniques for quality assessment of the information;
- Providing tools for the creation and the management of knowledge resources, such as dictionaries, thesauri, ontologies, white/black lists.

Data gathering for the KM is performed in a semi-automatic way: it is going to be supported by a limited number of specialized human operators ("knowledge managers"). At the functional level, the Knowledge Management subsystem interacts with the Front-end subsystem, which provides user interfaces for data insertion in the Content Management module. This subsystem provides support for the management of the knowledge base and for consistency maintenance among all data stored in the Knowledge management subsystem, in the Content management module, and in data sources. These tasks rely on a set of knowledge managers, specialized in the management of knowledge base contents and in the identification, manual validation, correction and structuring of external data sources. Operators will be supported by software tools for the semi-automatic validation of data, able to derive and learn new validation rules from the analysis of human operators activities and choices. The infrastructure subsystem includes all computing, storage and networking resources used by Italia.gov.it and all services related to their management. It also provides all functionalities related to communication, information protection and security, and interoperability with other data sources, such as the Index of Public Administrations (IPA). The infrastructure is composed by three subsystems: crawling and data source connection; KMS hosting; Front end hosting. A monitoring module provides all functionalities related to the continuous and orderly tracking of Italia.gov.it data sources, including the monitoring of the infrastructure, the knowledge base contents, the content manager and the users access.

4 Managing Knowledge and Services Provided by Italia.gov.it

Managing knowledge discovered in and extracted from tens of thousands of data sources is a challenging task. Our aim is the study of the possibility of designing an economically viable information system able to manage the knowledge spammed in open data and over the Internet by public administrations on a national scale. The approach we are following is based on the following operating steps:

- The knowledge base is built starting from the contents of centralized (institutional) sources of data.
- The institutional data are the basic to develop ad hoc software solutions to discovery, crawl, analyse the unstructured contents spammed over the web by digital administrations
- The knowledge extracted from the unstructured contents enriches the knowledge base (e.g. with new classified entities and new relationships)

- The uncertain knowledge cannot be extracted automatically, so human operators are to be engaged to disambiguate the situation
- The explicit and implicit feedback coming from operators is also used to improve the knowledge of the system
- The previous steps should be continuously repeated to improve the knowledge of the system and update the contents

A Web search engine is essential to offer the best way for public organizations to find information between their big databases, partners archives, and citizens/SMEs email and documents. The search engine used in the project is built by using open-source software tools, is highly extensible, thus allowing the integration of ad-hoc search components and making it possible to fully exploit additional information in the KM (e.g. linguistic resources such as list of acronyms, or formalized knowledge such as, organization charts, the institutional mission of PAs and their jurisdictional boundaries). These ad-hoc search functions are designed and experimented with the contribution of researchers from several Universities, who take advantage of the Italia.gov.it project to gain access to data and information typically available only to commercial search engine providers. Beyond the Web search engine, a large number of ad-hoc search services have already been planned. Currently, the following ones are under development:

- news.italia.gov.it: a service to monitor all news related to PAs;
- faq.italia.gov.it: a question-answering system able to search answers in FAQs published on PAs web sites;
- form.italia.gov.it: a search service aiming to help citizens looking for forms published on PAs web sites.

5 Conclusion and Further Work

The Italia.gov.it project formally started in August 2010 and will last for 5 years. Most efforts during the first 3 years are focused to build-up the system, providing a number of highly specialized search services. The most critical activity is the organization of data and the automation of the knowledge base update process, that drive most of the costs of the project.

The technical and economical results obtained so far are encouraging. The table shows the results of the system in performing the following tasks:

- Task 1: Automatic discovery of the institutional web sites of the Italian municipalities (about 8,100 administrations)
- Task 2: Automatic discovery of certified mail addresses (PEC) of the Italian municipalities
- Task 3: Automatic discovery of the web site sections devoted to legal advertising

For each task, the table shows the completeness (level of coverage with respect to the target domain) of the best institutional source that is known and a comparison with the results automatically obtained by the italia.gov.it system.

Task 1	84%	92%
Task 2	42%	67%
Task 3	0%	73%

The quality of these results can be further and significantly improved through the involvement of human operators. Future works are focused on finding the proper balance between the costs of human operators and the quality of the results the system as a whole can reach.

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Data Mart Integration at Measure Level

Claudia Diamantini and Domenico Potena

Abstract In the present literature Data Mart integration is typically considered from a dimension point of view. Approaches elaborate upon the hierarchical structure of dimensions to find the minimum common hierarchy where original dimensions can be mapped to. Although the problem of the conformance of measures has been recognized in the literature (see e.g. Kimball R, Ross M (2002) The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling (2nd Ed.), John Wiley & Sons, p. 87) as a condition for effective Data Mart integration, it is considered as a pre-requisite, so that integration strategies borrowed from the Database domain can be used. Considering the functional structure of a measure, that is the formula used to compute it, method and tools can be developed to support conformance checking and reconciliation. In this paper we review the problem of Data Mart integration, introducing the major types of conflicts considered in the literature. Next, we define novel types of conflicts hindering the conformance of measures and propose strategies for their reconciliation based on formula manipulation.

1 Introduction

A company Data Warehouse (DWH) is usually built following a bottom-up approach, where the Data Warehouse is a set of materialized view over the whole information system of the organization, namely Data Mart (DM). Although bottom-up approach is not as efficient as top-down one, it is the most widespread for several reasons, among other: design the whole DWH as a single project is very expensive and requires long time; analysis needs evolve dynamically following business changes, so it is not possible to a-priori define all DWH requirements; if the

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organization grows by consolidation, it inherits the information systems and then the DMs already built in merging companies.

These DMs contain several indicators that measure the performances of the company (i.e. Key Performance Indicator (KPI)), which are computed by means of complex ETL procedures against all available (internal and external) transactional sources. Hence, in cases where one wants to obtain a new DM for comparing KPIs of different DMs or for extracting a new KPI that is defined by re-elaborating upon existing ones, it would be desirable to build such a DM by directly integrating available DMs. However, different Data Marts are designed at different time, changing designer, models, tools, and data sources. Hence, several heterogeneities among DMs exist, which make it difficult (if not impossible) to integrate them into a common view.

In the literature, Data Warehouse integration is treated as a separate topic from database integration; in fact, the multidimensional model (MDM) underlying a DWH has peculiarities that calls for specific studies. MDM is based on three elements: the *fact* to be analyzed, the coordinates by which to analyze the fact (i.e. members of *dimensions*) at different granularity level (i.e. with respect to the dimension's hierarchy) and *measures* that allows to quantitatively evaluate the fact [2]. The heterogeneities hindering DM integration may be classified on the basis of conflicts that occur between semantically related elements of MDM [3]. In particular, we have *dimension conflicts* and *measure conflicts*. The former depends on differences between both dimensions hierarchies, members of dimensions, and names of members, levels and dimensions. Some works have dealt with dimensions conflicts, proposing approach to their resolution both for the integration of DMs [3, 4] and for the execution of drill-across queries [5]. The latter kind of conflict are usually classified as: *naming conflict* that occurs when the same measure is in two DMs with different names or two measures with the same name refer to disjoint concepts; *scaling conflict* occurs when the same measures is presented with different units of measurement; and *inconsistent values* occurring when values related to same members are different. In [3] an XML-based approach to the resolution of these conflicts is also presented.

Since the way a measure is calculated (i.e. its formula) is a fundamental element to describe its meaning [6], in this paper we introduce conflicts based on formulas. Hence, we define the *inconsistent formula*, which is a further subclass of measure conflicts that occurs when semantically related measures have different underlying formulas. This is typical of KPIs, that being high-level indicators can be computed through different formulas involving different low-level data. For instance a cost could be given with or without tax, could be given in absolute or relative term, and so on. Please note that the inconsistent formula conflict leads to inconsistent values, but not the vice versa; in fact, difference between values can be checked only for members where (and if) DMs overlap, while being formulas properties of the DM schema, their inconsistency is independent on members. We introduce also a conflict at fact level, namely *inconsistent fact schema*, which occurs when two DMs describe the same fact through different measures. This is similar to a structure conflict in database integration, where the same concept is described using two different structures.

In this paper we focus on the resolution of both inconsistent formula and inconsistent fact schema conflicts. To this end, we exploit the semantic annotation model proposed in [7] for the enrichment of data warehouses. The main novelty of such a model is the use of a mathematical ontology, which is able to also describe formulas underlying KPIs. We propose strategies for conflicts reconciliation based on formula manipulation, illustrating them by means of a suited case-study.

In the next Section we present a case-study, which allows us to introduce an integration problem and to discuss conflicts among Data Marts. Next sections are devoted to present the model we adopt to semantically enrich DMs, and to discuss strategies for measures reconciliation based on such a model.

2 Case Study

This Section is devoted to present a case study that will be used as an illustrative example through this paper. In particular, we consider the scenario of a company that sells computer accessories throughout the Italy. This company is based in Ancona and has two agencies that deal with sales to customers in the northern and central Italy. They are based in Milan and Rome respectively. In the company's headquarter is available the sales Data Mart (DM_{sales}), where are stored information about the sales of the whole company. Recently, the two agencies have conducted two separate email marketing campaigns, each in its target area.

Email marketing is a form of direct marketing where the communication channel is the email. This kind of campaign is easy to manage, requires few resources and allows companies to have a timely response (usually 24–48 h after the launch of the campaign). The underlying mechanism is plain: a company sends emails that advertise one or more target products; the email is an hypertext with some links that refer to online resources at company sites, usually the catalog of products or promotional sites. Any *click* to resources is traced so that the company is able to evaluate the interest of the customer on advertised products. During an email marketing campaign, a lot of data are collected, like the number of sent emails (*sentEm*), the number of undelivered emails (*errEm*), the number of users who have read the email at least once (*reader*), times the message is opened (*op*), users performing a specific target action (*action*), number of target actions performed (*achObj*), number of total clicks (*click*), and so forth. Several performance indicators have been also defined for evaluating a campaign, among others: number of received email ($recEm = sentEm\text{-}errEm$), open rate ($opr = op/recEm$), bounce rate ($br1 = errEm/sentEm$ or equivalently $br2 = 1\text{-}(recEm/sentEm)$), delivery rate ($dr = recEm/sentEm$), click through rate ($ctr = click/recEm$), click through open rate ($ctor = click/reader$), operative rate ($or = achObj/action$), and so forth.

Hence, at the two agencies, two different Data Marts have been built to analyze the effect of campaigns, DM_{MI} and DM_{RM} respectively. Figures 1 and 2 show the star schemas of any Data Marts involved in the present case study.

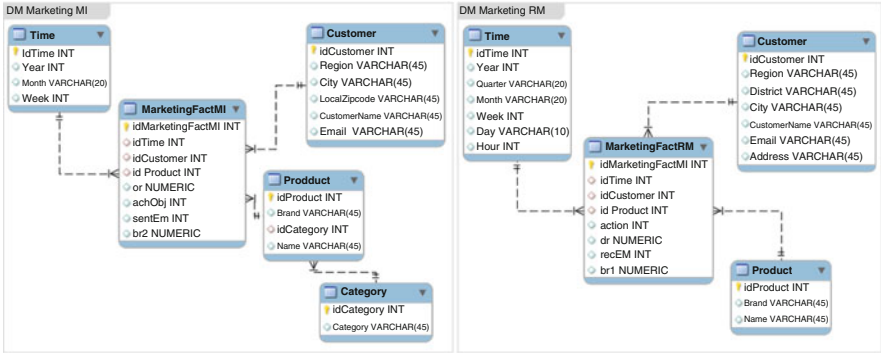

Fig. 1 Marketing data marts of the two agencies: star schemas

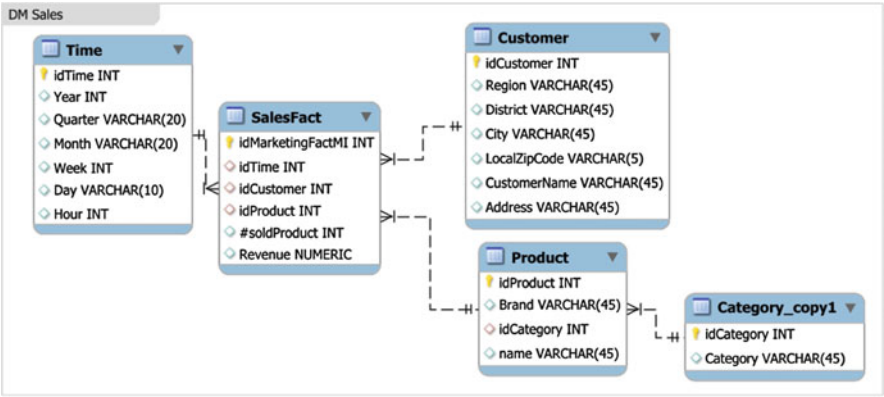

Fig. 2 The star schema of the sales data mart

As one can see, we have chosen to build these examples with *compatible dimensions*, namely the functional dependencies occurring within dimensions are consistent among themselves [1]. In particular, except for time dimensions that in DM_{sales} refers to date of purchase while in marketing DMs refers to the date of email sending, all the DMs are similar in term of hierarchy levels, differing only in terms of members; for instance, since the two agencies have distinct target areas, DM_{MI} and DM_{RM} have different customers. This choice was made to highlight that in this work we do not deal with the integration of DM with heterogeneous dimensions, but we focus on measures. On the contrary, we have introduced some conflicts that are useful for our goals: *inconsistent formula* between br1 in DM_{RM} and br2 in DM_{MI}; and *inconsistent fact schema* between the two marketing Data Marts, which do not have common measures.

Now, assume that the head office wants to evaluate the performance of the whole marketing campaign. To this end, it is necessary to pool data from both the two marketing Data Marts; and from the seals DM for evaluating the return of the

campaign. New DMs could be, of course, built extracting data from the transactional databases, but this clearly involves a high expenditure of resources and it could be not possible. Hence, the best solution is to exploit information of the available DMs, by integrating them. Two realistic analysis scenarios, which help to explain our research work, are the design and development of two DMs that show as measures *action* and the *Return of Investment* (ROI) of the campaign respectively; ROI is the ratio between the number of products purchased by a customer and the number of emails sent to the same customer. The former DM (DM_{action}) is obtained by combining information in the marketing DMs, while the latter (DM_{ROI}) is given by integrating all the three DMs.

The action measure is available only in DM_{RM}, while the ROI does not exist in any DMs. Hence the integration is not possible. Indeed, from the formulas above, action could be computed exploiting the other measures in the two marketing DMs; and the ROI could be computed by appropriately combining also measures of the sales DM. In order to make de-facto possible to integrate these DMs and to satisfy the analysis requirements, we rely on the introduction of semantics to annotate Data Marts, as in the following Section.

3 Semantic Multidimensional Model

In order to resolve measures conflicts we rely on a Semantic Multidimensional Model, where any DM elements is annotated by means of a link to a concept of a ontology. In this Section we describe characteristics of such an ontology.

A measure in the fact table usually refers to a Key Performance Indicator (KPI), which is a strategic-level measurement of a property of the company. Hence, a KPI quantitatively express a financial, economic or productive property, which has a shared definition among business managers and in turn is correlated with other properties. In our case study, for example *ctor* and *ctr* are efficiency indicators, which measures the number of click per readers and received emails, they are disjoint siblings, and so forth. Nevertheless, KPI are strategic-level indicator; this means that such an indicator is a structured datum built by combining several indicators of lower level. Dependencies of KPI on its constituent elements are defined by means of algebraic operations (i.e. formulas); see for instance formulas presented in previous Section. An indicator is fully described only if its shared meaning, structure and dependencies are made explicit. This led us to define a new kind of ontology, whose peculiarity is the contemporaneous use of logic axioms as well as algebraic formulas to represent the information about the domain. In fact, domain ontologies, typically expressed in description logics (DLs), are not able to semantically describe a mathematical formula, with its operators and operands. In order to highlight this peculiarity, we design the ontology as formed by two parts: Business Ontology (BO), and Mathematical Ontology (MO), describing logical and mathematical relations respectively. The BO is used to represent the commonly understood definition of the indicator, while the MO represents its structure and

dependencies. In the BO, besides *is-a* relations describing a taxonomy of indicators, we describe also the dimensions along which an indicator is analyzed and for each dimension the suited aggregation operator. In the ontology, besides structured data (i.e. KPI) also *atomic indicator* are described as a special kind of indicator, which is obtained as direct aggregation of transactional data. Between BO and MO a set of links are defined, representing the relationship between the formula and the conceptual definition of an indicator. Note that an indicator may have many formulas, while a formula refers only to an indicator. For instance, in our case study, *bounce rate* is associated both to *br1* and *br2* formulas.

The peculiar structure of the whole ontology allows us to extend classical DL reasoning capabilities on BO, to include reasoning on mathematical formulas. Such a reasoning is the capability to manipulate a formula according to strict mathematical axioms, like commutativity, associativity and distributivity of binary operators, and properties of equality needed to solve equations. We introduced some reasoning functionalities that are based on the application of these axioms to MO formulas [7]. Among these functionalities, *formula inference* and *formula equivalence checking* are exploited to resolve measure conflicts. The former is used to infer new formulas, which do not explicitly belong to MO. This is done by combining rewriting formulas in MO by means of mathematical axioms. The latter checks the equivalence of two formulas: formulas F and G are equivalent if exploiting MO formulas and axioms, F can be rewritten as G, which is a formula in MO. At present we have a Prolog implementation of these and other reasoning functionalities. For lack of space, we do not further detail the semantic model, referring the interested reader to [7].

4 Measures Reconciliation

In this Section the semantic model is exploited to resolve measures conflicts and, in particular to build both DMs of the case study (i.e. DM_{action} and DM_{ROI}).

Let us assume to have at disposal an ontology describing formulas as well as other atomic data about email marketing. Nevertheless, we assume that Data Marts introduced as the case study are annotated through concepts of this ontology; that is each measure is linked to a specific concept (i.e. a formula) in the MO, that in turn refers to a unique BO concept. Figure 3 shows the links between measures in fact tables and their ontological descriptors, as well as the graph of dependencies among these concepts.

In order to build the DM_{action}, we proceed as follows:

1. We directly extract *action* from DM_{RM};
2. Rewriting the *or* formula, a new formula for *action* is inferred that is formed by measures of DM_{MI}, namely $action = achOby/or$. Then, a new Data Mart DM'_{MI} is built by extracting values of *action* over DM_{MI} members;

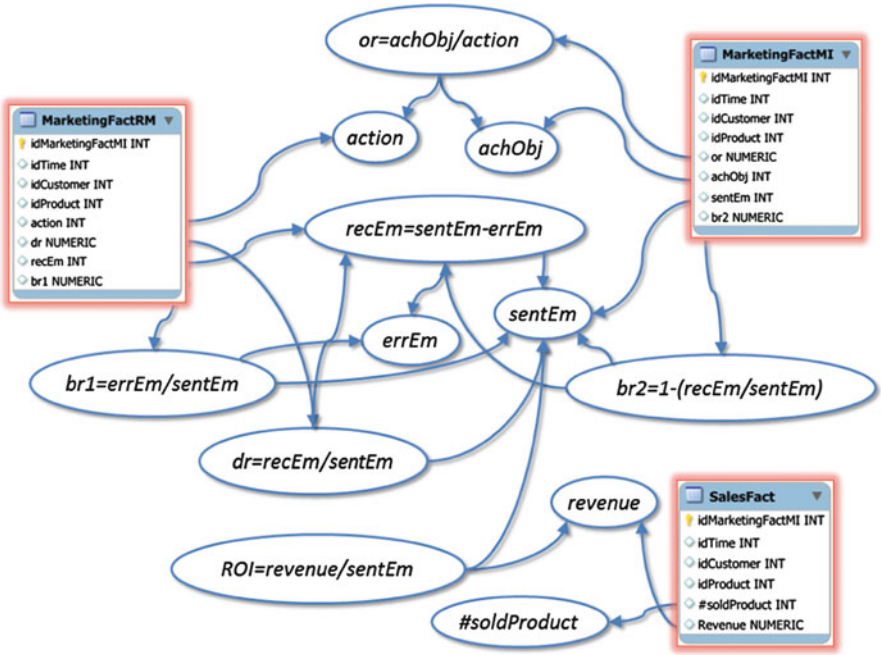

Fig. 3 The graph of dependencies of the ontology's concepts that annotate measures

3. Now we have two DMs measuring *action* for Northern and Central Italy customers respectively. Since *action* formulas in the two DMs can be proved to be equivalent, they are de-facto the same measure. Hence there are no more measure conflicts, and the DM_{action} is straightforwardly given as the union of instances in DM'_{MI} and DM_{RM}.

Since *ROI* is not available in any DMs, the procedure to build the DM_{ROI} is quite different:

1. From the ontology, we extract that *ROI* is computed as *revenue*/*sentEm*;
2. Following the annotations of Data Marts, it returns that *revenue* is in DM_{sales}. So, we directly extract revenue from DM_{sales};
3. *sentEm* is available only for Northern Italy customers (in DM_{MI}), and we have to check if it can be also extracted from DM_{RM}. Hence:
   (a) We directly extract *sentEm* from DM_{MI};
   (b) It can be inferred (at least) two new equivalent formulas to compute *sentEm* through measures in DM_{RM}, namely $sentEm = recEm/(1\text{-}br1)$ and $sentEm = recEm/dr$. Hence, we compute DM'_{RM} that has the requested measure for Central Italy too;
   (c) A new Data Mart DM_{sentEm} is then obtained as the union of DM'_{RM} and DM_{MI};

4. Now DM_{sentEm} and DM_{sales} are merged (by union of instances), returning a new DM with *revenue* and *sentEm* for all customers;
5. Finally, the *ROI* is straightforwardly computed over the new Data Mart.

In both cases the procedure starts from measures to visualize (i.e. the goal of the analysis) and, exploiting reasoning over the ontology, it checks if and how we can obtain these measures. We like to note that our strategy for integration is mainly based on the use of two operators: *union of instances* and *inference of equivalent formulas*. Given two (or more) Data Marts with compatible dimensions, the former operator returns a new DM defined on a common dimensional schema, having as measures all the measures of the given DMs, and as values the union of values of the DMs. The latter elaborates upon a DM returning all formulas, equivalent to a given one, that can be inferred by the measures of the DM.

Besides the integration of Data Marts for building a new one, the previous operators can be applied to drill-across queries as well. As matter of facts, in both cases we derive a new view over the whole data warehouse: a new DM is a materialized view, while a drill-across is a virtual view.

5 Conclusion

In this paper we have treat the problem of integration of Data Marts, mainly focusing on conflicts occurring between Data Marts with heterogeneous measures. In particular, we focused on the situation where the inconsistency is due to formulas used to compute the measures. In order to resolve these conflicts, we based on a semantic multidimensional model, where any elements of a Data Mart is enriched by both its logical and mathematical meaning. Hence, by means of formula manipulation, we have shown through a case study a strategy for the resolution of conflicts and reconciliation of measures.

At present we are working on the formalization of the proposed approach in more general scenarios, in which dimensions conflicts can occur. Since our approach is orthogonal to existing solutions for dimensions reconciliations, we believe that our approach can easily be used in combination with existing ones. A prototype implementing our solution is under development as well.

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Part IV
Human-Computer Interaction

Towards ICT Support for Elderly Displaced People: Looking for Natural Gestures

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Abstract In the aftermath of natural disaster ICT-based tools can support technology-erudite people but risk to sharpen the isolation of vulnerable population groups because, e.g., of grey digital divide. In this paper we discuss some usability studies performed after L'Aquila earthquake on elderly people at risk of social isolation, to single out interaction needs and platform requirements for easy-to-use elderly oriented tools ideally not requiring learning need. In particular, we focus our analysis on intuitiveness of multifinger gestures on tablets.

1 Introduction

The study here reported originated within the context of more general studies launched after the L'Aquila earthquake, aimed at designing ICT-based support tools for populations hit by natural disasters. Though in the immediate aftermath of a disaster most of the attention is focused on material needs and material damages, social and psychological immaterial damages may result even more relevant than material ones (see, e.g., [9, 14]). Social interaction is recognized as a key factor for the reconstruction of broken social ties and of a new universe of legitimate shared meanings [14], but this process can be hampered by the geographical dispersion of the population caused by post-disaster evacuation and displacement.

In the cyberspace era, which offers immaterial spaces where communication may take place, it is legitimate to investigate on the kind of ICT-based interaction that may support the social recovery [1]. Actually, many ICT-enhanced support tools, categorized as Disaster Management Systems, have been developed to this

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end [3, 8, 12], mostly aimed at enabling real-time, categorized, geo-referenced data sharing and based on communication via sms or web portals. Unfortunately, if the recourse to technology may help technology-erudite people in cutting distances and re-tying broken linkages, at the same time it may exacerbate the isolation of vulnerable population groups, as in the case of elderly people, emphasizing the imbalance derived by grey digital divide. To overcome the reluctance of users of this kind, often nearly technophobic, it is necessary to conceive easy-to-use tools tailored to the capabilities of aging users and that can be used with almost no learning need. While cellular phones, though diffused, suffer from small sized displays and small buttons, not appropriate for visual and motor impairments typical of the aging process [4, 5], recent tablets based on touch interfaces promise to be an appropriate platform on which to base elderly-centered applications that allow to exploit the potential of networked communication in disaster recovery phases.

In the rest of the paper we report on a preliminary usability study on iPad conducted in the aftermath of the L'Aquila earthquake with senior people at a risk of social isolation and with scarce e-literacy: after a brief discussion on the context of use, we discuss the platform requirements and the experiment results.

2 Context Specific Platform Requirements

The 6.3 quake that hit L'Aquila on April 6, 2009 made unlivable about 50% of residential buildings and most public buildings, forcing the evacuation of more than 70,000 people. In the immediate aftermath of the disaster, evacuees were scattered over the whole Abruzzo region. Official reports [11] show that more than 2 years after the quake more than 35,000 people are still displaced: about 20,000 are housed in more than 20 "new villages" built by the Civil Defense after the quake and located all around the city territory (along a 100 km closed path), about 1,000 are hosted in temporary shelters (like barracks and hotels, some still on the coast), and nearly 15,000 live in autonomously arranged housing solutions. The historical city center, which previously hosted almost the entire public life, is still inaccessible to citizens, as well as historical centers of surrounding villages.

The condition of elderly people is particularly heavy: they are often separated by family members, far from their homes and their original communities, and with scarce travelling or commuting capabilities. In the series of interviews we conducted with 15 senior (65–85 years) citizens hosted in temporary shelters and nursing homes, a recurring concern coming out was the impossibility to "see my house" or "see what is going on in the city" or to "get news about my former neighbors". It was soon clear to us that, beside needs traditionally addressed by research on assistive technology, ICT-supported ageing and elderly care networks (see, e.g., [2, 4, 13]), also specific displacement-related needs had to be addressed. Based on our interviews, we determined functional and non functional requirements for an elderly-centered application that would result appealing also to "technology

reluctant" users (nearly 50% of interviewees never used cellular phones, let alone PCs) [6]. In this paper we focus on platform requirements.

In a post-disaster context a specific aspect to be considered is the instability of the housing conditions, with many evacuees already moved two or three times after the disaster. This suggests to prefer mobile computing solutions over, e.g., smart house oriented approaches [2]. Actually, recent mobile devices relying on relatively large (10″) touch screens allow to overcome usability problems typical of cellular phones, since text and icons can be displayed reasonably large and buttons can in principle be made scalable [10]. The benefit of touch screen interfaces over indirect input devices for elderly users has already been demonstrated [7, 15]. Furthermore studies show that older users may be slower than younger ones in performing simple gestures, but not necessarily less accurate, and that familiarity of the gesture can influence the performance [10]. While these studies are conducted mostly at syntax level, it remains unclear to which extent gestures result natural to use and effective also at semantic level, that is whether novice older users (in our case often with low education background) succeed in easily associate gestures to their function/effect and to remember the association for later re-use. We aim at making one step further in the research in this area, by providing answers to this open problem. In the following we report on a preliminary usability study.

3 Evaluation

The main research issue of the study was to evaluate whether customary iPad gestures are intuitively understood, accepted and adopted by elderly users with no or scarce e-literacy. In order to do so, we studied how five elderly users interacted with five different applications (iBook, Skype, Photos, VLC and iScopa), based on a set of seven simple gestures: Tap, Double Tap, Press, Drag, Pinch, Flick/Swipe, and Flick/Scroll (as defined in http://www.lukew.com/ff/entry.asp?1071).

Participants: On a voluntary basis, five novice older users, age 68–83, took part in the test. None of them ever used a touch device before the experiment; one of them never used even a cellular phone, one uses a smart phone, while the others regularly use a first generation mobile phone. Their formal education varies from illiterate to high educated people. Overall, the sample covers the classes singled out in the users' analysis: *User A* (female, age 71) is dynamic and socially active; *User B* (male, 79) lived part of his life is the United States as emigrant involved in a variety of jobs, from reception desks to driver, used to interact with people and is familiar with everyday consumer items like cellular phones and video cameras; *User C* (male, 83) has always worked as a farmer in a small town and doesn't have any familiarity with any type of technology; *User D* (female, 70) is a housewife who does not likes to interact with people and with technological artifacts; *User E* (male, 68) used to work in a bank and possesses a PC and a smartphone.

Venue and dates: The evaluation took place in users' living environment to make them feel comfortable without extra pressure. All users were living in

temporary accommodations: users A and B in removable wooden houses installed after the quake (in Villa Sant'Angelo (AQ)), users C and D in a nursing home (Opera Santa Maria della Pace, Fontecchio (AQ)), and user E in a hotel (on the Abruzzo coast). The sessions took place in three different days in November 2010.

Procedure: To recruit users in the nursing home we presented the project to the manager and he introduced us to users C and D. For others users we asked directly to them whether they wanted to participate. Before performing the tests, users were met individually to explain ethical considerations concerning consent, withdrawal and confidentiality, and asked permission to make videos. They were informed about the expected duration of the session, what the experiment intended to evaluate, the characteristics of the applications and the order in which these would be presented, and what they were expected to do. A brief practice session was then conducted to help participants understand the iPad basic behavior and let them get familiar with it. Users were reassured that it was not a problem if they did not know how to perform a task and that they could freely try to touch or ask for help. When the participants had assured the experimenter that they fully understood the tasks and that they were ready to proceed, the experiment began. The evaluation was conducted using a combination of the thinking aloud protocol and the "cognitive walkthrough" inspection method [16]. Four users were filmed with two cameras, to record both gestures and faces, and to be able to study later, from facial expressions, user's emotions related to the interaction (see Fig. 1). One user preferred not to be filmed.

Tasks: The selected gesture set was tested in five different applications, each allowing us to evaluate the effectiveness of a subset of gestures, as follows:

1. **iBook**: Tap, Press, Flick/Swip, Drag
2. **Skype**: Tap, Flick/Scroll, Drag
3. **Photos**: Tap, Double Tap, Flick/Scroll, Flick/Swip, Pinch
4. **VLC** (video player): Tap, Drag
5. **iScopa** (traditional Italian card game): Tap, Double Tap, Drag.

The use of the same gesture in more than one application allowed us to evaluate gestures memorability by looking at user's behavior in successive steps. There were five consecutive rounds for each participant, one for application. Different users were assigned different application orders, to avoid biases derived from particular orderings (see Table 1). For each round and each user, the first task was always a

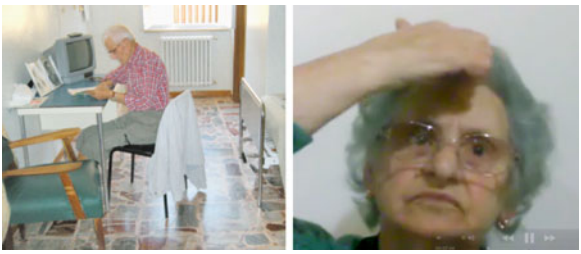

Fig. 1 Pictures from the tests: a room of the nursing home (*left*) and a user in trouble (*right*)

Table 1 Descriptions of evaluation sessions

Users	Round order
User A	2,1,3,4,5
User B	1,2,3,4
User C	5,1,3
User D	1,5,3,2,4
User E	3,1,2,5,4

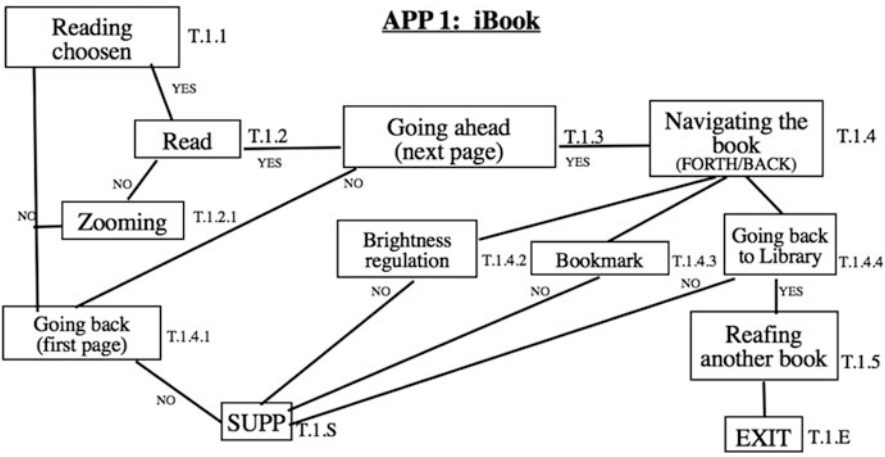

Fig. 2 Structure of the iBook evaluation tasks

free interaction with the application during which the user was invited to comment aloud. Then we tried to enforce a sequence of specific tasks (e.g., "go to next page" while using iBook) depending on the application they were using. For example, Fig. 2 shows how we designed the walk through the iBook application (other evaluation rounds were similarly structured [6]). In many cases the tasks were performed in a sequence different from what we planned or not performed at all (users B and C gave up with some applications); in these cases we asked explanations about the choices the user made or the reason for abandoning the task. Users were not forced in any actions but when in trouble (unexpected system behaviors or long time for task execution) or asked help, they got help from us.

Experimental measures: System usability was evaluated by qualitative efficacy measures, qualitative and quantitative efficiency measures and subjective and objective satisfaction measures. In particular:

- *Efficacy*: we studied which gesture is selected to achieve a particular goal, if gestures are correctly performed, if one or two hands are used for multifinger gestures, if cursors are used, if numbers and letters are correctly typed, if visualized items are readable and comprehended;
- *Efficiency*: we counted the number of gestures performed to reach a goal, and we considered: the path followed to reach a goal, if the user remembers already performed gestures, if the user is able to associate a gesture to a goal re-utilizing

it to reach the same goal later, if the user remembers the position of interactive items necessary to activate a function;
- *Satisfaction*: video recorded facial expressions helped us to evaluate whether the user was relaxed, worried or amused while performing a task (see in Fig. 2 a user in trouble diverting attention from the device to ask help); direct questions posed during task execution helped us to evaluate if the user has readability problems, if s/he appreciates interface properties (e.g., colors, icons, etc.), if s/he understands the meanings of symbols, icons, buttons and the like.

Results and discussion: Due to space limitation, we report here a general discussion on the evaluation session and summary data on tasks execution presented according to a Likert scale (0. . .5), as follows:

- 5 (Accurate): the user accurately identifies objects and perform gestures;
- 4 (Good): the user completes the task in a short time without problems;
- 3 (Discreet): the user completes the task with some age-related problems;
- 2 (Poor): the user has many difficulties in completing the task and often requires help;
- 1 (none): the user does not understand what to do.
- 0: the user needs help

For each tested application, evaluation results were organized in a summary table arranged according to task similarity determined on the basis of the gestures a task requires (see an example in Table 2 for iBook). Then a global summary table for individual gestures (see Table 3) was derived according to scores obtained by each gesture in different tasks of different rounds. The scores were weighted to take into account the influence that individual gestures have on task completion when the task requires more than one gesture (e.g., for regulating brightness (Task T.1.4.2) a sequence of Tap and Press is necessary). To assign weights, relative difficulty of gestures within the task was evaluated on the basis of observation of users during task executions. Our findings can be summarized as follows:

General aspects: all users instinctively put the tablet in horizontal position; expected problems related to lack of haptic feedback are found (e.g., users keep

Table 2 Results summary for iBook

Task	Gestures	Users				
		A	B	C	D	E
T.1.1, T.1.5	Tap	4	3	4	4	5
T.1.2, T.2.2.1	Tap, press	4	2	2	4	5
T.1.3	Double tap, flick/swip	3	3	4	4	5
T.1.4.1	Drag, tap	4	1	3	3	5
T.1.4.2, T.1.4.3	Press and tap for near object	4	3	3	2	5
T.1.4.4	Tap, memorability	3	2	4	1	4
T.1.E	Tap, physical button	4	3	4	2	4
T.1.S		□	□		□	

Table 3 Summary figures

Gestures	User A	User B	User C	User D	User D
Tap	4	3	5	3	5
Double tap	3	1	3	2	4
Drag	3	2	4	3	5
Press	3	2	3	3	5
Flick/swip	4	3	5	4	5
Flick/scroll	4	3	4	4	5
Pinch	3	2	3	3	4
Physical button	4	4	5	3	5
Support	□	□		□	

on pressing on a specific interface item even if they do not get any system response); scroll bars and tab bar items are not perceived as interactive objects.

Age specific impairments: users constantly look for a support where to lean the tablet; they have problems in selecting items with size below 2 cm and in reading characters below 17 pt.

Gesture performance: expected slowness in performing gestures is confirmed [10]. Furthermore the following observations can be done:

- Flick/Swipe are friendly for all users;
- Drag is done easily and is quite intuitive;
- Flick/Scroll is sometimes complex to perform and the vertical-scroll, from bottom to top, is preferred over the horizontal one (e.g. in scrolling photos, the user sees to the empty spaces on top and bottom of the screen and makes a movement upwards, whereas horizontal white space is not seen);
- Users have difficulty in Press, and in fast single Taps that often become Press;
- A Double Tap is never used except by mistake (e.g. by double tapping on a photo, or double tapping on the left side of the page of a book they accidentally achieve a result, but they did not notice which gesture was done and then they are not able to redo it to achieve the same result);
- Pinch is never done intuitively but is done only after an example and is always done with two hands.

Memorability: most users do not remember gestures and interactive actions done to achieve a specific goal, ask confirmation on whether the present action was already previously done, and follow different paths in different tasks to achieve the same goal.

Emotion: while users initially show anxiety and concern in using the tablet, as they acquire familiarity with the tool they start to appreciate what they can get from it: they look interested in the book readings (which they do aloud), they are amazed while interacting with photos, and enjoy with emotional participation the card game commenting aloud while playing as if the iPad was a human player.

4 Conclusion and Future Works

We discussed some issues about platform requirements for an ICT application aimed at supporting elderly people after natural disasters. It is necessary to rely on intuitive interaction based on direct input languages, preferably on mobile devices with touch sensible medium sized screens (about 10″). In this scenario, the evaluation study was aimed at verify flaws and deficiencies of existing iPad applications with respect to gesture use. Though our results are preliminary with respect to the number of involved users, the overall experiment setting up contributes to the research area by providing a setting for evaluating gestures at semantic level. The evaluation results constituted the basis for the design of a prototype that, in a first round of usability tests at mockup level, proved to be more elderly-oriented than the traditional iPad applications (errors and numbers of attempts necessary to reach the goals were lower than in the tests here reported). Future works will be aimed at the implementation of the system and at more extensive evaluation experiments.

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Towards Improving Usability of Authentication Systems Using Smartphones for Logical and Physical Resource Access in a Single Sign-On Environment

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Abstract The design of authentication methods raises crucial questions on how to solve conflicts between security and usability goals, that are at opposite ends of a "see-saw". As a matter of fact, the usability of security systems has become a major issue in research on the efficiency and user acceptance of security systems. An authentication is more strong as more tokens are involved in authentication process. The main disadvantage is that users need to purchase and keep with them several tokens and cards. To address the above issues, we propose a two factors authentication scheme that allows users to employ their smartphones as unique authentication token providing access to both online and physical resources in a user-friendly and secure manner.

1 Introduction

Most of the Internet services serve users carrying out human-oriented processes and often requiring authentication mechanisms for different reasons, such as privacy, access to logical or physical resources, and so on. Thus, the design of usable yet secure authentication methods raises crucial questions concerning how to solve conflicts between security and usability goals. As a matter of fact, the usability of security systems has become a major issue in research on the efficiency and user acceptance of security systems [1]. As an example, conventional static password-based authentication systems are widely used in several applications, but users often employ authentication keys easy to remember and to guess or the same username-password couple for different services. These typical user behaviors strongly reduce the security of an already weak authentication mechanism. In many security-oriented environments this low level of safety is not acceptable,

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thus it is important to improve the quality and robustness of the adopted access control mechanisms. To this end, the National Institute of Standards and Technology (NIST) proposed several guidelines to ensure that a certain desired security level is met using "tokens" [2]. Tokens are physical or logical items that the claimant possesses and controls and may be used to authenticate claimant's identity. The NIST categorization of tokens is: *something you know*, like a password or Knowledge-based Authentication (KBA), *something you have*, like an ID badge, a cryptographic key, or a digital certificate, and *something you are*, like a voice print, facial pictures, and other aspects involved in biometric-recognition. An authentication process gets stronger as more tokens are involved. For example, a "two factor authentication" checks at least two tokens, such as something that the user knows and something that he/she has. However, this kind of authentication requires that users need to purchase and keep with them several tokens and cards to access online and physical resources, thus impacting on usability of the authentication systems.

To address these issues, in this paper we propose an authentication scheme that allows users to employ their smartphone as unique authentication hardware token providing access to both online and physical resources. In particular, we intend to achieve several goals: increasing security level enforcing a two factor authentication; reducing hardware complexity by using only one hardware token; improving usability and being applicable in real-world scenarios; being easy to use by non-expert users to discourage bad practices (e.g., writing passwords on notes or reusing the same password) that may decrease the security level; being backward compatible to be usable even in environments that cannot be upgraded for either technical or policy reasons; it should not require additional specialized hardware.

The rest of the paper is organized as follows. We first give some technical details needed to understand the proposed authentication scheme and then we describe the proposed solution providing architectural details and a sample use-scenario. Security threats and countermeasures are also discussed followed by related work. Final remarks and future work close the paper.

2 Technical Background

We provide a brief explanation of Single Sign-On (SSO) mechanism [3] and of one of its implementation, namely the Shibboleth System [4]. SSO is an authentication mechanism whereby a single action of user authentication and authorization allows him/her to access all systems where he/she has access rights, without the need to enter multiple passwords. Thus, SSO both splits the complexity of architecture security and helps security workers to reduce the gap between security and usability. Several protocols can be used to manage SSO, such as Shibboleth and OpenID [5]. We chose Shibboleth because of its flexibility, robustness, and widespread usage. It works as follows: when a user visits web resources protected by a Service Provider (SP), he/she needs either to have a valid Shibboleth session (i.e., he/she is already authenticated) or to authenticate himself/herself. In the latter case, the SP

redirects the user's browser to the Where Are You From (WAYF), which presents the user with a list of organizations whose users may access to the resources. The user chooses one of the listed organizations and he/she is redirected to his/her Identity Provider (IdP). The user can log in submitting his/her credentials to the IdP accordingly to the sign-on method the home organization chose. If the user is successfully authenticated, he/she will be associated to specific attributes, such as his/her username, roles that he/she covers, etc. Thus, the IdP component sends the browser back to the original resource web site and sends to the SP a message that contains the authentication statement and the user's attributes. Therefore, the SP processes the message and, if the provided credentials match the service's access control policy, a new Shibboleth session is instantiated for the client. The browser requests again the protected resource and the user can access to it.

3 The Proposed Approach

The authentication scheme we proposed extends Shibboleth capabilities to grant online and physical resources access using a smartphone as unique hardware token (something you have) with a password or others tokens established by the IdP (usually something you know). This allows us to be backward-compatible, enabling a wide usage of the solution without changing the existing IdPs. Moreover, since usability is our main goal, off-the-shelf smartphones combined with an SSO mechanism lets us significantly improve system usability. Indeed, the user does not need to remember more than one password and he/she does not need to carry with him/her multiple tokens to authenticate to different systems. To perform physical access, session data are transferred from the smartphone to the authentication terminals using an optical recognition system based on 2D bar-codes called QR-codes. This lets us to expose a smaller attack surface to possible eavesdroppers that may stay close to the user while he/she enters his/her credentials. Fig. 1 shows some snapshots of the client-side software that runs on smartphones using Google Android, but that can be easily ported to other mobile phone operating systems. The *Login* functionality (Fig. 1a) lets users to authenticate themselves in case of the SP is already configured to communicate directly with a certain IdP. Otherwise users can exploit the embedded web browser clicking on *Custom login* to start the Shibboleth-process. All configurations can be done touching *Configure*. After a successful authentication, the application shows the main menu (Fig. 1b) and through it users can load the QR-code needed to access physical resources (*Get QR-code*), can reconfigure their SP (*Configuration*), or can surf the Internet to access logical resources (*Navigate*).

In the sequel we detail how the authentication scheme works showing how the involved components interact each other and providing an example of usage.

Fig. 1 Some application snapshots

3.1 Architecture Details

To authenticate users through a mobile phone, only two requirements must be satisfied: users have to use a smartphone both connected to the Internet and with a working SIM card, while the IdPs need to use an LDAP server [6] to store users' IMEI (International Mobile Equipment Identity) and IMSI (International Mobile Subscriber Identity) which are unique identifiers associated to mobile phone and SIM card, respectively. Fig. 2 shows the architecture underlying the proposed authentication scheme. The smartphone software application, needed for starting the authentication process, is composed by two modules: the *Authentication Module* and the *Android Session Handler*. The first one transparently manages the HTTP communication with the configured SP and the relative IdP accordingly to the Shibboleth protocol (1–2), by letting the user to authenticate himself/herself via HTTPS. If the application is configured to use a statically known SP, the authentication process is carried on automatically: the mobile application will send a first request to an ad hoc protected resource on the *Service Provider First Access* to start the identification and the user has only to input his/her credentials that will be checked by the IdP (3). If the application is not configured to use a specific SP, the user can exploit the web browser embedded in the application to connect to his/her

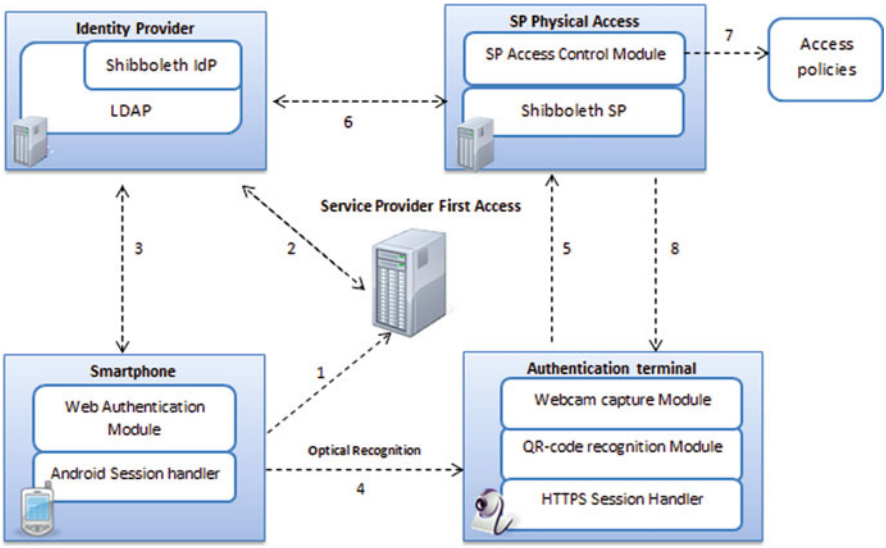

Fig. 2 The proposed protocol

preferred SP and log in using his/her credentials. For simplicity, we suppose that the mobile application is configured to interact with our SP, but it can be statically changed or be chosen at run time via our embedded web browser.

Until the session expires, the user can request to the smartphone application a QR-code, representing his/her current Shibboleth session that can be then exploited for physical access. Indeed, The *Android Session Handler* generates the QR-code that contains the Shibboleth cookie, needed to associate users to a valid Shibboleth session and the IMEI and IMSI identifiers. When an user wants access to a restricted physical environment, he/she only has to show the QR-code displayed on his/her mobile phone to the webcam (4) of the *Authentication Terminal* that is located in the building that he/she wants access to. The *Webcam Capture Module* captures the QR-code and communicates it to the *QR-code Recognition Module*, also running on the *Authentication Terminal*. This module decodes the data stored in the QR-code and sends it to the *HTTPS Session Handler*. Notice that QR-code changes mirroring Shibboleth-cookie, so a certain QR-code is valid only until the session expires. The *HTTPS Session Handler* transforms the received data into web cookies and tries to access to the resource protected by the *SP Physical Access* (5). The *SP Physical Access* requests IMEI and IMSI to the IdP (6) and compares them to the ones provided by the *Authentication Terminal*. If they match and the received cookies represent a valid Shibboleth session, it grants access to the requested resource. Organization's access policies can be easily plugged into the *SP Access Control Module* (7) to check other attributes before granting access, such as time or other information relative to the user that is trying to access to protected resources. The final page redirection is handled by the *Authentication Terminal* (8) that can, for example, unlock a door to let the user enter the building.

3.2 Example

The proposed authentication system is very flexible and can be applied within several organizations' information systems in which a physical access is required to protected resources (e.g., laboratories, documentation), such as higher-education institutions, consulting firms or governmental buildings access. As an example, in Fig. 3 a scenario where several consulting firms provide different services to many other organizations is depicted. The workers of a firm can access to all (or to a part of) the resources of a certain organization in agreement with its access policies. For example, *Worker2* of *FirmA* is a legal counselor of both organizations 1 and 2 thus he/she can access to their documents, while *Worker1* is a computer technician and can access only to the organization's laboratory. The access will be denied to any unauthorized person, such as an intruder or a person who works for a consulting firm which is not related to another organization and cannot access to its resources (e.g., *Worker3*). This scenario highlights several advantages of our proposal for both end-users and organizations: (1) users can manage their identities in a simple way enjoying a higher protection; (2) it is globally available; (3) organizations can easily integrate the system into their existing Shibboleth-based solutions, saving costs for upgrade; (4) it enables a finer-grained control on user accesses.

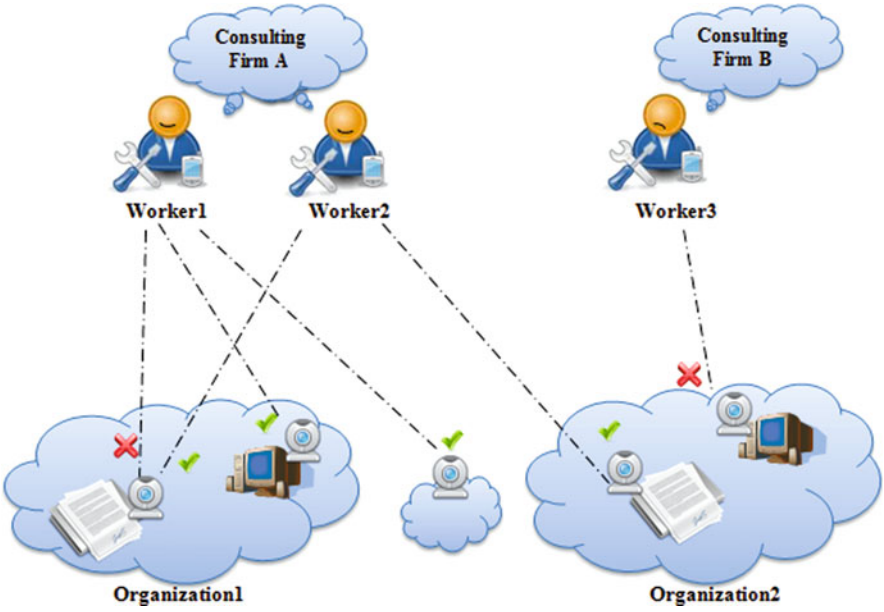

Fig. 3 A consulting firm sample scenario

4 Security Evaluation

In this section a security evaluation of the proposed authentication scheme is discussed showing how the solution resolves possible threats. Threats related to the *password authentication* (usually adopted by IdPs) concern attackers trying to guess or steals user's password via social engineering or using malicious software such as keystroke logger. To avoid such threats a two-factor authentication was exploited, thus attackers require both tokens in order to reconstruct the necessary information. Moreover, passwords are not shown as plaintext, while it is up to the user to look at the permissions during the installation of a new keyboard and to be sure of what he/she is installing; otherwise to completely avoid the problem, the software keyboard installation function can be completely disabled. There are several threats related to the *user device*: (1) attackers might steal a mobile phone (or IMEI and IMSI) to impersonate a valid user; (2) attackers might try to guess IMEI and IMSI; (3) attackers might install on the mobile phone a malicious software that tries to steal Shibboleth Session. In the first case, the two-factor authentication allowed us to prevent the attack. In addition, IMEI and IMSI are hard to guess, so we prevent the second threat too. To thwart brute force attacks, up to three unsuccessful authentications are allowed, after that the access is denied to the user. Moreover, no application has permission to read or write the user's private data or other application's files, to perform network access, etc., thus Shibboleth's cookie is accessible only inside our application. To prevent threats related to the *internet connection* (i.e., attackers might try to spoof sensitive information over the network or to mount a man-in-the-middle attack) it was secured with TLS. Finally, concerning threats related to the *QR-code authentication*, attackers staying close to the screen which displays the QR-code might try to steal information or to guess QR-code. These attacks are hard since, on the one hand, it is not feasible for a person to recognize information stored into a QR-Code and, on the other hand, brute force attacks are not allowed as we explained before.

5 Related Work

Several works in the literature have focused on using smartphones as hardware token for authentication systems providing logical or physical resources access. However, to the best of our knowledge, our approach is the first that aims to grant both logical and physical resources access in an SSO environment taking into account also usability issues. In the following, we outline a selection of previous research works. Concerning authentication systems to grant access to physical resources, in [7] the authors exploit mobile phones to control admittance services. In particular, they propose to use Near Field Communication (NFC) [8], which is a low-power and short-range wireless interface, to enable SIM cards as security tokens, while the authentication process is carried out via GSM. However, NFC

is not available on most of existing mobile phones thus limiting the applicability of this approach. With the same aim Tsai and Hung [9] proposed to use digital keys on Bluetooth-enabled mobile phones together with an SMS-based authentication. The authentication relies on NFC showing the same limitation of [7]. As for secure access to logical resources, Hallsteinsen et al. [10] proposed the use of both mobile phones and computers exploiting GSM network and SMS-based communication to perform authentication based on Java Middlet. Thanh et al. [11] describe a SIM-based authentication system involving Bluetooth and specialized hardware, such as USB dongle, card readers, and GPRS/3G PC card, to access directly to the information stored in the SIM card. As we said, the use of additional hardware can impact on system usability. Moreover, many of these works provide on-line authentication, thus the mobile phone used as token needs constant access to GSM or similar networks, whereas our system accesses to the network only when the first log in occurs (until timeout expiration).

6 Conclusions and Future Work

In this paper, we proposed a novel approach for authentication systems, for both logical and physical resources, based on SSO. We showed how to turn a smartphone into a user-friendly and secure authentication token. The proposed approach avoids some security weakness, such as the possibility of shoulder surfing attacks, guessing attacks, and more other common attacks. The solution can be easily integrated into all already existing Shibboleth-based services. Let us stress that since we use Shibboleth, all organizations can easily add their additional access policies into our solution. As future work we plan to evaluate the usability of our system on a wide scale and exploit the obtained experimental results to formulate metrics that allow us to better control security and usability aspects. On the implementation side, we want improve the portability of our system, by realizing the smartphone client on different operating systems, and its usability, by providing a flexible interface to automatically interact with custom IdP pages.

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A Biometric Interface to Ambient Intelligence Environments

Andrea F. Abate, Michele Nappi, and Stefano Ricciardi

Abstract As domotic technologies are evolving from home automation towards Ambient Intelligence, context aware adaptive solutions for advanced environment management are emerging, featuring a broad range of services customized on each user's specific needs. This scenario offers the opportunity to exploit the potential of face as a not intrusive biometric identifier not only to regulate access to the controlled environment but to adapt the ambient intelligence to the preferences of the recognized user. In this paper we present a 3D face recognition method applied to such an Ambient Intelligence framework. The proposed approach relies on stereoscopic face acquisition and 3D mesh reconstruction to avoid highly expensive and not automated 3D scanners, typically not suited for real time applications. For each subject enrolled, a bi-dimensional feature descriptor is extracted from its 3D mesh and compared to the previously stored correspondent template. This descriptor is a normal map, namely a color image in which RGB components represent the normals to the face geometry. A weighting mask, automatically generated for each authorized person, improves recognition robustness to a wide range of facial expression.

1 Introduction

Information and Communication Technologies are increasingly entering in all aspects of our life and in all sectors, opening a world of unprecedented scenarios where people interact with electronic devices embedded in environments that are sensitive and responsive to the presence of users. Indeed, since the first examples of "intelligent" buildings featuring computer aided security and fire safety systems, the request for more sophisticated services, provided according to each user's specific

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needs has characterized the new tendencies within domotic research. The result of the evolution of the original concept of home automation is known as Ambient Intelligence [1], referring to an environment viewed as a "community" of smart objects powered by computational capability and high user-friendliness, capable of recognizing and responding to the presence of different individuals in a seamless, not-intrusive and often invisible way. As adaptivity here is the key for providing customized services, the role of person sensing and recognition become of fundamental importance. Biometric recognition [2] refers to the use of distinctive physiological (e.g., fingerprints, face, retina, iris) and behavioral (e.g., gait, signature) characteristics, called biometric identifiers, for automatically recognizing individuals.

Because biometric identifiers cannot be easily misplaced, forged, or shared, they are considered more reliable for person recognition than traditional token or knowledge-based methods. Others typical objectives of biometric recognition are user convenience (e.g., service access without a Personal Identification Number), better security (e.g., difficult to forge access), and higher efficiency (e.g., lower overhead for computer password maintenance). All these reasons make biometrics very suited for Ambient Intelligence applications, and this is especially true for a biometric identifier such as face, which allows to recognize the user in a not intrusive way, without any physical contact with the sensor. This aspect is particularly relevant in an Ambient Intelligence context, where face is one of the most acceptable biometrics as it is one of the most common methods of recognition that humans use in their visual interactions. A generic biometric system could operate either in verification or identification modality, better known as one-to-one and one-to-many recognition [3]. In one-to-one modality it authenticates a person's identity by comparing the captured biometric characteristic with her own biometric template pre-stored in the system, while in one-to-many it recognizes an individual by searching the entire template database for a match. In the proposed Ambient Intelligence application we are interested in one-to-one recognition, as we want recognize authorized users accessing the controlled environment or requesting a specific service.

In this paper we propose a face recognition system based on 3D features to verify the identity of subjects accessing the controlled Ambient Intelligence Environment and to customize all the services accordingly.

This paper is organized as follows. In Sect. 2 related works are presented and the proposed method is introduced. In Sect. 3 the Ambient Intelligence framework is briefly discussed. In Sect. 4 the proposed face recognition method is presented in detail. In Sect. 5 experimental results are shown and commented. The paper concludes in Sect. 6 showing directions for future research and conclusions.

2 Related Works

Face recognition has been originally approached as a 2D pattern recognition problem. Several 2D methodologies briefly classifiable as Image Based [4] (analyze face image as an array of grey shaded pixels), Features Based [5] (analyze

anthropomorphic face features and geometry), or Combined [6] (extract areas of features and apply image based algorithms on these areas) have been proposed. All this face recognition methods are based on 2D image processing using intensity or color images or video footage but, as showed in Face Recognition Vendor Test [7], current 2D approaches could not be sufficient to achieve optimal performances when subject pose is not carefully controlled.

The term 3D face recognition refers to a recognition methodology operating on three-dimensional dataset representing face (or head) shape as range data or polygonal mesh. 3D face representations promise to better cope with the large amount of variations present in human face: extra-subject variations (individual appearance) and intra-subject variations (facial expression, pose, lighting and aging). Various extensions of 2D face recognition techniques to the range images have been proposed, such as those based on eigenface [8] or Hausdorff distance matching [9]. Other works compare faces through a spherical correlation of their Extended Gaussian Image [10], or through Principal Component Analysis (PCA) [11], or even measure the distance between any two 3D facial surfaces by the Iterative Closest Point (ICP) method [12].

We present a 3D face recognition system applied to an Ambient Intelligence Environment. This method is based on Normal Map [13], a 2D array representing the local curvature of a 3D polygonal mesh in terms of RGB color data. 3D face capture is achieved using a couple of digital cameras arranged to shoot in a stereoscopic configuration whose output is used to build a 3D dense representation of point and therefore a 3D polygonal mesh. The normal map represents the signature extracted from facial surface and the comparison between any two faces is performed computing and analyzing the angular differences between normal map elements. In addition, using an expressive weighting mask automatically generated for each subject, we improve the system's recognition success rate.

3 The Ambient Intelligence Framework

Our implementation of a face recognition system as a part of an advanced Ambient Intelligence architecture is based on [14]. This framework is shown in Fig. 1 and its foundation is a fuzzy control system operating on a multilayer design to link low-level details (the hardware layer) with high-level view (software layer).

Briefly, at the bottom level of this layer there are the domestic devices like lamp, HVAC system, electrical doors and other sensors and actuators. In order to aggregate such components, the Ambient Intelligence architecture defines the Control Devices layer and Control Network layer. Control Devices layer is used to add a computing unit at domestic devices, thus obtaining ubiquitous computing. Control Network Layer permits to interconnect the control devices implementing ubiquitous communication. The adaptivity is delegated to the Agent Based Core Middleware. Such layer implements an evolutionary-based

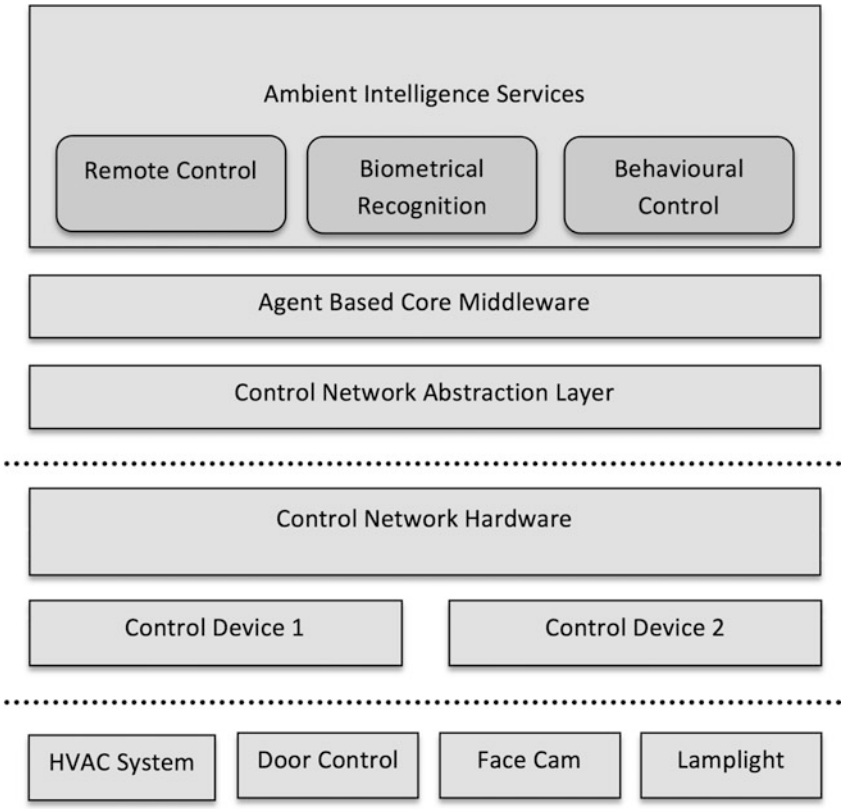

Fig. 1 Ambient intelligence multilayer environment

mechanism able to customize the services available in the environment, by producing new fuzzy rules that correspond to control activities of the involved components. This goal is achieved in two steps: learning mode and control mode. The *learning mode* captures the ambient features representing the input to the adaptive algorithm to manage the services. These features correspond to user's actions (for instance: temperature setting) and the status of environment. The *control mode* is used to supervise on different computing hosts of Ambient Intelligence network achieving the transparency and distributed intelligence of control. The output of adaptivity algorithm is a set of fuzzy rules used to control in automatic way the sensor/actuator domotic framework. In this framework, the Face Recognition System regulates the access to Ambient Intelligence environment and allows the system to adapt all the services and the environmental parameters to the preferences of recognized person.

4 Face Recognition System

The basic idea behind proposed system is to represent the 3D facial surface of the user by a digital signature called normal map. A normal map is an RGB color image providing a 2D representation of the 3D facial surface, in which each normal to each polygon of a given mesh is represented by a RGB color pixel. To this aim, we project the 3D geometry onto 2D space through spherical mapping. The result is a bi-dimensional representation of original face geometry which retains special relationships between facial features. As shown in Fig. 2 the user gains access using a personal badge and targeting a blinking led on the stereoscopic camera during face capturing. Then, the system reconstructs from the stereo pair a 3D mesh of captured face and calculates its normal map. Face matching is performed comparing the normal map of subject in input to the corresponding normal map stored in the reference database. The result of this comparison is a new map called the Difference map which is evaluated to decide if the subject is who he claims to be. To improve the robustness to expressive variations, a pre-calculated expression weighting mask is applied during the comparison.

4.1 Face Acquisition

As the proposed method works on 3D polygonal meshes we firstly need to acquire actual faces and to represent them as polygonal surfaces. The Ambient Intelligence context, in which we are implementing face recognition, requires fast user enrollment to avoid annoying waiting time. Usually, most 3D face recognition methods work on a range image of the face, captured with laser or structured light scanner. This kind of devices offer high resolution in the captured data, but they are too slow for a real time face acquisition. Face unwanted motion during capturing could be another issue, while laser scanning could not be harmless to the eyes. For all this reasons we opted for a 3D mesh reconstruction from stereoscopic images, based on

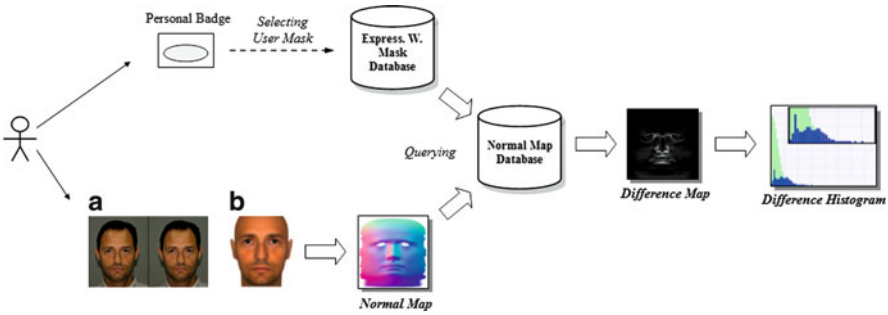

Fig. 2 Face recognition workflow

[15] as it requires a simple equipment more likely to be adopted in a real application (a couple of digital cameras shooting at high shutter speed from two slightly different angles with strobe lighting) and though the resulting face shape accuracy is inferior compared to real 3D scanning it proved to be sufficient for recognition.

4.2 The Normal Map as a Digital Signature

As the 3D polygonal mesh resulting from the reconstruction process is an approximation of the actual face shape, polygon normals describe local curvature of captured face which could be view as its signature. As shown in Fig. 3, we intend to represent these normals by a color image transferring face's 3D features in a 2D space and, to this aim, we first need to project vertices' coordinates onto a 2D space using a spherical projection (opportunely adapted to mesh size). At this point, we can store normals of mesh M in a bi-dimensional array N to represent face geometry using the previously 2D-projected vertex coordinate and quantizing the length of the three scalar components of each normal. We refer this the resulting array as the *Normal Map* N of the mesh M and this is the signature we intend to use for the identity verification.

4.3 Face Matching

To compare the normal map N_A from input subject to its template N_B previously stored in the reference database and selected by the personal badge, we compute the angle included between each pairs of normals represented by colors of pixels with corresponding mapping coordinates, and store it in *Difference Map* D. The value Θ, with $0 \leq \Theta < \pi$, is the angular difference between the pixels with coordinates (xNA; yNA) in NA and (xNB; yNB) in NB and it is stored in D as a gray-level.

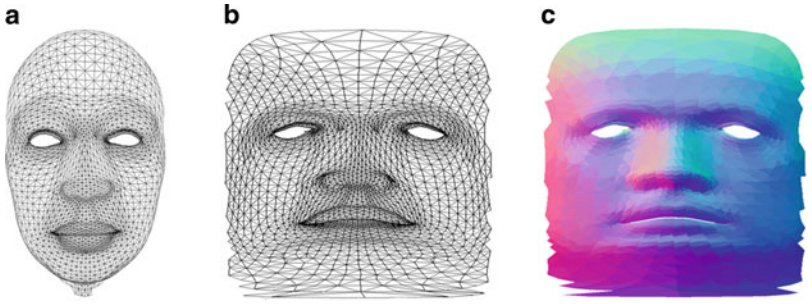

Fig. 3 From mesh to normal map. (**a**) 3D mesh model, (**b**) projection in 2D spatial coordinates, (**c**) normal map

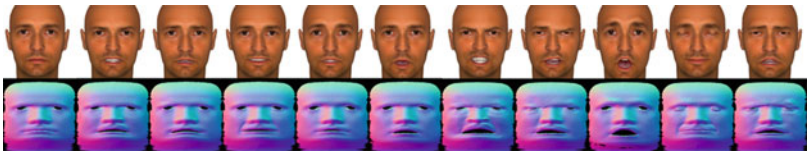

Fig. 4 An example of normal maps of the same subject featuring different facial expressions: neutral, rage (*moderate*), fear, smile (*closed*), doubt, surprise (*moderate*), rage (*extreme*), closed eyes, surprise (*extreme*), disgust

To improve robustness to facial expressions we introduce the *Expression Weighting Mask E*, a subject specific pre-calculated mask whose pixel values assign different relevance to different face regions. Indeed, for each subject enrolled, each one out of nine expression variations (see Fig. 4) is compared to the neutral face, resulting in nine difference maps. We generate the expression variations through a parametric rig based deformation system previously applied to a prototype face mesh, morphed to fit the reconstructed face mesh [15]. This fitting is achieved via a landmark-based volume morphing where the transformation and deformation of the prototype mesh is guided by the interpolation of a set of landmark points with a radial basis function. To improve the accuracy of this rough mesh fitting we need a surface optimization obtained minimizing a cost function based on the Euclidean distance between vertices. The expression weighting mask E is the average of a set of nine difference maps, with components opportunely normalized from 0 to 1, and it allows to better cope with bending facial regions. At this point, the histogram H of resulting multiplication $D \cdot E$ is analyzed to estimate the similarity score between N_A and N_B. On the X axis we represent the resulting angles between each pair of comparisons (sorted from 0° to 180°), while on the Y axis we represent the total number of differences found. The curvature of H represents the angular distance distribution between mesh M_A and M_B, thus two similar faces featuring very high values on little angles, whereas two unlike faces have more distributed differences. To estimate the histogram H, we simply used a weighted sum between H and a Gaussian function G, given by:

$$similarity\_score = \sum_{x=0}^{k} \left(H(x) \cdot \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{x^2}{2\sigma^2}} \right) \tag{1}$$

where with the variation of σ and κ is possible to change the sensibility of the face recognition system.

5 Experiments

As our main aim was to test the performance of the proposed method in a realistic operative scenario like an Ambient Intelligence environment, we have acquired the 2D facial pair images from 135 different persons (87 males and 48 females, age

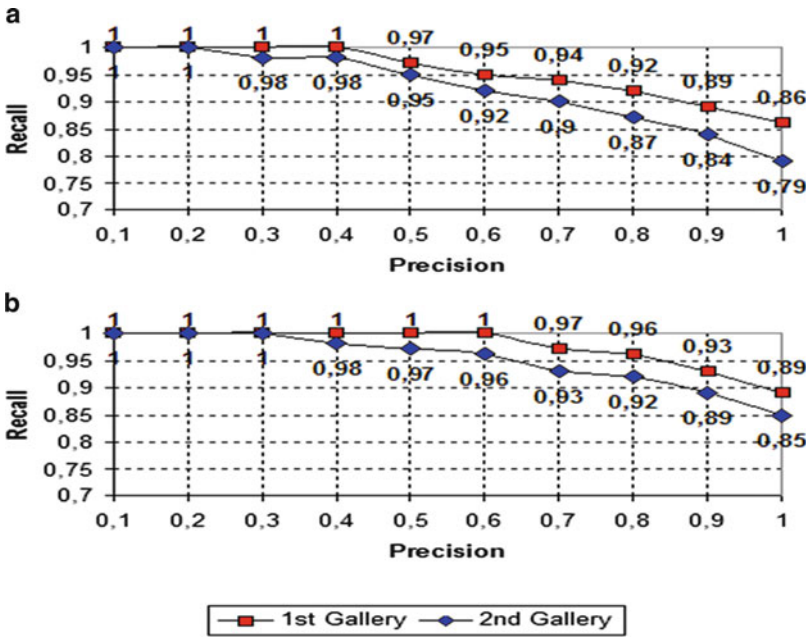

Fig. 5 Precision/recall testing on two galleries without expression weighting mask (*top graph*) and with expression weighting mask (*bottom graph*)

ranging from 19 to 65) to build a database of 3D facial models organized in two galleries. From this 135 subject, we have selected 13 authorized users to build the enrolled reference database and to compare with all the others. The results are generally good providing the lowest error of 3.2% the Equal Error Rate using the expression weighting mask, the Gaussian function with $\sigma = 4.5$ and $k = 50$ and normal map sized 128×128 pixels. As shown in Fig. 5, the improvement given by the use of the expression weighing mask is significant and, in addition, the proposed method proved to be very fast in the recognition process as it required approx. 4 ms on a dual-core 3.4 GHz based PC for a single one to one comparison, allowing to use the method in a real time application.

6 Conclusion

We presented a 3D face recognition interface to an Ambient Intelligence Environment. The proposed approach to acquisition and recognition proved to be suited to the applicative context thanks to high accuracy and recognition speed, effectively exploiting the advantages of face over other biometrics. As the acquisition system requires the user to look at a specific target to allow a valid face capture, we are working on a multi-angle stereoscopic camera arrangement, to make this critical task less annoying and more robust to a wide posing range.

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Exploring the Effectiveness of Web Ads Via Greenwald and Leavitt's Involvement Model

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Abstract Taking the continuous growth of online advertising into account, the necessity to adequately measure the effectiveness of web ads emerges, by having an approach broader than the Click Through Rate (CTR). As scholars underline web ads can be unconsciously processed even when not clicked on, and it is therefore necessary to consider the involvement level of the users and the elaboration level of the messages even though users do not interact with the advertisement by clicking on it. This paper presents a preliminary effort to verify the effectiveness of web advertisements using the involvement model elaborated by Greenwald and Leavitt, basing it on the analysis of how users interact with ads and the way in which they process the information contained in them. To pursue this goal we conducted a survey using an online questionnaire sent via e-mail to the Economics students at the University of Cagliari.

1 Introduction

According to the American Internet Advertising Bureau [www.iab.net] online advertising revenues reached a record of 26 billion in 2010, up by 15% in 2009. The Internet has continued to grow significantly when compared to other ad supported media. In 2010, Internet Advertising surpassed advertising revenues in newspapers (22 billion), becoming the second largest advertising market by media revenues. This growth requires a continued focus on digital media advertising

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expenditure. Therefore advertisers should have adequate measures in order to evaluate the effectiveness of their advertising.

A right measures of the effectiveness of ads should evaluate if specific brand performance has been obtained, that is: brand recall, brand awareness, brand image. To this end the traditional measures of ad effectiveness as click through rate (CTR) do not offer adequate information about the interaction and the involvement of the users with ads, and it may be more appropriate to consider a model which analyzes the way in which users process ads.

In light of this, the aim of this paper is to analyze the effectiveness of a selection of banner ads by applying the Greenwald and Leavitt model [1]. To pursue this goal, we conducted an online survey in the form of a questionnaire sent via e-mail to the Economics students of the University of Cagliari.

The paper is organized as follows: in the next paragraph we put forth background information on web advertising measures; then we illustrate our research methodology and research findings; finally, some conclusive consideration is given.

2 Theoretical Background

Several studies have focused on web advertising measures. According to Alijani, Mancuso, Kwun and Omar [2], one of the advantages of web advertising is that, unlike traditional media, it provides real time and direct information of an advertisement's efficacy using the Click Through Rate. The CTR is defined as the percentage of ads exposed that users click on [3]. This would imply that a low CTR indicates low effectiveness of web ads. We can define the CTR as a direct measure of the effectiveness of web advertising; from what has been said it could imply that un-clicked ads are, therefore, ineffective.

As a hyperlink element [4], in order to achieve the best results in terms of effectiveness, the banner should activate through a click. Many studies [5–10] have demonstrated that often banner ads are not clicked on because they are avoided. Web users are described as goal directed: the Gratification Theory shows that users surf the web pursuing a precise objective: searching for information, bargains, entertainment, social interaction [11–13]. Therefore, they are intercepted by the ads, but by satisfying their gratification they are cognitively absorbed [14]. Some authors described this condition of web users with the expression "state of flow" [15, 16].

Furthermore Several scholars [16–18] assert that users see the web in a holistical way, thus, they fail to separate the ad from the web site editorial content. Moreover, an eye tracking research [19] revealed that web users read web pages following an F shaped pattern: they observe two horizontal stripes followed by a vertical stripe, avoiding a considerable portion of the page [10].

As far as avoidance is concerned, prior research distinguishes it into cognitive and physical [5]. Cognitive avoidance occurs when the ad is avoided without any conscious decision or behavioral action by the user. It is an automatic process and

it is characterized by the presence of an implicit memory and the absence of explicit memory. Implicit memory could be defined as a memory which presents a lack of conscious awareness, and which can not be put into words; it may lead to the identification of a specific object as a result of previous exposure to the same object [20]. By contrast explicit memory requires conscious recollection of a previous experience. A research suggests that even when cognitive avoidance occurs, ads are accidentally processed [5]. That is to say that despite this, an implicit memory of ads can generate preference, induce consideration, and lead to choice behavior [7]. Physical avoidance is defined as the result of a conscious decision by the consumer to avoid ads (i.e. closing the window of a pop-up ad) [21].

From what has been said we can deduce that: firstly banner ads can be processed even when avoided, secondly CTR as an unique measure, is not an adequate tool to measure the effectiveness of web advertising. Therefore, it's clear that in order to measure effectiveness a model that analyzes the way users process ads would be more suitable.

Greenwald and Leavitt [1] studied audience involvement as an attention concept. According to their study, "*audience involvement is the allocation of attentional capacity to a message source, as needed to analyze the message at one of a series of increasingly abstract representational levels. Low levels use little capacity and extract information that is used first to determine whether a higher level will be invoked, and if so, as raw material for analysis by the next higher level. Higher levels require greater capacity and result in increasingly durable and cognitive and attitudinal effects*" [1: 591].

In their model the authors classified four levels of audience involvement: pre-attention, focal attention, comprehension and elaboration. The pre-attention level enables users to determine that the ad is not a continuation of what was being processed previously. At this level there is no cognitive and attitudinal effect and no trace of the ad remains in the mind of the user. The focal attention level is characterized by an image formation. This fact implies a most enduring effect of the ad if compared to the pre-attention level. At the comprehension level users construct propositions to assign a meaning to the image previously formed. When elaborated there is the integration of the ad content with prior knowledge [22].

This model was primarily improved by Finn [22] who developed it with measurement units at each level. Subsequently Yoon [23] adapted Finn's conceptual model to banner advertising in order to explain the information processing of the content. According to this extension, the detection of banner adverts takes place at a pre-attention level. At this level the key effects are: the banner style, size and location. At a focal level the audience should notice the format of the advert (static, animated, interactive), and the textual and graphical elements of the format that influence mental imagery. Finally, the identification of the content of the advert takes place at the comprehension level.

The content of the advert determines personal relevance and predisposition to continue further processing. At an elaboration level the user should identify himself with the content of the message determining his intention to click and purchase. Hence, according to this theory the best scores in terms of the effectiveness of the

banner advert are obtained by getting to the elaboration level. Despite this, it is interesting to analyze how users process a specific banner and to note at which level they have arrived. In fact, as we said before, even at pre-attention level the presence of an implicit memory, despite the absence of an explicit memory, could lead, under specific stimulus, to consideration as well as generate preference for a brand.

3 Research Methodology and Sample

To examine the effectiveness of web advertising using the involvement model [1, 22, 23] we conducted an online survey using a questionnaire sent via e-mail to the Economics students at the University of Cagliari. Over a period of 2 weeks, 154 students responded to the questions. The sample consisted of 107 females (69%) and 47 males (31%), at an average age of 25 years.

The questionnaire was designed based upon a review of the existing literature, and it intended to collect a wide range of information: demographic characteristic; propensity to click on web ads and propensity to buy as a result of remembering a web ad; frequency of visits over the last weeks to the three websites previously selected; whether or what they remembered about some ads on the selected sites during the weeks that were considered; if they click on these ads to get more information; if in the previous weeks they bought, or thought of buying, the products/services on these web ad campaigns; and finally the importance of these web ads on their propensity to buy. We conducted a pre-test to identify the three websites most visited by students. A sample of 89 students was asked to choose five websites that they usually visit from a ranking that showed the 20 websites most visited by Italians, and they were asked to put them in order of frequency. We then observed the three most visited websites over a period of 2 weeks and we chose five web ad campaigns for our study: Nivea (static leaderboard, placed at the top of the page), Oral B (small size expandable, placed at the bottom of the page), Jeep Compass (animated banner ad, placed in the middle of the page), Eni gas and electricity (big size interactive banner ad with video), Call of duty (big size interactive web ad, placed at the top of the page). To verify the level of memory of the selected web ad campaigns firstly the respondents were asked to rate them according to a five-point scale based on the four levels of involvement of the Greenwald and Leavitt model [1]. To these four levels we added a zero level, indicating no explicit memory (Table 1).

Table 1 Involvement scale

Scale points	Levels	Meanings
Zero	–	No explicit memory of web ad
1	Pre-attention	I noticed it
2	Focal attention	I noticed it and I remember the colors and images
3	Comprehension	I noticed it and I remember the text
4	Elaboration	I remember a clear and comprehensive view of it

Secondly, in order to verify the veracity of the previous answers based on the involvement scale, the participants were asked to select graphical elements and a text of any web ad, choosing among four options of which only one is correct, two are wrong, and one is *I don't know*.

4 Research Findings

We first considered the phenomenon of web advertising in general. Data highlights that the majority of the sample (63.64%) click on web ads only when they are interested in the product or service advertised, 30.52% don't click on them under any circumstances, and only 5.19% click on them out of curiosity. Furthermore, an interesting finding is that 56.7% of our sample indicated that they had never purchased a product or service as a result of the recall of a web ad.

With reference to the five web ads selected, as shown on Table 2 the majority of the sample declared not to have any memory of them. This percentage is lower (37.66%) only with reference to the Eni gas and electricity ads, and respondents declared to have a more clear memory of these ads: 14.29% of the sample stated that they remembered a clear and comprehensive view of it. Moreover, if we only consider the percentage of clicks and the first column of the table below (no explicit memory of the web ad), we may conclude that advertising for this brand was ineffective. But taking into account also the other columns we note that even though the percentage of no-memory is considerable, banners have been processed at different levels.

Data about graphic elements and texts of the five web ads analyzed, respectively in Tables 3 and 4, show some differences in the responses based on the involvement scale. For instance, although 14.29% of the respondents stated that they remembered the colors and image of Nivea cream ads, when they were asked to

Table 2 Results based on click and the involvement scale

	Click (%)	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)
Nivea cream	4	59.74	18.83	14.29	1.95	5.19
Oral B	3	57.14	22.08	14.94	2.59	3.25
Jeep compass	1	77.92	16.88	3.25	0.65	1.30
Eni	3	37.66	27.91	15.58	4.56	14.29
Call of duty	3	77.92	11.04	4.55	–	6.49

Table 3 Effective memory of the graphic elements of the web ads

	Correct answer (%)	Wrong answers (%)	I don't know answer (%)
Nivea cream	5.84	61.04	33.12
Oral B	28.57	18.83	52.60
Jeep compass	0.65	12.99	86.36
Eni	40.26	29.87	29.87
Call of duty	14.29	5.19	80.52

Table 4 Effective memory of the web ad texts

	Correct answer (%)	Wrong answers (%)	I don't know answer (%)
Nivea	10.39	69.48	20.13
Oral B	26.62	38.32	35.06
Jeep compass	5.19	19.49	75.32
Eni	9.09	69.48	21.43
Call of duty	7.79	11.04	81.17

identify its graphic elements among the options, only 5.84% of the sample chose the correct answer. On the contrary, with reference to the text, percentages shifted from 1.95% of participants who stated that they remembered it selecting point three of the scale, to 10.39% of them who chose the right text among the alternative answers.

Despite the fact that there isn't a complete overlap between effective memory of graphical elements and texts, and the level of memory that respondents thought they had, the overall results do not change significantly. Overall it appears that: Call of duty and Jeep Compass ads are not very effective because approximately 90% of the respondents do not have any explicit memory of them, Nivea cream and Oral B ads reveal a higher level of involvement, and finally Eni gas and electricity ads are the most recalled and processed ads by participants. To explain these results we can consider the creative factors of the Eni ad. As a matter of fact, according to previous researches features such as the big dimension [5], the position at the top of the page [10], the content [24], and the use of a strong image with well-known characters [10] increase the level of information processing.

Regarding the propensity to click, majority of the respondents (88.31%) declared not to click on any of the five websites considered in our study. Furthermore, 87.31% of them stated that they had not bought, or thought of buying the products/services advertised on these campaigns in the previous weeks. Students who positively responded to the latter question (12.34%), were also asked to evaluate the importance that the web ads on their propensity to buy, using a five-point scale (from 1 = *not important at all* to 5 = *extremely important*). The highest percentages of the sample considered these ads as not important (31.58%) and not important at all (21.05%) in their decision making process.

5 Discussion and Conclusion

In this paper we proposed the use of the Greenwald and Leavitt involvement model [1] to verify the effectiveness of web advertising. Results firstly confirm that CTR is not a comprehensive measuring instrument. As we noted, respondents have a low propensity to click on web ads, and with specific reference to the adverts analyzed in our study, the percentage of students who did not click on any of them in the considered period is nearly 90%. Despite this, the involvement level of memory and

processing for each web site is different, demonstrating that the ads can be analyzed and elaborated, without being clicked on. Secondly, the results highlight that although the respondents visited the websites in which the ad campaigns considered in our study were displayed, in some cases they didn't have an explicit memory of them. To this end we may deduce that, as Chatterjee [5] underlines, these ads may have been cognitively avoided and therefore they may have been processed at an implicit memory level. Then, as we previously stated, under certain stimuli they may lead to consideration and preference behavior for a specific brand. Furthermore, the different levels of information processing seem to be the result of several creative factors of the ads. These elements, consequently, should be an important guideline to consider carefully when deciding to implement strategies to increase the effectiveness of online advertising.

In light of this, a further step of our research should focus on the one hand, on evaluating the implicit memory of the ads and on the other hand on investigating the main creative factors that may lead users at the highest level of attention, in order to increase the click and purchase intention.

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An Augmented Reality Application to Gather Participant Feedback During a Meeting

Rita Francese, Ignazio Passero, and Telmo Zarraonandia

Abstract The new features offered by top-of-the-range mobile devices can be exploited to support Face-to-Face collaboration, providing collaborative interfaces that go "beyond being there" perception. In particular, Augmented Reality interfaces appear to be a natural medium for Computer Supported Collaborative Work. In this paper, we present an Augmented Reality system, named Augmented Reality Mind Scanner System (ARMS), aiming at supporting the speaker of a meeting in receiving feedback from the audience concerning their agreement with and the clarity of the presentation. The ARMS system is a phase of deeper ongoing research on the possibilities of applying Augmented Reality technology on mobile devices, and is anticipating future technological developments that will bring more powerful devices on current customer markets.

1 Introduction

Even if Computer Supported Collaborative Work (CSCW) provides a wide choice of technologies to carry out virtual or distance meetings, it is well known that Face-to-Face collaboration is always more effective, when possible, for conducting meetings or presentations. The success of an oral presentation strongly depends on the speaker's ability to effectively communicate with the participants and, in particular, on his or her communication skills (verbal, nonverbal, visual or multimedia). In addition, it is also necessary that during the course of the presentation, the speaker obtains continuous feedback from the audience in order to know

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whether they are following the presentation and understand it or not. Based on that information, the speaker can then take corrective actions such as providing extra examples, repeating previous explanations, or reducing the pace of the speech, for instance. The most common way to obtain this feedback is to periodically ask the audience if they had had any problems or if they have any questions. Unfortunately, it is a fact that many participants are shy and feel reluctant to communicate their difficulties when trying to understand a concept or following a presentation. Another usual method is to infer the feedback from the expressions and attitudes of the audience. This is not a totally reliable method as interpreting audience's expressions can lead to misinterpretation and error.

At present, the popularity of Augmented Reality (AR) is increasing. This is mainly due to the possibility of implementing AR applications using advanced mobile devices, which offer features that allow the overlapping of informative content to a real world image, observed by the on-board device camera [1]. The technological improvement is mainly due to:

- The innovative and cheap equipment offered by the latest generation of mobile phones, such as on-board cameras, accelerometers, compass, GPS, etc.;
- The increased processing power;
- High speed internet connectivity.

By making use of these innovations, it is possible to determine where the user is, what the orientation of the device is with respect to the ground, and in which direction the device is pointing. These new features can be exploited to support Face-to-Face (F2F) collaboration, creating collaborative interfaces that go "beyond being there" perception [1]. Indeed, AR supports independence and individuality [2], because each person participating in the collaborative activity can access personalized content according to her needs and the current situations. This kind of interface naturally supports collaboration, as the user can create new content and interact with both his/her own and each other's data.

In this paper we propose a system, named Augmented Reality Mind Scanner System (ARMS), for enhancing communication among the participants of a Face-to-Face meeting. ARMS is based on the use of AR and mobile device technology.

2 Background and Related Work

As mobile phones become more pervasive in our lives and their capability to deliver visually rich content and multimedia services continuously increase, many researchers and developers have adopted them as devices for supporting AR applications. In this way they have been used to support single user AR applications such as providing instruction to the user during a maintenance activity with different purposes [1, 3, 4], or performing a guided tour in a museum or a cultural heritage site, such as LibreGeoSocial [5].

One example of an AR enhanced application which supports collaboration among users is Invisible Train [6]. The user collaboration is performed as follows: users move around in the real world to view a virtual train set and then touch the screen with a stylus to change the position of the tracks. Another example of collaboration is the AR-Tennis game application [7] is based on ARToolkit, ported to Symbian. This game adopts the mobile phone both as an interaction tool, simulating a tennis racket, and as a display. As a consequence, the players cannot easily examine their view of the virtual world and concurrently move the device.

Billinghurst & Kato presented several Mixed Reality applications that are "seamless", because they allow the users to use traditional tools and workplace practices while overlaying virtual images onto the real world [2].

More recently, in [8] the characteristics of mobile devices are exploited to create a cooperative handheld AR game, the Art of Defense (AoD) game. It is an example of AR board games that uses handheld devices and tangible props to combine the tangible elements of board games with the continuous simulation of a computer game.

De Lucia et al. proposed SmartMeeting, an AR application aimed at supporting group collaboration [9]. It augments indoor environments with location-based content in the form of augmented boards, as better described in the next section.

However, in spite of all these successful examples, it is worth noting that mobile phones have not been designed to support AR application as a major function, and therefore, they are not without limitations as AR devices. For instance, user interaction can be hampered by the limited size of the touch screens and other hardware or software constraints. With this in mind, several industrial consortia are developing ad-hoc AR devices that will overcome these limitations and transform the user experience. These devices range from AR spectacles with retro-project the virtual content in the glass surface (see for example currently available devices at [10] and [11] or a ongoing project at [12]) to the really futuristic Augmented Reality in a Contact Lens ([13]) that can incorporate a led matrix to provide AR information.

In the near future, these new devices will allow personal mobile content to be mixed with real world images, allowing users to be constantly in contact with their social networks without even having to pull the phone out of the pocket.

3 The Proposed Approach

The aim of the system proposed in this paper is to assist a speaker during a presentation, providing him with information concerning the opinion of the other participants. The system should be able to enhance non-verbal communications during F2F activities. This tool complements the SmartMeeting system presented in [9], briefly described in the following, by adding augmented information concerning the attitudes and the feelings of the meeting participants.

It is important to point out that even if Augmented Reality Mind Scanner System (ARMS) is a prototypical system that currently relies on smartphone technology, it is explicitly designed for exploiting the future adoption of low cost AR glasses which it is expected will provide a more natural interaction. In addition, it can also be efficiently migrated to regular desktops equipped with low cost webcams.

3.1 The SmartMeeting System

SmartMeeting is a location-based mobile system aiming at supporting group collaboration [9]. The system adopts AR interfaces exploiting the onboard camera of mobile devices. The orientation and acceleration sensors, as well as a complex user localization system, are exploited for a careful adaptation of AR objects to user movements.

Each work group has assigned a Group Augmented Area, referred to a specific location, where information relevant for the group is shared.

Each group disposes also of a meeting setting, composed of the Meeting Area and the Booking List Area. All the group areas appropriately manage the user permissions for privacy concerns. A typical usage scenario of a collaborative group activity is detailed in [9].

In Fig. 1 an example of Augmented Area is shown: the Booking List Area. This area shows the intervention order. A user can book an intervention double touching on the area and his image is added to the queue of the list. An innovative pagination interface, described in [14], enables to scroll-up and down the content, using only the device sensors.

The Meeting Area shows all the content that should be exposed during the presentation and the material to be examined.

SmartMeeting also enables the meeting participants to present to the others the meeting related content, without using additional hardware, by using the Augmented Projector feature. This application has the peculiarity to provide the

Fig. 1 The booking list augmented area

Fig. 2 The augmented projector as seen by a participant

user context information, while observing the projected content. Indeed, when a traditional wall projector is used, generally the attention is attracted towards the projection on the wall, without observing the speaker. In the proposed approach, the user frames both the speaker and the presentation at the same time (Fig. 2).

3.2 The Augmented Reality Feedback Interface

The idea underpinning the (ARMS), the proposed extension of SmartMeeting, consists of providing speakers or, in general, meeting participants, with an AR instrument capable of reporting feedback on other participants' opinions and feelings.

Figure 3 shows the proposed AR interface highlighting a participant from whom the feedback would be obtained. As depicted in the picture a triangular view is superimposed on the image of the participant. The feedback information is represented via the well recognized and frequently used smile icons metaphor. In addition, above the viewfinder triangle, the user name is reported. Furthermore, a bridge between SmartMeeting system and the social world of Facebook, the well known and popular social network, is also provided. This way, by touching the "f" logo icon on the top right hand side of Fig. 3, the user of the interface can access the profile of the participant being observed.

With regard to the feedback communication functionality, the system is able to represent the following feelings and sensations:

With regard to the feedback communication functionality, the extended SmartMeeting interface allows participants to communicate the following feelings and sensations:

- Participant Comprehension;
- Participant Involvement and Interest;
- Participant Agreement.

Fig. 3 The proposed AR interface provides feedback to the meeting speaker

Fig. 4 The proposed AR metaphors

Each piece of feedback information is shown in a different position of the AR interface via the corresponding iconic image. As shown in Fig. 3, the upper rightmost side of the triangular area depicts an icon which represents the participant's level of interest and involvement in the subject of discussion, while on the upper leftmost side the indicator of the participant's comprehension level is depicted. The lowest corner of the informative triangle depicts the Agreement indicator, which should be triggered by the speaker through a voting request. Let us point out that if the user does not provide a piece of feedback on one or more feelings and sensations the associated space in the interface does not show any symbol.

Figure 4 depicts the icons adopted as visual metaphors for the feedback information. The first five symbols on the left hand side are used to represent the level of Interest and Involvement, in an increasing order. The next five are the ones used for representing the participant's level of comprehension. Both indicators range in the set {Very Low, Low, Medium, High and Very High}. The rightmost side of Fig. 4 shows the binary User Agreement status (respectively no/yes). In accordance with this representation the participant depicted in Fig. 3 reports a Very High level of Interest and Involvement, a High level of Comprehension of the covered subjects, and a positive response to the last voting session requested by the speaker.

The proposed AR interface will be connected with the SmartMeeting user localization sub-system, and the orienteer and accelerometer sensors, embedded in the devices, will provide the necessary information to identity the framed participant and the shooting angle adopted for increasing the perceived quality of AR objects.

4 Conclusion

In this paper, we presented an Augmented Reality mobile application aimed at enhancing the feedback information obtained from the participants during an oral exposition in a meeting session. The proposed interface provides detailed information to the speaker concerning the comprehension and involvement of the participant as well as the agreement of the other team members.

At present, the usability of the proposed tool is being evaluated. The possibility of providing the speaker with an additional view of the global audience feeling is also being explored. It is worth pointing out that the practical use of the system will be limited because the current implementation of the system is based on mobile device technology. Therefore, the "looking at the user" gesture has to be made through the mobile device and may seem unnatural at first. However, it is anticipated that future implementation of the system using more pervasive AR devices such as glasses will greatly reduce this problem.

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ICT for Small to Medium Enterprises: Focus on Usability for a Web-Based Spreadsheet Mediated Collaboration Environment

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Abstract Access to ICT is a necessary prerequisite for SME to get business opportunities by connecting to networks both as part of the global market and as support to distributed internal business activities.

Unfortunately, the process of migrating from traditional activities towards IT-supported activities is in fact slowed down by several practical issues which small organizations have to face in order for the process to be effective. In this paper we present the case study of a spreadsheet mediated collaboration system designed to enhance existing business activities, in the context of SMEs. We describe the field study carried out with real stakeholders, to evaluate usability of the proposed prototype, and analyze the experimental results.

1 Introduction

Small and medium enterprises (SME), the enterprises with less than 250 employees, represent the most important business sector all over the world. In the European Union, for instance, they represent 99% of businesses which corresponds to over 23 million of companies which drive the growth, the innovation, the employment and the social integration of all the continent. In Italy the percentage is even higher, indeed SME are near four million which is 99.9% of all the companies in Italy. With these numbers, it is clear that much work and research need to be carried out in order to support their activities and promote their growth by helping them tackle the problems which hamper their development. The document entitled "Small and

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Medium Enterprises and ICT" looks at how the knowledge-based economy has impacted small and medium enterprises (SMEs); explores why so few SMEs have adopted ICT so far and provides some policy recommendations for promoting SME adoption of ICT [9]. The authors observes that many small and medium enterprises have not yet fully benefited from ICT support, especially because they lack engagement in regional and global business networks. Access to ICT is a necessary prerequisite for SME to get business opportunities by connecting to networks both as part of the global market and as to support distributed internal business activities.

Unfortunately, the process of migrating from traditional activities towards IT-supported activities, known as *eTransformation* process, is in fact slowed down by several practical issues which small organizations have to face in order for the process to be effective [8]. The small size and the limited human and financial resources, which usually characterize SME are one of the main obstacles to making business processes more effective by using appropriate information and communication technologies. Nevertheless if a cost effective solution can be found which is both easy to use and maintain then these organisations will benefit immensely.

Spreadsheets are intensively used for crucial management activities by several organizations. Since the introduction of the first computerized spreadsheet, VisiCalc, in 1979, the adoption of spreadsheet applications has been continuously increasing in different domains, and is today recognized to play a central role in the evolution of work systems. Many years ago Nardi and Miller observed that spreadsheets functioned as de facto cooperative work, but they lacked technological support for cooperative work environments [11]. Since then, little progress has been done in that direction. Grossman and colleagues concluded from their research on the use of spreadsheets as an effective software development platform that 'spreadsheets are vitally important to business, and merit sustained research to discover techniques to enhance quality, productivity, and maintainability' [7]. This is especially true for SMEs, where the way how collaborative activities using spreadsheets are performed, namely by email exchange of the spreadsheet artifact or by keeping it on a network drive, may seriously mine the effectiveness of the business process.

In previous work, we investigated SME business in order to understand which problems and which solutions can be adopted to improve their work in terms of efficacy and efficiency and, then, increase their opportunities. In particular, in 2009 we started a research project meant to enhance the business processes presently carried out by SME using spreadsheets, designing and developing a web based spreadsheet mediated business collaboration system [5, 6]. In particular, in [5] using a scenario-based design approach, a set of user's requirements were extracted from an appropriate field study. In this paper we show how, starting from the given list of requirements, suitable interactive collaboration scenarios were developed and a web-based spreadsheet mediated collaboration environment was built.

The paper is organized as follows. Section 2 recalls the scenario-based design process used to extract the initial set of user's requirements from an appropriate field study. In Sect. 3 we give a summary description of the interaction design

phase, which led to the development of the current prototype of the system. In Sect. 4 we explain how we conducted the usability evaluation of the system prototype and analyze the achieved results. In Sect. 5 we give some final remarks.

2 The Contextual Inquiry and the Scenario-Based Requirements Analysis

In the present section we recall the scenario-based process we followed to derive the initial set of interface requirements for the spreadsheet-mediated collaboration system. The preliminary activity we performed for our field study consisted in a survey on the use of spreadsheet applications conducted among people with different backgrounds and operating in different application domains.

Analyzing the survey results, we were able to set up the right investigation thread for the contextual inquiry and observations that followed. We identified a group of five SMEs operating in the Western Sydney Region as interesting subjects for further observation. In fact, the collaborative nature of some of their usual activities accompanied with a minimal or non-existence of information technological support to such activities, turned out to be the right context of study for our research. The five SMEs were selected out of a cluster of 30 companies taking part in a wider project carried out at University of Western Sydney [9], meant to provide a methodological roadmap. The goal of this fieldwork was to depict scenarios of established work practices, from which user's requirements could be derived for a spreadsheet-mediated collaborative web environment. The informal interviews performed in situ allowed us to gain a comprehension of collaborative activities requiring the use of spreadsheets, as they really occur in small working environments. As a result, we gained useful insight of the obstacles which, in the context of small organizations, appear to hinder the full exploitation of the powerful functionalities of spreadsheet applications as a way of supporting to collaborative activities. Indeed, the major problem turned out to be the small size and the limited human and financial resources, which usually characterize SMEs. Although all the interviewees recognized that great benefits would come to their business process from the adoption of a web-based collaboration environment for their spreadsheet sharing activities, their major concerns were related to the cost of this technological evolution within their small organization.

In order to formalize the requirements elicited from the interviews, we capitalized the knowledge gained from the fieldwork and envisaged some scenarios of working practices, from which we could start our brainstorming activity for the design of a possible solution. We were first able to identify three separate categories of user interface requirements for a web based spreadsheet mediated collaboration system, namely: (a) *collaboration environment awareness*, (b) *overall collaboration process analysis*, and (c) *operations on the artifact*.

Table 1 The interface requirements derived from the field study

	User interface requirements
R1	List of participants steadily visible in the collaborative environment
R2	Interface control for access control and privileges setting by the manager
R3	A visual cue associated to each participant to indicate the role
R4	Individual status setting from idle to busy for temporary interruptions from idle/busy to absent if the participant abandons the collaboration
R5	Chatting window tool available on demand
R6	Multiple users conflict resolution – cell editing vs. cell locking notification
R7	Notification flags associated with each of the updated sheets in the document
R8	Color changes highlighting modifications
R 9	Spreadsheet re-structuring and spreadsheet locking notification

The first category comprises all the functionalities that allow collaboration awareness issues to be properly addressed by the environment, both during synchronous or asynchronous collaboration through a spreadsheet. The second category focuses on the spreadsheet artifact itself and on some important parameters that would better support individual exploration as well as recoverability during the overall business process. Finally, the third category includes all the functionalities that would allow the spreadsheet artifact to be effectively manipulated by multiple participants through the web environment, in terms of either data updating or structure modification. The complete list of requirements is reported in Table 1.

3 Interaction Design for the Collaborative Environment

In this section we briefly describe the interaction design phase, which led to the development of the current prototype of the system. When designing possible collaborative interaction scenarios we also adapted existing design patterns to spreadsheet-mediated collaboration [10]. The selected interactive collaboration patterns allowed us to gain a better understanding of the spreadsheet based collaboration domain and gave guidance for the interface design process.

Figure 1 shows the collaborative interface of the spreadsheet-based prototype, as it appears to one of the participants. It encompasses some of the basic design choices we made to fulfill the derived requirements. In particular,

- *R1, R2, R3, R4, R5* were addressed by the following *Design Choice*. The shared spreadsheet is provided with a window which lists the users currently connected. Each element in the list is associated with a given color which indicates the user's status.
- *R3. Design choice*. Any single cell may be accessed in Read/Write, Read-Only or Hidden mode depending on individually assigned privileges. The user will see a cell red if it is hidden, yellow if it is read-only accessible, or in the original background color if he has R/W privileges for that cell.

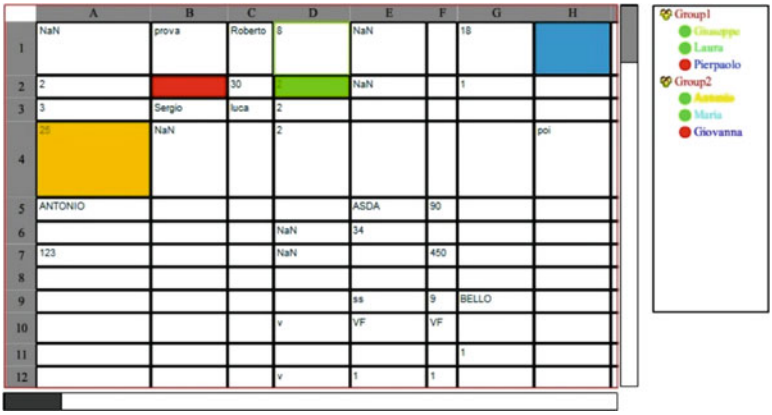

Fig. 1 The interface of the collaborative spreadsheet

- *R6, R9. Design choice*. Whenever a participant is editing a cell/a block of cells, those cells are colored with the user's identifying color so as to appear 'locked' to the others, and avoid undesirable overlapping. If a user tries to modify a locked cell, he is notified by means of an error message.
- *R7, R8. Design choice*. After the user changes the content of a cell and unlocks it, the system draws a line along the border of the cell with the color identifying the user. The colored border is visible to each participant, who may click on the cell to acknowledge the other's update and make the border disappear.

The major differences that a user will perceive with respect to the standalone spreadsheet is the effect of synchronization achieved through cell locking. A user may decide to modify a set of cells, while making sure that no other participant modifies them at the same time. Further, a multiple cell selection mode is available, named *Multilock*, which allows users to lock a cell and all the related ones (e.g., when a user locks a formula).

4 Usability Evaluation

In this section we describe the usability evaluation process. A think-aloud observational technique was performed on the system prototype. For this study we invited seven SMEs working in the industrial district of Salerno, Italy, which adequately corresponded to the typology of companies on which the field study had been initially conducted in Western Sydney Region, Australia. In fact, they were all characterized by the collaborative nature of their business processes, which were performed with little information technological support. The choice of companies located in a completely different geographic area with respect to those selected for the initial study, assured the generality and the significance of the results achieved from this analysis.

In order to evaluate the extent to which the identified user interface functionalities would fit real business needs, we considered a collaboration scenario, which was derived from the identified user requirements and from the selected HCI patterns. The managers of each of the seven involved SME were in fact invited to analyze such a scenario and to select a team of employees who could suitably play the roles appearing in it, during the experiment. The experiment was conducted in situ and during regular working hours, so as to make subjects feel at ease while performing the collaborative tasks within the new collaborative environment. Each participant was asked to perform appropriate tasks within the selected collaboration scenario.

Scenario Description. Employee *F* checks who is presently connected to the collaboration environment and starts to share the financial spreadsheet with the General Manager (*GM*) and with the Financial Chair (*FC*) while locking the portion of cells she is working on to prevent others' from modifying these cells. *F* also assigns read/write permission to them and then shares the conference room agenda spreadsheet with the others. Initially, she consults the financial spreadsheet to verify the amount of money currently allocated to her unit, focusing on the cells related to social events expenses, then she formulates a budget scheduling for the event. While she is working, *GM* proposes some changes and updates the financial spreadsheet accordingly. *F* and *FC* are notified about those changes. *F* stops for a while, then she starts modifying again her budget proposal. *FC* attempts to modify some of the locked cells and she is warned about their read-only status. Finally, *GM* approves and unlocks all cells in the document making it available to the other units.

The first step we performed in designing the experiment was to divide the scenario into some minor tasks and identify which requirements are related to them (see Table 2).

In order to carry out the scenario we needed three persons for each trial. Since we performed the experiment in seven businesses we used seven trials, namely 21 subjects were required. For each task, the evaluation was carried out by the Think-

Table 2 Requirements for the tasks and participants

User	Task	Participants	Involved requirements
F	Looks at the connected users	F	R1
F	Shares the financial spreadsheet assigning permission accesses	F, GM, FC	R2, R3($x2$), R9($x2$)
F	Locks some cells	F, GM, FC	R6($x2$), R7($x2$), R8($x2$), R9($x2$)
F	Shares the conf. room agenda spreadsheet	F, GM, FC	R2, R3($x2$), R9($x2$)
F	Proposes a budget scheduling	F, GM, FC	R5, R6($x2$), R7($x2$), R8($x2$), R9($x2$)
GM	Proposes some changes and updates	F, GM, FC	R6, R7($x2$), R8($x2$), R9($x2$)
F	Modifies again the schedule	F, GM, FC	R5, R6, R7($x2$), R8($x2$), R9($x2$)
FC	Attempts to modify some of the locked cells	FC	R6
GM	Approves and unlocks all cells	F, GM, FC	R2, R3($x2$), R9($x2$)

aloud protocol, requiring participants to make their comments while performing the set of specified actions. They were encouraged to explain whatever they were looking at, or thinking, or perceiving, as they went through their task. Every time a user correctly performed a task or perceived other participants' activity (e.g., the feedthrough effect of some modification on the shared spreadsheet or the status change of some participant), we assigned a point for each requirement involved. As an example, for Task 1 "Looks at the connected users", the user F should look at the list of connected and active participants and mention aloud their names. If the answer of the user was correct we assigned one point referred to requirement R1. If the user needed some help but at the end she completed the task, we assigned no points. If the observer was asked to intervene and complete the task in place of the user, we subtracted a point. In case of notification requirement the score was multiplied by the number of notified users. The final score was given by the sum of the scores for each task. The maximum score was achieved when all the session participants reached their relative maximum (49). Most of the users executed their tasks without problems. Indeed, in nearly every case we assigned 1 point (296 out of 343). In 41 cases help was required (we suggested that something happened but did not say what), for which we assigned 0 points. Finally, in very few cases (6 cases out of 343), more advanced help was required and we subtracted 1 point each.

Through a detail analysis of negative points, we were able to understand that some problems exist with the perception of spreadsheet sharing. In fact, four out of six negative cases concerned with this point, while the other two concerned with the awareness of who was simultaneously connected. On the other hand, in very few cases the problem was related to the notification of updated cells. Therefore, in summary, the communication of changes by means of colors could be judged effective. As for the 0 points cases, in 23 of them the participant did not immediately notice changes on cells, while in the others the participant did not perceive the unlock of cells by other participants.

5 Concluding Remarks

In recent years several web based spreadsheet applications have been developed with the aim to exploit the data sharing and collaboration capabilities through distributed manipulation of spreadsheets within complex organizations [1–4, 12]. Review on existing online spreadsheets proves the emerging need to provide tools by which cooperative activities on spreadsheets could be effectively performed. Summarizing from our analysis of commercial online spreadsheets, we realized that a common limitation is that usability issues have not been adequately addressed when conceiving the transformation of spreadsheets from single user to multiple user application. This has in fact been the starting point for our research. The results of the usability evaluation process we have described in this paper confirm that continuous focus on usability, since the early stages of development, contributed to achieve a collaborative system which small organizations may be willing to adopt for their daily activities.

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Representing Visual Aspects of Web Services

Antonio Piccinno and Daniela Fogli

Abstract Web services are more and more used on the web, but presenting them adequately in user interfaces is often difficult. In this paper, a new specification language is presented, based on the Web Service Description Language, called GWSDL (Graphic Web Service Description Language), which tries to overcome this limitation. In the proposed language, based on XML, tags to identify user interface elements are introduced; thanks to such tags, a web service presentation can be specified, also permitting its visualization on different devices and according to different users' characteristics and preferences.

1 Introduction

The boom of Web 2.0 and, more in general, the current development of Information and Communication Technology (ICT), is pushing towards a continuous growth of both computer systems and end user population. Designers are forced to do their best to create software applications that behave as end users expect, but often they fail [1, 2]. End users, on the other hand, not only need to use software artefacts, but also to modify, create and compose them. The Web already supports some kind of end-user development activities [3], ranging from simple parameter customization to modification and assembly of components, with the aim of creating business processes, simulations, games, web contents [4].

Recently, the advent of (Web) components, enriched with Application Programming Interfaces (APIs) favoring their reuse, has led to the development of a number

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of platforms supporting software composition. A common characteristic of such platforms is that they claim to be oriented to end users [5]. Ease of use and understandability are often cited as the main reason for adopting these technologies. Indeed, they usually provide a graphical language for specifying the composition logic. However, the complexity of the specifications of many composition languages makes not only end-user orientation impossible, but also very difficult for developers to use them.

As highlighted in [5], this is a recurring situation: every time there is a new component technology, several papers, conferences, and IT platforms begin to appear, developed by large and small companies, and inevitably they disappear. A further reason determining this failure is, in our opinion, the fact that component descriptions and composition logic specifications are exclusively focused on software internal behaviour, whilst component external presentation within an interactive application is totally neglected. This way, platforms for software composition often lead to the creation of unusable interactive applications.

However, today a variety of consumer services, widgets and devices are available, thus we need suitable composition approaches and technologies [6]. *Web services* represent nowadays the most promising solution to this problem, even though they have the same limitations that affect other composition technologies.

Web services are software components that offer specific functionalities to other web applications through a network. WSDL (Web Service Description Language) is the W3C standard language [7], based on XML, to describe web services. More precisely, through WSDL the public interface of a web service can be described, as well as how to interact with it. In this way, it becomes easy for a software developer to include web services in her/his applications. However, WSDL does not include elements to describe aspects regarding presentation, namely the kind of GUI (Graphical User Interface) the web service should have.

Moreover, lastly more and more people access information and services available on the web through several kinds of devices, e.g. laptops, palmtops and cellular phones. Managing such a diversity of devices is not costless for service providers; they should develop many different user interfaces, one for each kind of device and context of use. An alternative approach is developing flexible user interfaces that can be adapted to the variety of devices providing them with the same information and services, regardless the used device.

The second approach is usually pursued by adopting abstract languages to represent user interfaces [8–10]. An abstract representation of a user interface consists of a representation not linked to a specific modality (visual, aural, tactile, etc.) neither to a specific kind of distribution. The use of abstract languages is motivated by the need to establish a basis for the generation of user interfaces that adapt themselves, in a completely or partially automated way, to the multiple contexts of use [11].

In this paper we propose an XML-based language to describe, beyond the software interface of web services, also their user interface aspects. This language is an extension of WSDL and, for this reason, it has been called GWSDL (Graphic

Web Service Description Language). The GWSDL description of a web service is built in two steps. In the first step a description independent from the user characteristics and the device the user adopts to access such a service is created; in the second one, the description is enriched by specific tags to adapt the web service presentation to the user and the device. The architecture of a system exploiting GWSDL is then delineated along with an example of its operation.

2 From WSDL to GWSDL

WSDL is an XML-based language to create documents that describe public interfaces of web services. A WSDL document, describing a web service, contains information on: (1) *what can be used*, i.e., all functionalities made available by the service (element <interface>); (2) *how to use it*, i.e., the communication protocol to be used to access the functionalities offered by the web service, including the format of input/output messages accepted and returned by the service (element <binding>); (3) *where to find it*, i.e., the web service endpoint, usually corresponding to the address, in URI format, which makes the web service available (element <service>). WSDL describes the API of a web service in an abstract way, focusing on the syntax of messages exchanged among interacting components (client and server), without taking into account how they will be graphically represented.

In this paper, we propose an extension of WSDL, called GWSDL, which overcomes WSDL limitations, by providing mechanisms to satisfy a fourth requirement: *what kind of external representation* the web service should have to cope with the current context of use, including device characteristics and user profile. Indeed, nowadays there is an increasing need of developing web applications that can be supported by the majority of devices available on the market and that can be adapted to their characteristics without losing in expressiveness and efficiency. Such applications should also be designed to satisfy the characteristics of the heterogeneous user population, such as different aptitudes, needs, age, gender, domain and system knowledge, culture, abilities/disabilities, and environments. Therefore, there is the need to make web page content and layout adaptable to the characteristics of each device and each user.

GWSDL describes the user interface components at a high level of abstraction, by using a set of tags and related attributes, which represent widgets independently from their actual materialization in the interface. Such widgets can thus be automatically adapted to different kinds of device and user profiles.

Figure 1 shows the grammar of GWSDL. After the elements foreseen by the WSDL 2.0 Recommendation [7] – namely, <types>, <interface>, <binding>, and <service> – such a grammar includes the element <gui>, which is used to represent the service user interface. This element has four children: the sub-elements <input_widget> and <output_widget> identifying widgets to collect data and to represent output data respectively; the sub-element <device>, which

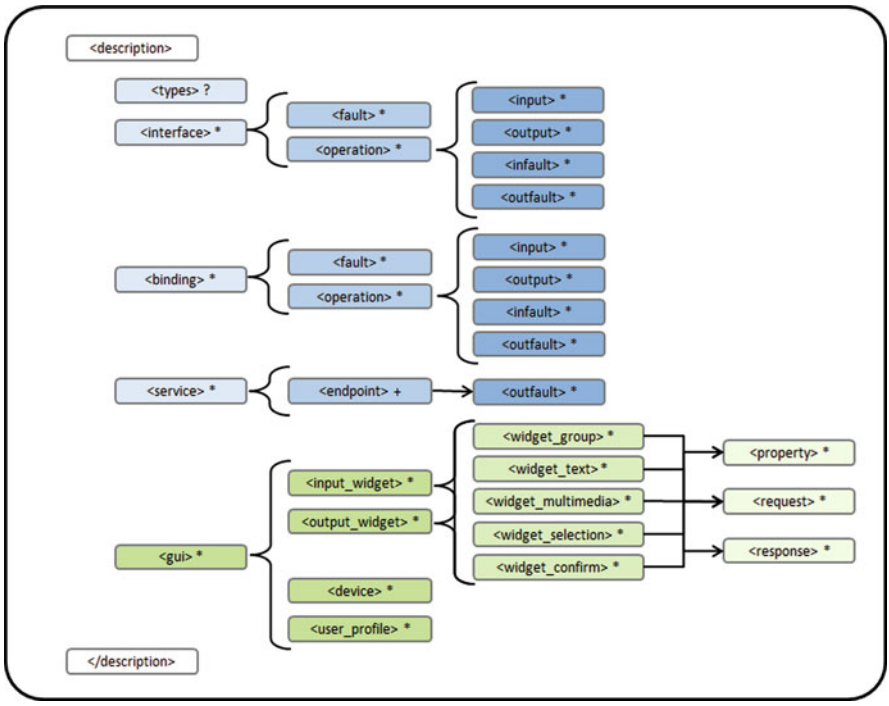

Fig. 1 The XML elements of GWSDL

identifies the considered device, on whose characteristics the final user interface will be adapted; the sub-element <user_profile>, which defines the user's characteristics and preferences, which may be also related with possible user disabilities (e.g., sight impairments) or previous behaviors of the user (e.g., disabled option for image visualization).

The first two sub-elements are defined by the service developer during service initial creation, whilst sub-elements <device> and <user_profile> are progressively completed to cope with service external representation in the actual context of use, according to the procedure illustrated in the next section.

More precisely, elements <input_widget> and <output_widget> are characterized by the attribute "operation name" which refers to the operation whose input/output is under consideration and described in the <interface> element of the service XML description. Since widgets can be related each other to make up a coherent part of the user interface, the sub-element <widget_group> has been introduced as a child for both <input_widget> and <output_widget>. This tag is used to describe groups of widgets. Elements <input_widget> and <output_widget> can also include further children that represent different types of widgets, and in particular:

- <widget_text>, to denote textual elements, such as text paragraphs, labels, input fields, textual links;

- <widget_multimedia>, to be used for defining images, video, sounds, flash objects;
- <widget_selection>, to be used for representing exclusive selections (e.g. radio buttons) or multiple selections (e.g. check boxes);
- <widget_confirm>, which allows defining buttons to be included in the user interface.

All the child elements of <input_widget> and <output_widget> are characterized by a variety of attributes, among which priority has a fundamental role for service external representation. Indeed, dealing with services that can run on different devices and can be used by different users leads to cope with the problem related with the choice of the most appropriate visualization of widgets for that device and that user.

For example, a PDA (Personal Digital Assistant) gives several possibilities for input, but has usually a display not large enough for including too much content, such as long texts along with images. This combination allows for example visualizing a user interface that includes a text portion and a number of buttons to browse the rest of the text distributed in other pages. On the other side, if we consider a personal computer display, the textual part can be represented with a bigger font, and buttons can be substituted, for example, by a lateral scrollbar; moreover, images can be inserted in the user interface.

The main problem is to understand and decide how the user interface elements can be put and organized in the display, whenever the user interface should be displayed on different devices. In our proposed language, the attribute priority is used to indicate the widget (or group of widgets) *significance*. This attribute can be assigned with a value between 1 and 10. When widgets have to be visualized, it is possible to exploit this attribute to position the most significant widgets in the most convenient way. It can also be used to decide which widgets must not be visualized in case the space available on the device is limited. This approach can also contribute to improve the interaction process between user and system.

3 System Architecture

Starting from the general GWSDL description of a web service, a richer description is generated by the so-called Web Service Presentation Tool (Fig. 2), which adapts the description based on the characteristics of the device currently used to access the web service by the user and her/his profile.

More precisely, the Web Service Presentation Tool operates as follows:

1. it selects from a library of device descriptions that one corresponding to the current device and uses it for defining the element <device> of the GWSDL document;
2. it fills the element <user_profile> with the information related to the user's characteristics and preferences.

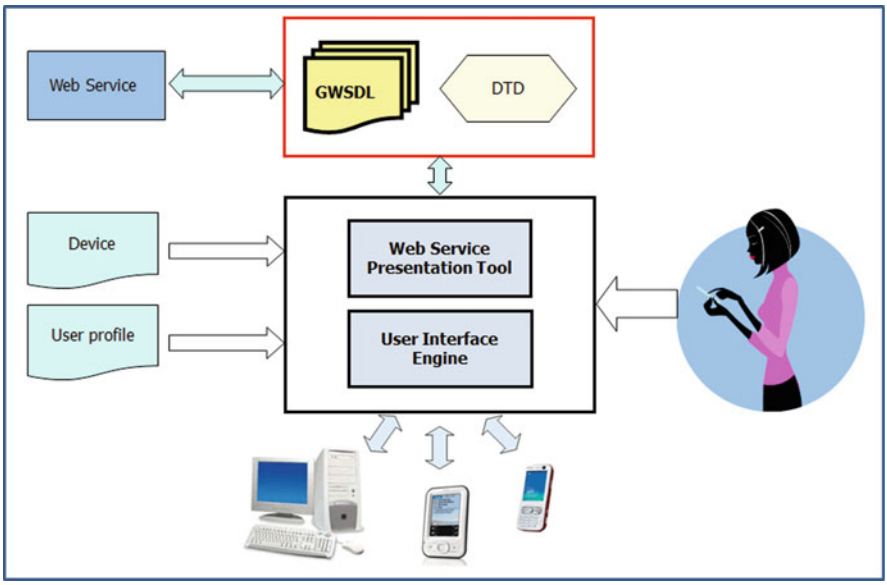

Fig. 2 Architecture for GWSDL interpretation and rendering

The web service GWSDL description is then further processed by the User Interface Engine, which tailors the web service GUI according to the device characteristics and user profile, and renders such interface. The User Interface Engine is also in charge of operating the selection of widgets based on their priority by implementing, currently, a simplified algorithm. We are studying an extension of the approach by capitalizing on the proposal presented in [12].

The architecture describing the overall process is shown in Fig. 2. We assume that a library of device descriptions is available, which includes, for each device, various information such as screen size, network bandwidth, audio device, and so on. The information related to the user profile are currently managed through an approach based on an authentication process that recalls some static user characteristics, such as genre, sight and hearing disabilities, visualization preferences. Also in this case, we are studying an extension of the approach, in order to take into account dynamic characteristics that could be derived from the observation of the user behavior. Literature on recommendation systems [13] will be taken as reference to address this issue.

4 An Example

In the following, an example of how the GWSDL description is created, updated and finally exploited for rendering the GUI of the web service on different devices is provided. The example is given for a web service providing weather forecast. In Fig. 3 the <gui> fragment of the GWSDL description is reported.

```
<gui name="Weather Ferecasts Web Service">
   <input_widget operation_name="GetWeather">
      <widget_text text_type="label" value="Country:" priority="9" />
      <widget_text id="CountryName" text_type="textfield" priority="9" />
      <widget_text text_type="label" value="City:" priority="9" />
      <widget_text id="CityName" text_type="textfield" priority="9" />
      <widget_confirm id="OkButt" priority="9"
         <request event="onClick params="CountryName, CityName"/>
         <response receiver="Result"/>
      </widget_confirm>
   </input_widget>
   <output_widget operation_name="GetWeatherResponse">
      <widget_multimedia id="Location" media_type="image" priority="5"
         <property name="source" value="../img/weather.jpg" />
         <property name="alternative_text" value="none" />
      </widget_multimedia>
      <widget_text id="Result" text_type="paragraph" priority="9" />
   </output_widget>
</gui>
```

Fig. 3 GWSDL fragment for weather forecast

a

```
<device>
   <device_type type="desktop" />
   <screen_size size="12" />
   <resolution width="800" height="600" />
   <color method="RGB" />
   <pointer_device pointer="not defined" />
   <bandwidth band="not definded"/>
   <audio media="absent"/>
</device>
```

b

```
<device>
   <device_type type="PDA" />
   <screen_size size="3.7" />
   <resolution width="600" height="320" />
   <color method="RGB" />
   <pointer_device pointer="not defined" />
   <bandwidth band="not definded"/>
   <audio media="absent"/>
</device>
```

Fig. 4 GWSDL device description: desktop (**a**) and PDA (**b**)

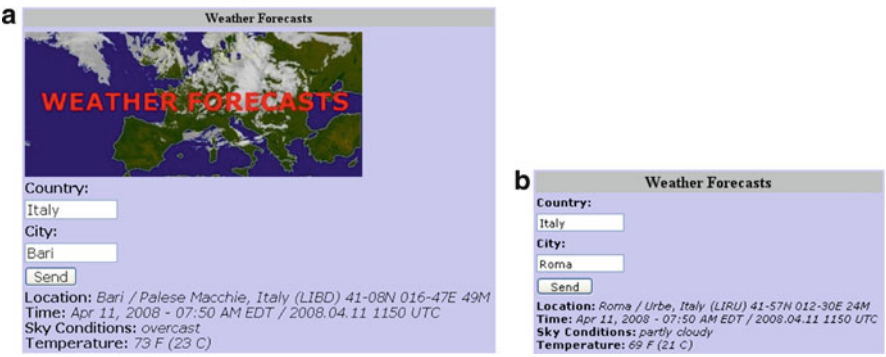

Fig. 5 Web service rendering on a desktop (**a**) and PDA (**b**) display

According to the device used by the user, the Web Service Presentation Tool will instantiate the tag <device>. Figure 4 reports two GWSDL fragments referred to two different examples of devices: a desktop (a) and a PDA (b).

Finally, according to the user profile and its interaction with the system, the Web Service Presentation Tool will instantiate <user_profile> accordingly. By assuming the same user profile, the rendering of the web service by the User Interface Engine on desktop and PDA is that reported in Fig. 5. As one can notice, the image is not shown on the PDA device since it has a low priority value.

5 Conclusion

In this paper, we have presented a new XML-based language for web service description, which extends the WSDL standard with information about service presentation. Our idea is in some way opposite to that of Paternò and colleagues [10], who propose a language for embedding web service descriptions within the XML-based specification of an interactive system. We argue that our solution may better cope with the problem of web service changes over time. However, in its current version, our approach needs further improvements, since it does not address the problem of specifying complex interactive applications yet. We are planning to work on this issue in our future work. Indeed, our final goal is to demonstrate that the use of GWSDL and the architecture presented in this paper may facilitate the creation of applications as web service compositions, by guaranteeing, at the same time, their usability and accessibility.

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Using a High Level Formal Language for Task Model-Based Usability Evaluation

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Abstract Evaluating usability is a challenge in many development projects. We propose a formal high-level task modeling language, called TaMoGolog, to define task model-based usability evaluation. TaMoGolog provides a well-defined syntax and semantics, enables precondition axioms of tasks, states postcondition effects to variables due to tasks execution, provides a rich set of operators for constructing task models of complex system behavior in an accurate and unambiguous form, and gives the facility to express domain knowledge in resulting task models. We suggest a framework to use TaMoGolog and describe the life-cycle for evaluating the usability of software products through formal task models. We further present a tool, called TaMUlator, to manage and automate the proposed evaluation life-cycle at the integrated development environment (IDE) level.

1 Introduction

The field of usability evaluation includes rigorous approaches and techniques that enable us to define and run experiments, collect and analyze results, and make decisions regarding which feedback to adopt and to what extent [1]. However, in

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many cases, usability is evaluated manually [8] and due to budget and schedule concerns, it is sometimes neglected. Automating evaluation techniques through the development lifecycle provides several benefits, including reduced development costs and time, improved error tracing, better feedback, and increased coverage of evaluated features [8].

Our previous work [4, 5] involves defining evaluation experiments and running them from within the Integrated Development Environment (IDE). This equips the development team with a mechanism to monitor and control a continuous process tightly couple with the development process, thus receiving on-going user feedback while continuing development.

In this work we focus on the formal modeling of user and system tasks. We present a formal task modeling language named **TaMoGolog** (**Ta**sk **Mo**deling **Golog**) [6], which was built on top of the Golog-family [2, 3, 9, 10] of high-level programming languages. TaMoGolog provides a solid foundation for defining complex system behaviors and scenarios in an appropriate, accurate, and unambiguous form. It also provides designers with the freedom to express domain knowledge in the resulting task models. Here we use the TaMoGolog language to model user and system tasks to evaluate the usability of a specific product, from both the usability and functionality perspectives. We use experiments to find usability issues and serve as an acceptance test for the developed features.

Illustrating the TaMoGolog structure, we present the TaMUlator tool, which enables an end-to-end evaluation lifecycle. TaMUlator defines the experiments using TaMoGolog-based task models and runs the experiments. This enabled us to record user and system behavior as per the defined mode. We were also able to automatically collect and analyze the results by comparing the task models and recorded data, and draw conclusions to derive relevant development tasks to improve the developing product. The automation support equips the software development team with an efficient and effective way to more accurately discover usability issues. We conducted a case study to evaluate the framework and we found that developers can effectively use TaMUlator to evaluate their developed product [7]. Due to lack of space, the case study is not presented in this work.

In Sect. 2, we present the TaMoGolog language for writing formal task models that can be used to define user and system tasks for evaluation experiments. In Sect. 3, we describe the framework in which we used TaMoGolog, including the evaluation life-cycle. In Sect. 4, we show how to implement this framework using the TaMUlator tool to manage and automate task model-based usability evaluation at the IDE level. We conclude in Sect. 5.

2 TaMoGolog Task Modeling Language

The Golog-family of high-level programming languages provides a rich formal foundation for reasoning about actions and complex processes [2, 3, 9, 10]. We define a formal task modeling language called TaMoGolog, built on top of the

Golog-family. TaMoGolog provides well-defined syntax and semantics, enables precondition axioms of task, states postcondition effects to variables due to successful task execution, provides a rich set of operators, and gives the facility to express domain knowledge in task models.

TaMoGolog distinguishes tasks into three basic categories: unit tasks, waiting tasks, and composite tasks. *Unit* tasks, reside at leaf levels in task structure and are considered to be performed in an atomic manner at some particular abstraction level. *Waiting* tasks *w*ait for a particular event to happen or for some set of conditions to be fulfilled. *Composite* tasks handle the structural behavior of the task model where each composite task may contain unit/waiting tasks or further composite tasks. Composite tasks contain plans for finding the right path to achieve a desired goal.

TaMoGolog provides a rich set of operators, mostly obtained from the Golog-family. The operator $\phi?$ represents a *waiting* or *testing* condition; $[\Gamma_1;\Gamma_2]$ represents *sequence* where task Γ_2 starts after task Γ_1 is finished; $[\Gamma_1|\Gamma_2]$ and $[\boldsymbol{agt}\ \Gamma_1|\Gamma_2]$ represents internal and external *nondeterministic choice*, respectively. Here, *agt* means some external entity (application/system or human user) who decides the nondeterministic branch. [**if** ϕ **then** Γ_1 **else** Γ_2] is a normal *if-then-else* choice, where ϕ is a conjunction of conditions; $[\pi x.\ \Gamma(x)]$ and $[agt\ \pi x.\ \Gamma(x)]$ are *nondeterministic choice of argument* where the system or the external entity chooses the variable binding for the task and then the task is executed accordingly. $[\Gamma]^*$ and $[agt\ \Gamma]^*$ are *nondeterministic iterations* (internally and externally). [**while** ϕ **do** Γ] is the usual *while-do* iteration. $[\Gamma_1 \parallel \Gamma_2]$ represents the *interleaving concurrency* of tasks. $[\Gamma_1\rangle\rangle\Gamma_2]$ represents the *priority concurrency* where task Γ_2 continues only if task Γ_1 is finished or in the blocking state. $[\Gamma_1]^{\parallel}$ is for *concurrent iteration*. $[agt\ \Gamma_1\langle\rangle\Gamma_2]$ represents that the external entity *agt* decides the priority concurrency at run time. $[agt\,\Gamma]^{\parallel}$ represents the concurrent iteration decided by external entity. $[<\phi \rightarrow\Gamma>]$ represents *interrupt*, where if the condition ϕ becomes true and the interrupt has control then the task Γ is started. $[\Gamma_1\Gamma_2]$ represents the failure handling, where Γ_2 executes if Γ_1 fails to finish.

The following is the TaMoGolog set of selected predicates use to write task models for usability evaluation.

- *UnitTask*(α): α is a unit task
- *CompositeTask*(Γ): Γ is a composite task
- *Precondition*(α) $\equiv \Pi_\alpha$: formula Π_α defines the set of axioms that must be true at the time of execution of a unit task α
- *Postcondition*(α, v, $\Omega_{(\alpha,v)}$) $\equiv \Phi_{(\alpha,v)}$: formula $\Phi_{(\alpha,v)}$ defines the effects of executing unit task α on related variable v under any condition $\Omega_{(\alpha,v)}$.
- *Fluent*(f): f is a functional or relational fluent (variable)
- *InitialState*(m) $\equiv I_m$: describes the values of variables at the beginning of a task model m through the formula I_m
- *TaskModel*(m): m is the task model name

```
TaskModel(managing_bank_account).
Fluent(userAge).
Fluent(balance).
Fluent(amount).
UnitTask(login).
UnitTask(logout).
UnitTask(view_account).
UnitTask(deposit(amount)).
UnitTask(withdraw(amount)).
CompositeTask(managing_bank_account).
CompositeTask(manage_account).
Agent(Customer).
Precondition(login) ≡ userAge > 18.
Precondition(view_account) ≡ TRUE.
Precondition(deposit) ≡ amount > 0.
Precondition(withdraw) ≡ (balance – amount) > 0.
Postcondition(deposit, balance, true) ≡ balance + amount.
Postcondition(withdraw, balance, true) ≡ balance – amount.
proc managing_bank_account
            login; [Customer manage_account]*; logout
end
proc manage_account
            [Customer (view_account | deposit(amount) | withdraw(amount)) ]
end
```

Fig. 1 Task model for managing a bank account

- *Agent*(*agt*): *agt* represents some external entity (e.g., human or application) participating in the task model
- *Responsible*(*agt*, α): external entity *agt* is responsible for executing task α
- *Goal*(g, v) $\equiv \Delta_{(g,v)}$: goal g is defined by formula Δ_g on fluent v

TaMoGolog semantics is also based on the Golog-family, where each unit task can be performed if all the related precondition axioms are true at that moment. After completing execution, the effects are shown on related variables (fluents). Unit tasks are performed in atomic manners. However, for the *composite* tasks, in one step a unit task or condition is executed and then the remaining parts are executed in the same manner. Each task model defines one or more paths (depending on nondeterminism) to achieve a goal. If a task model achieves a goal through any of the possible paths, then it succeeds; otherwise, it fails.

A Task Model Example: *Figure 1 shows a simple task model for managing a bank account, in TaMoGolog. We omit many other details due to limited space. The task model structure defines that a bank customer can check her account after login to the system, and then can view her account, deposit money, or withdraw it, as often as she wants until she logs out from the system.*

3 Task Model-Based Usability Evaluation (TaMU) Framework

We propose a framework, called **Ta**sk-**M**odel-based **U**sability Evaluation (**TaMU**), which uses formal task models written in TaMoGolog to evaluate the usability of developing/developed applications. Following are details of the TaMU framework.

3.1 Defining and Tagging Tasks and Variables at the Code-Level

The TaMU framework suggests defining and tagging tasks in the program at the code level. This helps define tasks at multiple levels of abstraction from lower abstraction level, such as pressing buttons or selecting an option from two inputs, to higher abstraction levels, such as complete payment transaction functionality. In each case, we also tag the interested set of those variables (fluents) that are either part of precondition axioms or postcondition effects of these tagged tasks. This gives us the flexibility to create task models from different abstraction levels for the same scenario and evaluate them accordingly. It also enables us to define user tasks and system internal functionalities separately in the resulting task models. This makes it possible to record users' actions and the system's internal behavior during evaluation experiments; it thus provides a way to test product functionalities alongside usability evaluation.

3.2 Modeling Usability Scenarios at Multiple Abstractions

A *usability-scenario* in evaluation experiments provides a scenario where the user much achieves some targeted set of goals by performing a series of tasks. The purpose of the experiment is to check usability aspects such as ease, efficiency, ability to learn and memorize, performance, and error handling of the targeted application. This is checked by applying appropriate usability metrics such as time to complete a task and time spent dealing with errors. The TaMU framework uses TaMoGolog to construct task models for each usability-scenario. Through TaMoGolog, it is possible to construct different task models for the same usability-scenario, where each task model resides at some particular abstraction level. This helps record data from several abstraction levels during execution of the evaluation experiment and enables us to highlight usability issues from multiple abstractions.

3.3 The Data Recording Process

The TaMU framework suggests to record data when a task, modeled in any of the attached task models or tagged at the code level, is enabled. This includes: variables' values related to precondition axioms; the necessary information of a task such as starting time, previous task, completion time, etc.; and the postcondition related variables' values when a task is completed. The TaMU framework also suggests record the inputs given or nondeterministic decisions taken by an external entity (some external application/system or human user). This data includes values of all those variables that come in any of the attached task models at the beginning and the ending of the evaluation experiment (for task model initial state and ending state values), and other relevant information.

3.4 The Data Analysis Criteria Using TaMoGolog-Based Task Models

The TaMU framework also uses TaMoGolog-based task models attached to the evaluation experiment to analyze the recorded data.

- The TaMU framework recommends many measurements suggested by Whiteside, Bennett, Holtzblatt [11]. These include: time to complete a task, per cent of task completed, per cent of task completed per unit time, ratio of success to failure, etc.; taking directly from the experiment's recorded data by applying the appropriate statistical techniques.
- The TaMU framework categorizes tasks in the recorded data into four categories for the analysis purpose: *completed-and-successful, completed-and-unsuccessful, failed,* and *avoided*. Completed-and-successful is if the task finished execution properly and the recorded attached postcondition variables' values satisfy the attached postcondition effect axioms in the task model. *Completed-and-unsuccessful* is when the task finished execution properly but the recorded attached postcondition variables' values do not completely satisfy the attached postcondition effect axioms in the task model. *Failed* is when the task failed to finish successfully or the user abandoned it midway. *Avoided* is used when the task was in the execution-path, but the user chose an alternative path or the user chose the defined execution-path but decided not to perform it. In all cases, the TaMU framework uses precondition axioms and postcondition effects and the related variables' values collected during experiments to analyze the reasons behind these.
- For each system task, the TaMU framework asks to check the attached postcondition variables' values to determine whether the system functions/actions performed as expected.

- The TaMU framework analyzes the users' selection of tasks and the attached task structure to evaluate the users' execution-path selection behavior.
- Using the exogenous actions' (actions performed by external systems/applications), the TaMU framework investigates the logged data to see the effects of these actions on system states and on other tasks.

In addition to the above, the TaMU framework also uses other information such as user groups, their particular preferences, and so forth; these are provided in the attached task models for different data analysis purposes.

3.5 TaMU Process Life-Cycle

The TaMU process life-cycle consists of five phases as shown in Fig. 2.

In Phase 1, the software team tags in the application code the set of relevant unit tasks and those variables that can be part of precondition axioms or postcondition effects. These tagged tasks and variables are then used in creating TaMoGolog-based task models during phase 2, where each created task model reflects the structure of the related scenario that is supposed to be followed by the evaluating user. In phase 3, the created task models are attached to related evaluation experiments. During phase 4, users are supposed to achieve a list of goals through performing tasks using the evaluating application, while their actions and application data are recorded. In phase 5, The logged data of users and evaluated-application are analyzed through comparing it with the attached task models, created in phase 1, to find out the errors and flaws (e.g., preconditions not fulfilled, skipped tasks, etc.), usability problems (e.g., wrong path selection by user), user behavior, etc.

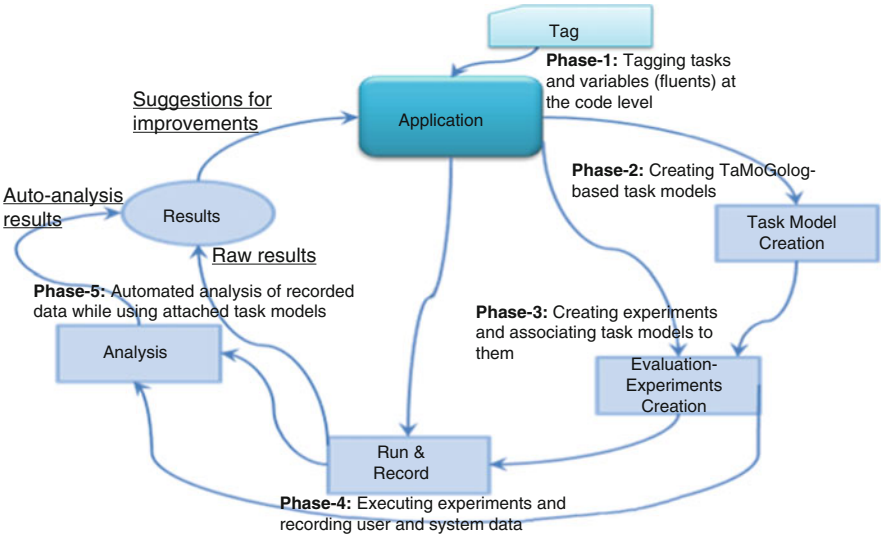

Fig. 2 TaMU process life-cycle

4 TaMUlator: A Tool to Manage the Usability Evaluation Life-Cycle

We developed **TaMUlator** (**Ta**sk **M**odel-based **U**sability Eva**luator**), a Java-based tool that provides a set of APIs and interfaces for the realization of an evaluation life-cycle at the IDE level. TaMUlator allows the software development team to tag tasks and variables of interest in the program at the code-level. A special API named **TTag-API** (**T**ask **Tag**ging **API**) allows these tasks and variable to be tagged and then used in task models. TaMUlator comprises five modules (as shown in Fig. 3):

TaMoGolog-Compiler is responsible for compiling the TaMoGolog-based script to a task model interpretation that can be understood by other modules.

Task-Model module contains specific usability scenarios that were specified in TaMoGolog-based task models and were created by compiling the scripts in *TaMoGolog-Compiler* module. It also provides an API, called **TM-API** (**T**ask **M**odel **API**), which developers can use to change task model parameters (e.g., task's name) and export these task models structures as a tree using the Java JTree[1] class.

Experiment module manages evaluation experiments, where each experiment is associated with one or more task models in the Task-Model module. Through the API provided by the module, called **EExp-API** (**E**valuation-**Exp**eriment **API**); developers can manage the associated task models inside this module.

Recorder retrieves and records the relevant data of a task and the variables related to precondition axioms and postcondition effects when a tagged task is enabled during the execution of evaluation experiment.

Analyzer module takes the evaluation experiment from the *Experiment* module and the related recorded data from the *Recorder* module. After analyzing the data together with the original task models associated with the experiment, it provides feedback.

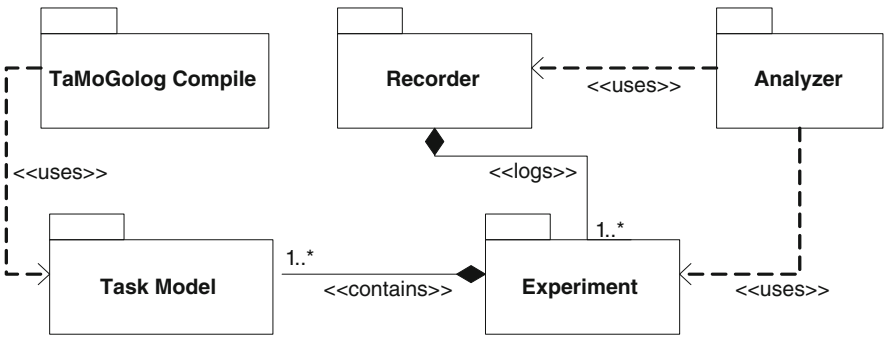

Fig. 3 TaMUlator high-level design overview

[1] http://download.oracle.com/javase/1.4.2/docs/api/javax/swing/JTree.html

5 Conclusion

We presented a formal high-level language, named TaMoGolog, to model user and system tasks for usability evaluation. Using TaMoGolog provides a way to construct task models from multiple abstraction levels that achieve the same set of goals. Thus, more than one task model can be defined for a usability scenario and can be attached to an evaluation experiment, where each task model represents a certain abstraction level. This allows the framework to record the behavior of users and the system, and to highlight usability issues. Moreover, we suggested an evaluation lifecycle and presented the TaMUlator tool to realize the use of the TaMoGolog-based task models. This helps the software development teams to evaluating their developing/developed product more effectively and accurately.

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Visualizing Geographical Information Through Tag Clouds

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Abstract In the last decade, the need to support decision makers in solving problems related to a territory and its phenomena has stimulated Geographic Information Visualization (GeoVis) researchers to propose highly interactive visualization tools able to both synthesize information from large datasets and perform complex analytical tasks. The goal of the present paper is to propose a GeoVis method based on a recent InfoVis technique, known as Tag Cloud, which combines tag clouds with advanced GeoVis techniques for visualizing geographic data and related spatio-temporal phenomena. The method elaborates a simplified map containing a georeferenced cloud of tags, placed where the associated information is appropriate and significant. As initial result a system prototype has been realized in order to obtain an overview of data distribution and classification. It is focused on data extraction and aggregation, and output visualization, and adopts various techniques to allow users to select data to visualize starting from a geographic dataset.

1 Introduction

Information Visualization, also known as InfoVis, is recognised as the scientific area where interactive visual representations of abstract data aim to amplify user's cognition of information [1]. In particular, recent InfoVis research has been targeted to support humans in solving problems through highly interactive visualization tools able to both synthesize information from large datasets and perform complex analytical tasks [2]. A similar need has also stimulated researchers from the Geographic Information (GI) field, who are proposing advanced tools able to semantically integrate quantitative, qualitative and cognitive aspects of a domain of

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interest, and generate visual information useful to provide an immediate overview of it [3]. GeoVisualization (GeoVis, for short) represents the research field where the efforts from both these two disciplines are integrated in order to define techniques and metaphors, such as maps and diagrams, capable to represent geographic data and improve their abstraction and interactivity. Due to pervasiveness of geographic component, applications from several domains can be labelled as GeoVis applications and strong relationships among them can be established, which allow designers to export advanced solutions from apparently different domains and extend them by properly taking into account the geographic component.

The goal of the present paper is to propose a GeoVis method based on a recent InfoVis technique, known as Tag Cloud, which combines tag clouds with advanced GeoVis techniques for visualizing geographic data and related spatio-temporal phenomena. A Tag Cloud is a visual representation typical for text data, used to depict keyword metadata (tags) whose importance is expressed by font size or colour [4]. The proposed method adopts the Tag Cloud rationale and extends it by exploiting techniques for summarizing datasets and simplifying their geographic representation, such as Cartograms [5] and Chorems [6]. Starting from a geographic dataset, the proposed method extracts relevant information about a geographic area by counting and/or summarizing data, and generates a simplified map containing a georeferenced cloud of tags, located within the geographic area which original data are related to. In order to apply this method, a system prototype, named TaGaMap, has been developed. It assembles results from an initial phase of our research and allows to build a map containing the tag cloud, representing summarized data extracted from the underlying dataset. The goal of our future work is to realize an interactive map by which users may perform visual analytics tasks.

The paper is organized as follows. Section 2 recalls the preliminaries about Visual Summaries and Tag Clouds methods. Section 3 introduces the proposed method. In Section 4 , the system architecture is described and the TaGaMap prototype built on it is presented. Conclusions and future work are drawn in Section 5.

2 Background

This section introduces the context of the paper, which is based on several topics related to map visualization and tag clouds methods. In particular, two cartographic solutions for visual summaries are briefly recalled, and the most popular tag cloud generators are described, useful to form the basis for the present proposal.

Cartograms are maps where a particular distortion is introduced to express a specific map attribute. According to the definition given in [7], a cartogram is a small diagram which shows quantitative information or an "abstracted and simplified map, the base of which is not true to "scale". They are targeted to show the relative importance of a variable, and make easy visual comparisons, as illustrated in Figure 1a, where the world repartition of wealth in 2002 is represented.

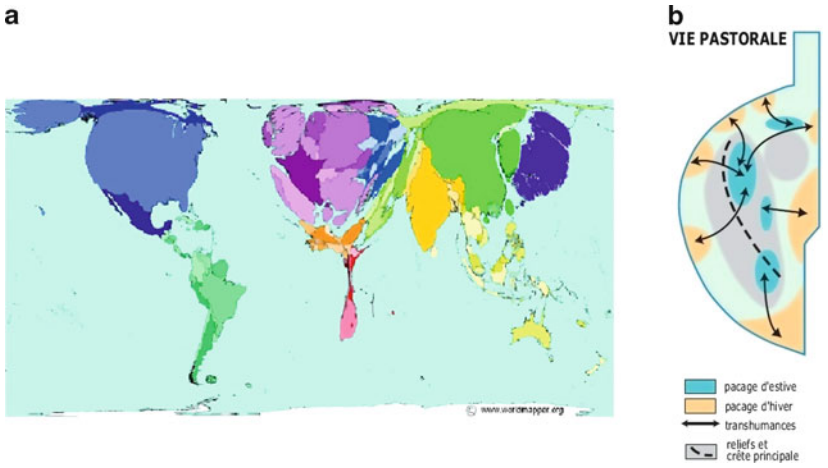

Fig. 1 A cartogram (**a**) showing world wealth in 2002 [8] and a map (**b**) containing chorems about the island of Corse [9]

While cartograms show values of a single variable at a time, chorems allow designers to assemble into a single map more than one thematic layer, thus representing the relative importance of a set of objects and phenomena related each others. According to the definition by Roger Brunet [10], a chorem is a schematic territory representation, which eliminates any detail not necessary to the map comprehension. Figure 1b shows a set of chorems related to the island of Corse, representing the transhumance between summer and winter pastures. This capability of chorems may be exploited to provide decision makers with a means to acquire syntactic information, as well as semantic aspects, useful to support human activity to model, interpret and analyse the reality of interest [11, 12].

Tags are usually single words whose importance is visually expressed by font size or colour. A tag cloud is a visual representation typical for text data, used to depict keyword metadata (tags) on websites, or to visualize free form text provided by the user [4]. This representation is useful for quickly observing the most important/frequent terms of a text, which are arranged with the juxtaposition of different font size and colour.

Wordle, Tagul and Tagxedo represent the most popular tag cloud generators. Wordle [13] is a web tool which generates tag clouds starting from a website or free form text. The rationale behind its algorithm is to provide a more appealing version of a traditional tag cloud, by trying to fix some typical typographic problems. In fact, the Wordle layout packs words tightly, avoiding overlapped tags. It also exploits the space of a letter O in a larger word by including a tiny word, and provides users with a broad set of visual parameters to play with, namely a large set of typefaces and several pre-created colour schemes. Such a capability breaks away from the pure horizontal alignment of conventional tag clouds, giving the option to place words vertical or even diagonally. Tagul [14] is

a web service tool that allows users to create tag clouds, by providing developers with the Tagul API [15], an XML-RPC server that uses HTTPS. A method called 'generateCloud' is invoked with an XML file as input parameter and an SVG cloud file (compressed by ZLIB) is returned. All cloud customizations (shapes, fonts, colours, angles, etc.) may be set in the XML file. The generated cloud file is rendered by a Tagul flash component. Both generated cloud and flash component can be hosted on a website, thus allowing independence from Tagul while serving clouds to website visitors. Tagxedo [16] is a web service tool that lets users to create tag clouds in a very interactive mode. The user may customize the tag cloud by choosing colour, theme, font, orientation, layout. Moreover, s/he may also choose a customized shape (from an image) in order to distribute the cloud on it. Like Tagul, also Tagxedo provides a service to obtain a tag cloud via HTTP request, by adding some parameters (URL, theme, orientation, and basic shape) to the Tagxedo URL. Figure 2 shows a tag cloud generated by Tagxedo representing a cloud of common names.

An interesting method, named Tag Maps [17] has been developed to display textual topics linked to a specific location on a map. As shown in Figure 3, it summarizes large collections of data and visualizes the corresponding tags associated with a real geographic space. Tag Clouds and Tag Maps share the visualization approach, which consists of differently sized and coloured aggregated tags, while they differ in the extraction and aggregation criteria, namely free form text with respect to structured and georeferenced data.

Fig. 2 A tag cloud of common names generated by Tagxedo [16]

Fig. 3 A tag map of London [17]

3 Visualizing Data Summaries by Georeferenced Clouds of Tags

The goal of this paper is to describe a method for visualizing geographic information which both combines Tag Cloud and advanced GeoVis techniques, and revises the Tag Maps approach. In particular, it exploits the GeoVis capability of summarizing datasets and simplifying their geographic representation also by altering their original shape. Moreover, it adopts tags to express concepts extracted from data sources, and finally, it adapts the georeferencing concept underlying the Tag Maps, by associating it with the whole cloud.

The method application results in a simplified map containing a georeferenced cloud of tags, each referring to a different map characteristics. In particular, it counts and summarizes data from a geographic dataset and expresses them through tag clouds within the geographic area which data are related to. It is worth to noticing that the position of each single tag is meaningless, because all of them refer to the geographic boundary, that is, the tag placement is "area based", thus implying a graphic approach for the map layout. As a consequence, two subsequent applications of the method on the same dataset may produce two different clouds. Differently, the tag placement in Tag Maps is "point based", that is, the solution is derived from the label placement, a well-established cartographic approach, which concerns with the prominence of spatially-coincident tags, the real time label placement, and a legible output production.

Figure 4 depicts a map produced according to the proposed method. It illustrates USA population divided by age classes and gender. In particular, the prominence of each class is expressed by the size, while the colour represents the different types of the same age class, namely male in blue and female in pink.

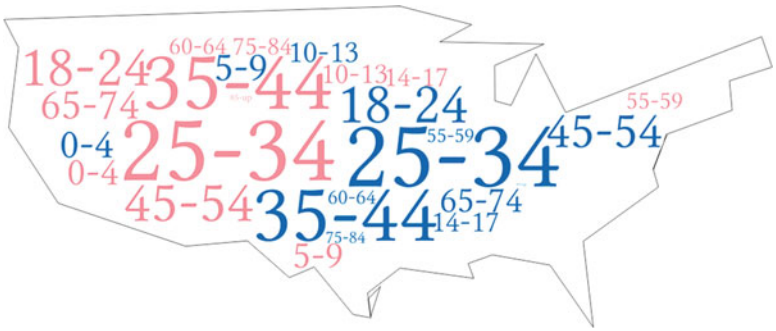

Fig. 4 A map obtained by applying the proposed method

4 The System Architecture and the *TaGaMap* Prototype

In order to apply the proposed method a system prototype has been developed based on the architecture consisting of the four following modules. The *Data Selection* module is meant to read data from the geographic dataset and allows users to choose both the geographic map boundary and the alphanumeric data to represent within the map as tag cloud. The *Data Aggregation and Generalization* module is meant to both generalize the map boundary and calculate a weight function useful for the cloud generation. The *Cloud Creation* module has been designed to create the tag cloud, which has to fit in the simplified map boundary. Finally, the *Data Representation* module is able to merge the boundary and the cloud in order to visualize the resulting map.

As initial result a system prototype, named *TaGaMap*, has been realized in order to check the method feasibility. It is focused on data extraction and aggregation, and output visualization, and adopts various techniques to obtain an overview of data distribution and classification. An usability study is planned in order to test the effectiveness and usability of the proposed system, but it is not the focus of this paper. *TaGaMap* has been implemented by using various technologies, such as Java and PHP as programming language, Java Topology Suite (JTS) as spatial data model and spatial analysis method set, and XML and SVG as exchange and storage means. Figure 5 depicts the process generation of a simplified map which represents the USA population partitioned in age classes. The *Data Selection* module has been implemented as a Java application. It takes as input a geographic dataset, such as an ESRI Shapefile or a Postgres/Postgis table, and allows the user to select both the geographic map boundary and the alphanumeric data to visualize. The *Data Aggregation and Generalization* module has been implemented to simplify the map boundary, as shown in Figure 5a, by using the well-known Ramer-Douglas-Peucker (RDP) algorithm [18, 19]. It produces the simplified map in XML and SVG format. Moreover, it also allows the user to select the weight function useful to establish the tag dimension. The *Cloud Creation* module has been implemented as a PHP application to call a remote API (Tagul API [16]) via XML-RPC, which

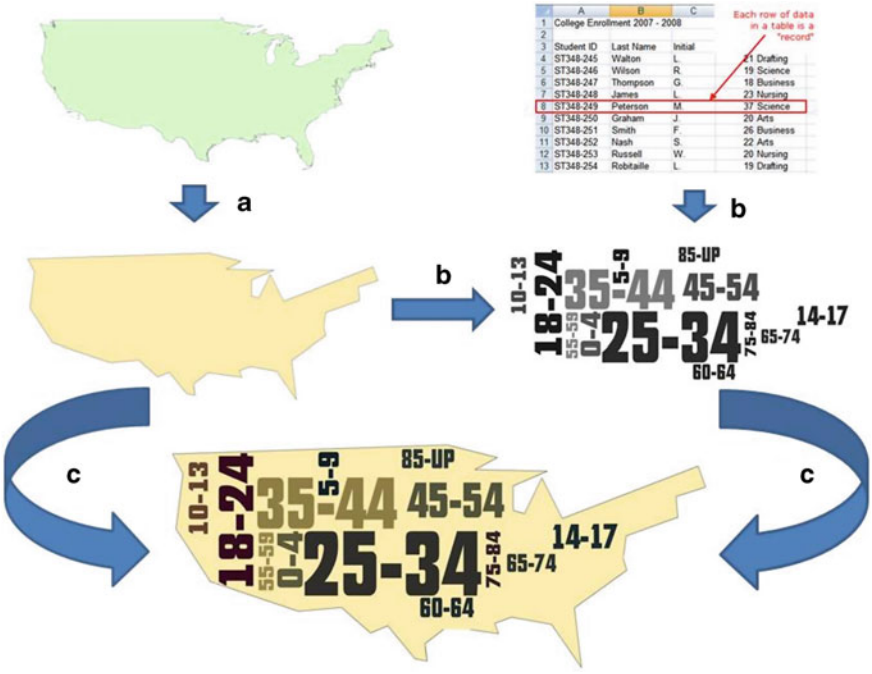

Fig. 5 The generation process of a tagged map representing the USA population partitioned in age classes

generates the tag cloud. The API takes an XML file as input parameter, containing the derived simplified map boundary and the calculated tag weight function, and returns an SVG file. As shown in Figure 5b, the cloud assumes the shape of the map boundary. Finally, as shown in Figure 5c, the *Data Representation* module has been implemented to merge the SVG version of the simplified map boundary and the tag cloud in order to derive the resulting map. Such a module is also useful to allow the user to customize the output map by modifying some graphic parameters, such as fonts, colours and angles.

5 Final Remarks

In this paper we proposed a GeoVis method able to produce a generalized map containing a georeferenced cloud of tags, in order to provide the user with an overview of data distribution and classification, significant for a territory in a specific domain. As future work, we first plan to improve the *Cloud Creation* module in order to embed a customized version of the algorithm for the cloud generation. Moreover, we aim to enhance the *TaGaMap* prototype to support visual analytics tasks, such as investigation of a spatio-temporal phenomenon by

interactively querying data underlying tags. In particular, the goal is to create an interactive map which allows users to zoom, pan and query data according to Shneiderman's Mantra, namely O*verview first, zoom and filter, then details on demand*. Finally, we plan to test effectiveness and usability of the system by designing and performing an usability study with potential users.

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Hand-Drawn Diagram Recognition with Hierarchical Parsing: An Experimental Evaluation

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Abstract This paper presents the evaluation of a parsing strategy for the recognition of sketched diagrams. The architecture of the recognition system consists of three hierarchically arranged layers where the user' strokes are first segmented and interpreted as primitive shapes, then by exploiting the domain context they are clustered into symbols of the domain and an interpretation of whole sentence is given. The experimental results achieved in the domain of UML class diagrams demonstrate good performances in terms of recognition accuracy.

1 Introduction

Hand-drawn sketches are a valuable tool of the early design process and of creative design for many different domains allowing users to quickly draw new technical solutions and effectively communicate them to a variety of audiences. The diffusion of different hardware devices supporting sketch-based input to computer applications has increased the interest in the creation of computer software that works exclusively on freehand drawings [5, 7, 10].

The sketchy graphic objects are usually not easy for machines to understand and process. In particular, the problem of recognizing the symbols in the hand drawn user's diagrams is particularly difficult since the symbols of a sketched diagram can be drawn by using a different stroke-order, -number, and -direction. For example, the border of a class symbol can be drawn as a single pen stroke (see stroke s_3 in Fig. 1), or as two or more separate strokes (such as strokes s_4 and s_5 in Fig. 1). Alternatively, a single pen stroke can contain multiple shapes, such as stroke s_6 in Fig. 1 representing an association symbol (the horizontal arrow) and the border of a

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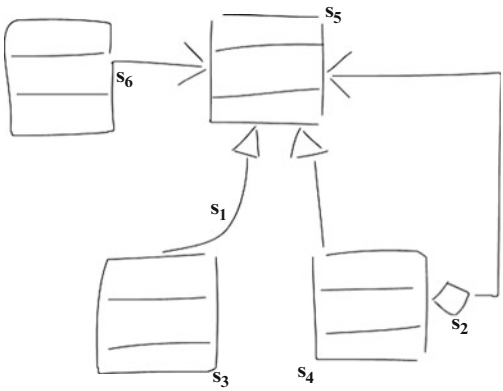

Fig. 1 A sketched class diagram

class symbol. The difficulties in the recognition process are also increased by the lack of precision and the presence of ambiguities in messy hand-drawn sketches.

This paper presents the evaluation of a parsing strategy for the recognition of multi-domain hand-drawn diagrams and a grammar formalism to enable domain experts to obtain sketch recognizers for new diagrammatic languages [3, 4]. In particular, starting from a grammatical specification hierarchically describing both the symbols' shapes and the abstract syntax of diagrammatic notations [2] the approach allows to obtain efficient recognizers based on LR parsing techniques [1]. These recognizers form the top layer of the sketch recognition system for a diagrammatic notation, while the bottom layer consists of a domain-independent primitive shape recognizer.

The effectiveness of the proposed approach has been tested in a variety of application domains, such as family trees and diagrams for user interface design. Here we present the results achieved in the domain of UML class diagrams. A significant recognition accuracy improvement is obtained when comparing the proposed recognition approach with a non-hierarchical parser whose disambiguation process is based on partial contextual information of the symbols. The results also demonstrate good scalability to larger drawings.

2 Overview of the Sketch Recognition Approach

Accurate sketch recognition requires clever techniques to resolve inherent interpretation ambiguities. As an example, the recognition of symbols from hand-drawn gestures is not independent from the analysis of the structure in which they are recognized. Indeed, the recognition of a sketched symbol is significantly influenced by the objects surrounding it. Thus, the contextual information around the ambiguous parts can be used for solving ambiguities in the sketches.

The recognition approach proposed in [4] exploits the context provided by grammars during the recognition of sketched ink. For example, when a recognized

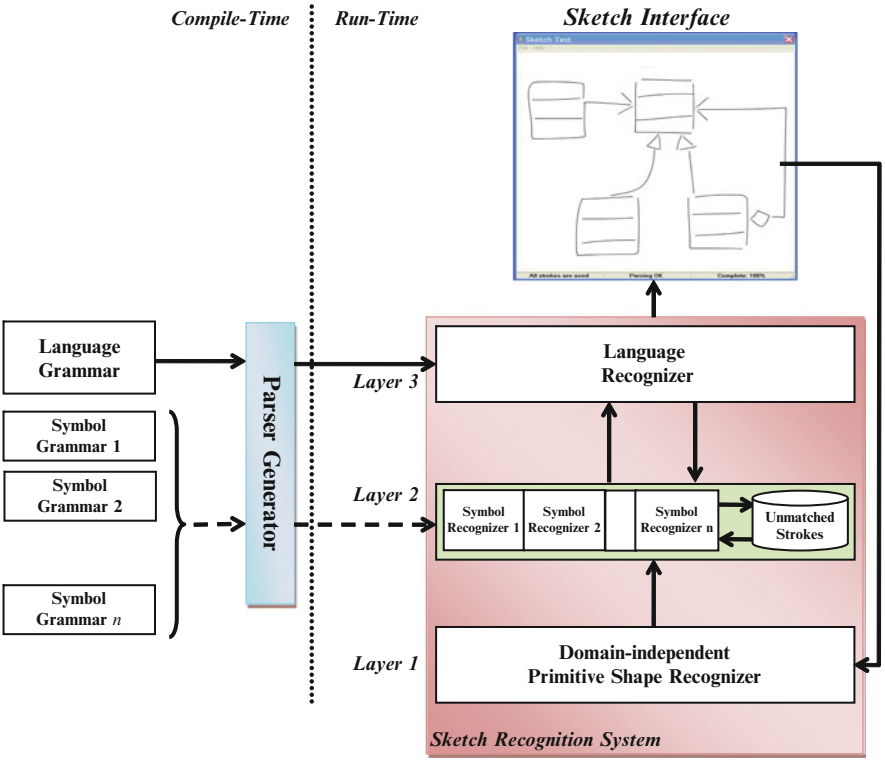

Fig. 2 The process of generation of the sketch recognition system

symbol is unique to a context then the recognizer uses this symbol to determine the context and thereby resolve other pending symbol recognition ambiguities. Moreover, the recognition process focuses on the shape of the strokes as opposed to other features, such as drawing speed and size.

As shown in Fig. 2, the process of definition of a sketch recognition system starts by specifying a grammar for each symbol of the domain language [3]. Successively, it is specified a grammar modeling the abstract syntax of the language, i.e., the possible relations among the symbols. For each one of these grammar specifications the Parser Generator constructs the corresponding recognizer.

The recognition process consists of three phases. First the strokes are interpreted as primitive objects, such as lines, arcs, ellipses, etc. In particular, to support the recognition of multi-stroke symbols the strokes to be classified are suitably split into single-stroke segments and classified by using suitable fitting functions: least-square fitting to fit a fragment into a line segment [11] or an elliptical arc [6]. Then, the symbol recognizers cluster the primitive objects in order to identify possible domain symbols. In particular, when a symbol recognizer is able to parse a new stroke, it gives as output the new status of the symbol, which can be partially or completely recognized. The strokes not parsed by a symbol recognizer are

temporarily stored in its unmatched strokes repository. This repository contains both graphical and classification information of each unparsed stroke. Finally, the language recognizer analyzes these candidate symbols produced by the symbol recognizers, prunes some of the symbol interpretations according to the recognition context, interacts with the symbol recognizers to force the recognition of incomplete symbols, and selects the most suitable interpretation.

3 Recognition Accuracy Evaluation

To evaluate the effectiveness of the proposed recognition system we have run a user study in the domain of UML class diagrams.

3.1 Experiment Setup

We recruited 20 subjects with basic knowledge of UML Diagrams and with little experience using sketch-based interfaces. They took a lesson of 10 min to learn the principles of drawing by sketches and we introduced them the main features of the drawing tool, included the multi-stroke symbol recognition capabilities.

We asked to the subjects to use the system for some minutes until they felt comfortable with it and with the pen based input device. Then we gave them the five class diagrams (in the following indicated with D1,. . ., D5), which they had to draw in an unconstrained fashion. We collected 100 sketches of varying complexity containing between 22 and 94 strokes and between 5 and 17 symbols. The subjects knew that they were not being timed and that they were able to erase strokes during the editing process only by using the undo operation.

Since the direct comparison with previous work is difficult, to measure the benefits of our approach we use as a baseline the bottom–up approach presented in [3]. This approach combined low-level shapes into language symbols by using a single monolithic LR-based parser for the domain language. The interpretation of the sentence was done by selecting the symbol interpretations that cover the higher number of strokes with a reasonable percentage of accuracy.

We conducted our experiments on a Tablet PC with a 1.73 GHz processor, 1 GB RAM, and Windows XP (Tablet PC Edition 2005).

3.2 Results and Discussion

We have measured the recognition performance of the system for each class diagram by determining the number of correctly identified symbols in each sketch. In particular, the recognition effectiveness has been measured by considering the precision and recall metric [9].

Table 1 Confusion matrix for the class diagram symbols

Shapes		Recognized						Recall
		Class	Package	Association	Aggregation	Composition	Inheritance	
Drawn	Class	**455**	5	22	9	2	1	0,95
	Package	0	**78**	7	1	0	0	0,98
	Association	0	0	**84**	9	2	8	0,84
	Aggregation	3	0	3	**51**	3	3	0,85
	Composition	0	0	2	8	**48**	2	0,80
	Inheritance	0	0	12	6	0	**142**	0,89
Precision		0,99	0,94	0,65	0,68	0,91	0,92	

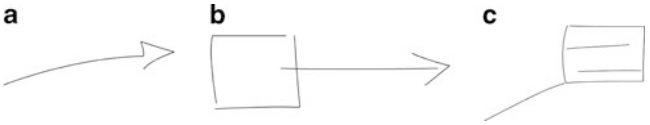

Fig. 3 Examples of sketched symbols misrecognized by the proposed approach

The confusion matrix depicted in Table 1 shows the types of errors made by the system. The rows contain the interpretations obtained for the drawn symbols, while the columns indicate the instances (mis-)recognized for a given symbol. As an example, the Inheritance row indicates that 142 out of 160 Inheritance symbols drawn are correctly recognized, 12 have been misrecognized as Association, and 6 have been recognized as Aggregation. Whereas the Package column indicates that 83 Package symbol instances have been recognized, 5 of which are false positives since they should be recognized as Class symbols. Thus, a number in the matrix indexed by (row, column) indicates how many times a row symbol is misclassified as a column symbol. The correctly recognized symbols appear on the diagonal.

From the matrix we can see that many of the errors are due to confusing different views of the same structure. In particular, Associations are often confused with Aggregations and Inheritances, and have the lowest precision and a low recall. This is mainly due to the (single-stroke) drawing of sloppy arrows by users (such as in Fig. 3a), which inhibit the parser to solve the ambiguities by using contextual information. The same issues occur for Aggregation, Composition, and Inheritance symbols.

Classes and Packages are the shapes which exhibit the highest recognition rate. This is due to their structure, which presents unambiguous features, and to the context defined by the abstract syntax of the language. In four cases a Class has been misrecognized as a set of Association symbols. This happened when users drawn the Class symbol as a messy square with syntax errors, such as in Fig. 3b. In 11 cases a class has been misrecognized as Aggregation or Composition. This occurred when the drawn class is messy and an association symbol is drawn on its corner, such as in Fig. 3c where the Association and the Class symbols are misrecognized as a Composition.

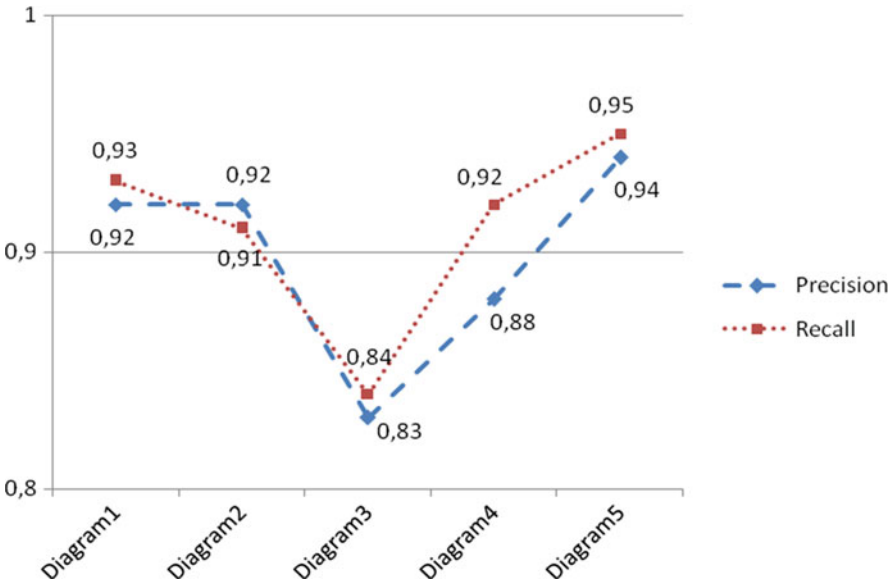

Fig. 4 Precision and recall by diagram

Figure 4 shows the precision and recall values by diagram. We can observe that there is no dependence between the size of the diagram and the precision and recall measures. This is due to the fact that the execution of a symbol recognizer is independent from the others; as a consequence the failure of a parser does not affect the performances of the other parsers considerably. Moreover, the pruning activities performed by the language recognizer allow the approach to limit the number of active parsers. On the other hand, we have obtained the worst performances on D3. This is mainly due to the low quantity of contextual information to be used for ambiguity resolution.

Tables 2 and 3 report the recognition rates of the baseline system (BL) and of the proposed multi-layer algorithm (ML). The latter performs consistently and notably better than BL system. Indeed, on average the BL system correctly identifies 79% of the symbols while ML correctly identified 90%. The recognition improvement obtained with the proposed approach is lower on Class symbols because we already obtained good performances with the BL system.

We also examined running time to determine how it scales with the number of strokes in the sketch. Figure 5a–e depict the average processing time for each stroke added to each sketch from diagram D1 to diagram D5. We have also depicted the processing time with the worst mean value.

In general the processing time scaled well as the number of strokes increased, but in some cases the performances get worse. In particular, we can observe a relationship between running times and recognition performances. Indeed, the worst performances have been obtained on diagram D3. This increase in processing

Table 2 Recognition rates for the baseline system (BL) and the proposed algorithm (ML). The size column indicates the number of strokes in each sketch

Diagram	Size	#Symbols	% Correct	
			BL	ML
D1	25	5	0,84	0,92
D2	35	6	0,79	0,92
D3	50	9	0,71	0,83
D4	60	10	0,74	0,88
D5	90	17	0,84	0,94
Total	52	9,4	0,79	0,90

Table 3 Recognition rates by shape

Symbol	Total	% Correct		#False positives	
		BL	ML	BL	ML
Class	480	0,98	0,99	10	3
Package	80	0,72	0,94	24	5
Association	100	0,44	0,65	97	46
Aggregation	60	0,52	0,68	51	23
Composition	60	0,77	0,91	13	5
Inheritance	160	0,85	0,92	26	13

time was due almost entirely to increase in the number of active parsers, which the system was not able to prune for the high number of misrecognized symbols.

Another interesting observation comes from looking at the trend of the time curves. The peaks in the curves represent the execution of the pruning operations, which need an extra computational time but allow to considerably reduce the recognition performances of the following strokes due to the reduced number of active recognizers.

4 Conclusions

We have presented the evaluation of a grammar-based parsing strategy for multi-domain hand-drawn diagram recognition. The recognition system consists of three hierarchically arranged layers that include context-based disambiguation and ink parsing. The performance of our approach has been analyzed in the domain of UML class diagrams. Even though multi-domain sketch recognition approaches are difficult to compare in their performance (mainly due to no standardized test corpus of annotated sketches as for pattern recognition; a first attempt has been presented in [8]) the obtained results clearly show the effectiveness of our approach and demonstrate good scalability to larger drawings.

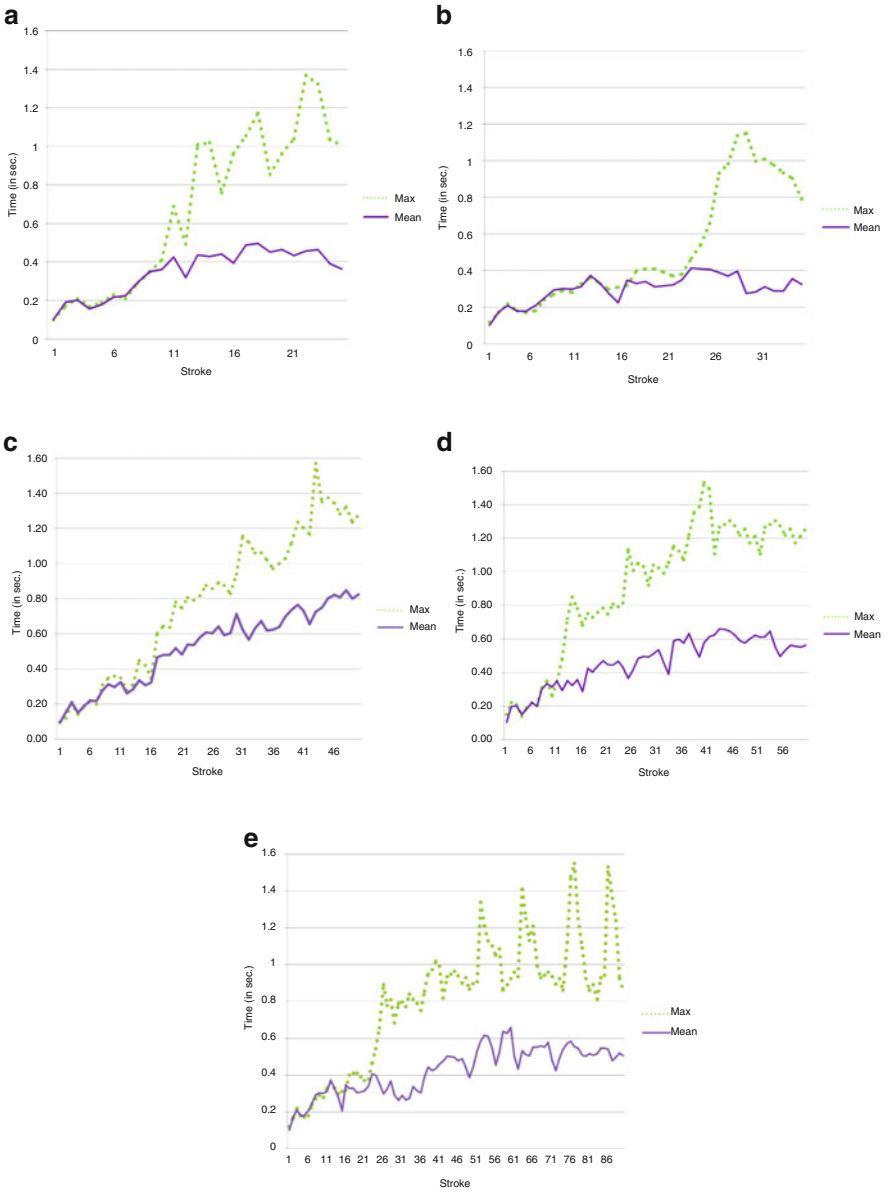

Fig. 5 The average and max incremental time it takes the system to process each stroke in class diagrams D1(**a**), D2(**b**), D3(**c**), D4(**d**), and D5(**e**)

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Part V
Information Systems, Innovation Transfer, and New Business Models

Innovation in Business Processes: Pattern-Driven Process Modelling

Pasquale Ardimento, Nicola Boffoli, Danilo Caivano, Daniela Castelluccia, and Giuseppe Visaggio

Abstract The globalization of the market has provided new challenges to small and large enterprises: the high dynamism of the business environment directly affects the consistency of business processes and the overall enterprise responsiveness. Therefore business processes, although complex, have to be highly flexible to react to new demands, in order to turn changes into opportunity in terms of process innovation and business competitiveness. This work faces this challenge and provides an approach to support business process management by means of a flexible process modeling related to the business environment. Such approach is able to manage the high variability of the environment parameters affecting the processes in use: process patterns support flexible modeling from a methodological point of view as they allow to represent the relationships between contexts and solutions; decision tables are the implementative support to the pattern theory. Furthermore, we discuss the experience of the proposed approach in a real case. Results are encouraging and drive further investigations in such a way.

1 Introduction

Due the spread of Internet as means for new trades, advertising and customer service, the market globalization has provided new challenges to small and large enterprises: nowadays, daily they have face pressures of competition, smaller profits and needs for compliance with new regulations and business conditions; in the same time, they have to improve productivity, customer satisfaction and

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business flexibility. In this context, changes in the operating environment, may be significant as well as high frequent: for example, changes can occur in market agreements, in internal organization of human resources or technologies, in business strategies, in suppliers or partnerships with other companies, mergers and acquisitions, and so on. These are all factors that directly affect on the consistency of business processes and on the overall enterprise responsiveness [1, 2].

On the other hand, business processes, although complex, should be high flexible and reactive to fulfill quickly to changing business needs [3]. Therefore, process formalization has to be very flexible so when we model a process, we have to take into account the complexity of its relationship with the business environment.

This paper provides an approach to support the Business Process Management (BPM) [4, 5], through flexible process modeling according to the operative environment. We start from the concept that modeling a process also means modeling the environment factors influencing it. For this purpose our approach uses the well-established concept of pattern: a pattern identifies a recurring problem and the related solution and aims to capture and explicitly state abstract problem – solving knowledge that is usually implicit and gained only through experience [6].

Many research works present the adoption of a pattern-based approach to model actions performing functional requirements [7–9]. However, they lack in supporting the decision-making process of selection of the suitable patterns by means of software tools.

Furthermore, the study presented here suggests the use of decision tables as implementative support to the pattern theory: they assure compact overview of a large number of information, modular knowledge organization, effective evaluation of consistency, completeness and redundancy. These peculiarities guarantee a representation of the relationships among problems, contexts and solutions in a complete manner, without inconsistencies. Moreover, decision tables are reusable and easily maintainable. This fact increases flexibility of dynamic reengineering of the relationships among problems, contexts and solutions.

The paper is structured as following: firstly, we presents our pattern-driven modeling approach then, we discuss the application of the methodology in a real case; finally, conclusions are drawn.

2 Pattern-Driven Process Modelling

The proposed approach adapts the pattern concept to the business processes modeling: a pattern allows to find a solution (a process component) able to model a given problem (a part of a process to be modeled) according to the specific context where the solution is performed [10]. In particular, we mean for:

– “Problem”: the part of a process to be modeled, by means of a general process component (general solution)

– "Context": the set of factors characterizing the operating context (i.e. technologies, industrial standards, budget, tools, cultural factors), whose values determine the suitable actions to specialize the general solution;
– "Solution": the process component suitably specialized solving the problem in that specific context.

A typical scenario consists of modeling a problem in a specific context starting from a general solution and identifying a set of appropriate actions to specialize the solution. Such actions can have influence on the activities, the artifacts or the control flow of the general solution, in fact, they can: add new activities, specialize existent activities, modify artifacts, modify control flow.

In details, the proposed approach consists of two steps:

– *Problem Step*: from a specific problem to a general solution modeling it.
– *Context Step*: from a general solution and a specific context to a specialized solution solving the problem in that context.

Problem Step. Given a problem, we have to find a general solution modeling it. If we call P the set of the problems, to which a general solution is related to and if we call GS the set of the general solutions themselves, we define the function:

$$\varphi : \ P \rightarrow GS, \forall p \in P : \varphi(p) = gs$$

where φ is able to select the general solution gs solving the problem p.

Context Step. Many factors (here called diversity factors) characterize a context: business environment, technology, industrial standard, quality program, vision, budget, size, structure and culture of enterprise. These factors have an influence on processes and must be taken into account when we model them. So, after having identified the suitable combination of diversity factors able to characterize the context, we can define a specific context (here called context profile) assigning a value to each diversity factor.

A set CP of context profiles is associated to each gs$\in$GS because the general solution can be specialized according to several operating contexts. A context profile characterizes a specific context and can be represented as a vector of instantiated diversity factors DF_i i = 1, . . ., n. Each DF_i is a factor characterizing a particular aspect of the context and has a definition domain $[DF_i] = \{df_{i1}, df_{i2}, \ldots, df_{iq}\}$ where each df_{ij} j = 1,. . .q is an instance of DF_i. So we can say that the set CP is:

$$CP = [DF_1] \times [DF_2] \times ..... \times [DF_n]$$

$\forall$gs$\in$GS given a context profile, we have to identify the set of the actions able to specialize gs according to that specific context profile. If we call SA the set of the actions to specialize gs, and SAS the set of all the possible combinations of specializing actions, we define:

$$\chi : CP \rightarrow SAS; \forall cp \in CP : \chi(cp) = sas, \text{with } sas = \{sa_1, \ \ldots, \ sa_r\}$$

where χ is the function that, given a context profile, determines sas the set of specializing actions corresponding to the specific context profile.

In conclusion, for each general solution gs it is possible to define a function χ to suitably specialize this process component according to the context where it works.

The pattern-driven approach is then implemented through decision tables.

2.1 Decision Table Implementation

A decision table is a tabular representation of a decision-making task, where the state of a set of conditions determines the execution of a set of actions [11, 12]. In general, a decision table has four quadrants: conditions (Cond), states (S), actions (Act) and rules (x) as shown in Fig. 1. The table is defined so that each combination of conditions and states corresponds to a set of actions to carry out.

At this level, we implement the functions φ, χ through suitable decision tables: Problem Decision Table (DTp) and Context Decision Table (DTc)

Problem Decision Table. For each function φ a DTp is implemented and structured as following Fig. 2:

- The CONDITION quadrant contains the problems domain
- The STATE quadrant contains the possible problem in the specific domain
- The ACTION quadrant contains
  - The general solutions available
  - A set of links to more specific DTp in order to investigate more problems
- The RULE quadrant identifies the relationship between each faced problem and the corresponding general solution or the link to a more specific DTp.

Context Decision Table. For each function χ a DTc is implemented and structured as following Fig. 3:

- The CONDITION quadrant contains the diversity factors DF_i $i = 1,\ldots n$ specializing the related general solution gs
- The STATE quadrant contains the possible value of each diversity factor: $[DFi] = \{df_{i1}, df_{i2}, \ldots, df_{iq}\}$

$Cond_1$	S_{11}				S_{12}			
$Cond_2$	S_{21}		S_{22}		S_{21}		S_{22}	
.....	... ...							
$Cond_N$	S_{M1}	S_{M2}	S_{M1}	S_{M2}	S_{M1}	S_{M2}	S_{M1}	S_{M2}
Act_1	-	-	-	-	x	x	x	x
Act_2	-	-	-	-	-	-	-	x
.....	... ...							
Act_M	-	x	-	x	-	x	-	x

Fig. 1 An example of decision-table

Fig. 2 An example of DTp schema

Problems	P_1	P_2	P_3	…	P_t
gs_1	x	-	-	…	-
gs_2	-	x	-	…	-
gs_3	-	-	-	…	x
…….	-	-	-	…	-
gs_s	-	-	x	…	-

Fig. 3 An example of DTc schema

DF_1	df_{11}				df_{12}			
DF_2	df_{21}		df_{22}		df_{21}		df_{22}	
…	……							
DF_n	df_{n1}	df_{n2}	df_{n1}	df_{n2}	df_{n1}	df_{n2}	df_{n1}	df_{n2}
sa_1	-	x	x	-	x	-	x	x
sa_2	x	-	x	-	-	x	-	x
.....	.....							
sa_r	-	x	-	x	-	x	-	x

- The ACTION quadrant contains
  - All the possible actions specializing the general solution gs
  - A set of links to more specific DTc in order to investigate specific contexts
- The RULE quadrant identifies the relationship between each context profile and corresponding specializing actions and links to more specific DTc.

Based on these definitions, we can highlight the strength of the decision tables: they allow to formalize decision models with many interrelated conditions that can be automatically verified for correctness and completeness. The number of conditions is only limited by human capabilities during the design of the decision tables: the semantics of the contents of a table can be checked by its designer, within certain limits of complexity.

3 Industrial Case Study

The proposed approach has been investigated in an industrial case during a research project. This project investigated the management of business processes about the "Data Archiving Management and Acquisition".

The enterprise collaborating to the realization of this experimentation is a ICT company, whose core business is about document management solutions for public and private financial institutions. Every day the company receives packets of documents from its clients. Such documents are primarily banking files containing pure text, images, diagrams, charts and so on. Because of the high number of documents to be stored, the enterprise needs the implementation of automated

Table 1 A summary of extracted items

General Solution (GS)	#DF	#SA
Consulting	6	7
Documents organizing	7	9
Documents reception	6	7
Documents recognizing	3	4
Indexing and verifying	6	8
Optical archiving	7	8
Physical archiving	5	7
Scanning	5	8
Total	**47**	**60**

processes able to scan every document in the packets, recognize errors in words, discern images from pure text and store everything according to their category.

Firstly, a *start-up analysis* has been conducted on the eight processes in use within the enterprise in order to: identify the general processes and the related general solutions (GS); organize and formalize, for each general process, the appropriate diversity factors (DF) affecting it; elicit the specializing actions (SA) for each process specialization; relate problems, diversity factors and specializing actions.

The Table 1 summarizes the extracted items ordered by the general solutions.

All the collected items have been used to build a *Decision Tables Set*. Such set is made of: 1 DTp, managing all the general solutions; 8 DTc, one DTc for each general solution. Using 9 decision tables the approach was able to handle 8 different general solutions, characterize them through 47 diversity factors, modify them using 60 specializing actions and obtain 88 specialized solutions.

Later, a case study investigation is started in order to evaluate the effectiveness of the approach to quickly adapt the processes in use according to the environment changes. In this section, for space reasons, a specific part of the case study is presented. In particular a part of the business process *Document Recognizing* is discussed. Such part is representative of two different kinds of events that may affect a business process in use: *expected change*, faced through "pattern" peculiarities; *unexpected change*, managed through "decision tables" properties.

In the *Document Recognizing* field a general process component is provided. It represents the general solution gs of this kind of problems. According to gs an appropriate DTc is build and adopted (Fig. 4). This table aims to support all the possible specialization. The table illustrates the possible causes of context variability represented by a diversity factor (DF) as: *Document Type*, *Writing Type* and *Document with Images*. Therefore we can identify the actions needed to properly specialize the general process gs according to the possible values of the diversity factors. Moreover, the DTc identifies the appropriate actions to obtain the final specialized solutions; the number specified beside each action suggests the sequence of the actions when performing (i.e. in Fig. 4 the action *Add "Layout Analysis"* should be executed before the other ones).

At first, the type of banking documents to be elaborated and stored was like structured and typewriting documents without images. Such values represent the

Document Type	Structured				Unstructured			
Writing Type	Typewriting		Handwriting		Typewriting		Handwriting	
Documents with Images	Y	N	Y	N	Y	N	Y	N
Add "Layout Analysis" (1)	X	X	X	X	-	-	-	-
Specialize "OCR" in "OCR Typewriting"(2)	X	X	-	-	X	X	-	-
Specialize "OCR" in "OCR Handwriting"(2)	-	-	X	X	-	-	X	X
Add "Image Extraction" (2)	X	-	X	-	X	-	X	-

Fig. 4 DTc supporting the "Document Recognizing" gs

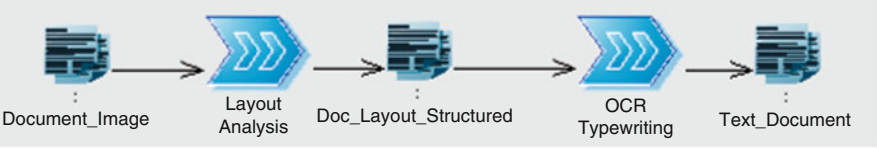

Fig. 5 Specialized solution

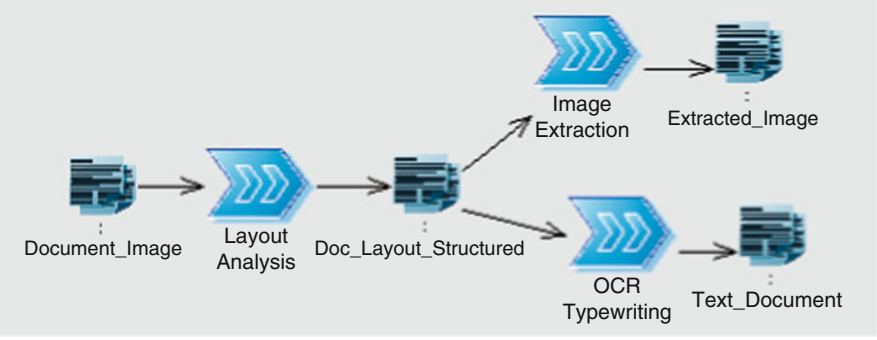

Fig. 6 New specialized solution

context profile that generates, by the means of the related DTc, the extraction of the following actions: *Add "Layout Analysis"* and *Specialize "OCR" in "OCR Typewriting"*. The specialized solution is built and used (Fig. 5).

After just 6 months, a business intelligence strategy suggested to manage also images inside the documents. Such change was expected and planned, according to the Pattern-Driven Model, in the Decision Tables Set. Therefore this change is mainly faced through pattern model and then it implies just a new browsing of the tables set. In fact a new context profile is considered (now we consider diversity factor *Document with Images* = *Y*). The result of the DTc is represented by the following actions: *Add "Layout Analysis"*, *Specialize "OCR" in "OCR Typewriting*" and *Add "Image Extraction"*. A new specialized solution is built and used (Fig. 6).

Document Type	Structured								Unstructured							
Writing Type	Typewriting				Handwriting				Typewriting				Handwriting			
Documents with Images	Y		N		Y		N		Y		N		Y		N	
Formal Control	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
Add "Layout Analysis" (1)	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-
Specialize "OCR" in "OCR Typewriting" (2)	X	X	X	X	-	-	-	-	X	X	X	X	-	-	-	-
Specialize "OCR" in "OCR Handwriting" (2)	-	-	-	-	X	X	X	X	-	-	-	-	X	X	X	X
Add "Image Extraction" (2)	X	X	-	-	X	X	-	-	X	X	-	-	X	X	-	-
Add "Formal Control" (3)	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-

Fig. 7 Updated DTc (adding "Formal Control" diversity factor)

Eight months later, a new type of banking order required a formal control activity in order to verify the text content after the recognizing phase. Such unexpected diversity factor requests in the Decision Tables Set a reorganization of the relationship between the general solution "gs" and all of the possible specializations, also by adding the variants referred to the introduced diversity factor. The decision table formalism supports the impact of such changes through the updating of DTc: the DTc is updated adding one row for the diversity factor *Formal Control* and one row for the specializing action *Add "Formal Control"* (Fig. 7).

After the tables updating, the DTc is consulted and the result is represented by the following actions: *Add "Layout Analysis"*, *Specialize "OCR" in "OCR Typewriting"*, *Add "Image Extraction"*, *Add "Formal Control"*. These actions compose the new set of specializing actions and a new specialized solution is built and used.

In synthesis, within 1 year and a half, the enterprise has been able to opportunely reengineer business processes and quickly adapt them according to two context changes.

4 Conclusion

This paper faces the innovation in business processes and provides a pattern-driven modelling approach able to manage the variability of the context parameters through decision tables, that allow to formalize many relationships between contexts and process components.

This approach was tested in a real context: the involved ICT company was able to analyse its legacy processes, to identify patterns and diversity factors, to adapt the processes according to the occurred context changes. The company was able to manage both expected and unexpected changes respectively just browsing or reorganizing the *Decision Table Set* with the correct relationships between processes and the context factors, also by adding the solutions referred to an unexpected diversity factor. Therefore through the proposed methodology, the company was able to increase business flexibility and constantly guarantee reliability, correctness and completeness. However, we will focus on more experimentation for collecting more empirical results to validate our approach.

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Methodology of Business Ecosystems Network Analysis: A Field Study in Telecom Italia Future Centre

Cinzia Battistella, Katia Colucci, and Fabio Nonino

Abstract The scope of this chapter is the analysis of business ecosystems as reticular structures interacting one with each other. The aim is to propose a methodology for analyzing and modeling the ecosystems and to illustrate its application via a field study conducted in Telecom Italia Future Centre, and in particular the Digital Imaging Ecosystem. The methodology is called methodology of business ecosystem network analysis (MOBENA). The methodology helps in drawing the shape and relationships among the constituent elements but also in taking into account the interrelated impacts and a dynamic picture by monitoring the trends.

1 Introduction

Today's dynamic and complex environment requires a higher level, network view of inter-organizational exchanges at both the conceptual and practical level. The Value Chain [1] and the Value Network [2] models are concepts focused on the

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value creation process of the firm, instead the Business Ecosystem [3] concept is useful to understand complex inter-firms relationships which form the background of the value creation process. In fact, the success of a business ecosystem lies in the combination of efforts from business, government, education, and all segments of the *community*. The cultural and two-sided interactions between actors of a community sharing the same values and especially the same interests have the implicit objective of long-term sustainability of the whole community. While value chains are based on volatile supplier/buyer relationships, the business ecosystems are based on a network of multi-directional relationships with firms with shared values and interests. The relationships are both monetary and not monetary, and the winners are those actors who can leverage *network externalities*. Whereas value chains are essentially defined by the accumulated value generated by monetary relationships, business ecosystems are also defined by the non-monetary advantages derived by firms participating in them. Therefore, a business ecosystems growth depends also on the quality of the non-monetary, qualitative interactions among stakeholders. These interactions create something intangible that is shared by all participants, the *social capital* [4, 5]. Networks, common norms, shared values and trust, comparable expectations, brought forth in cooperation and business relationships, create a web of social relations that have productive benefits by facilitating coordinated actions. While value chains create value, business ecosystems generate value and social capital, resulting in a long-term and sustainable relationships. If a company would like to know the complex dynamics intercepting it and/or if it would like to enter and act in an ecosystem, it has to rely on a deep knowledge and analysis of the ecosystem itself. It is a matter of identifying and describing the ecosystem components, the relationships between them and the balance of power that guarantees their existence. All these elements together define the shape and behaviour pattern: how the ecosystem "lives". Moreover, also the time variable is fundamental: the relationships between the constituent elements may change the ecosystem structure. So, understanding the ecosystem means not only drawing the shape and relationships among the constituent elements in a certain moment in time, but understanding how it can evolve by monitoring the evolutionary trends with all the variables involved. It is thus important that companies establish monitoring processes for their ecosystem from a static and dynamic point of view, and that they analyse business ecosystems and investigate how it can potentially impact their businesses. Clearly, these analyzes need to be supported by appropriate tools and methodologies to work on. But, despite the importance of the practical application of the business ecosystem concept as a representation of the real situation, literature on methodologies for business ecosystems is still in its infancy, while the majority of the contributions are focused on the discussion of business ecosystems per se (i.e. comparisons between natural ecosystems and business ecosystems, differences between value chain and business ecosystem, business ecosystems properties, their strategies, etc.). The scope of this research is the analysis of the business ecosystems, as reticular structures interacting one with each other. The aim is to propose a methodology for analyzing and modeling the ecosystems and to illustrate its application in a field study

conducted inside the Telecom Italia Future Centre. The methodology is called *methodology of business ecosystem network analysis (MOBENA)*.

The chapter, after a discussion of the current literature on business ecosystems (Sect. 2), presents the field study methodological strategy (Sect. 3) and introduces the MOBENA and its application in a peculiar business ecosystem in Telecom Italia, the digital photography ecosystem (Sect. 4). Finally, we discuss the findings and draw conclusions (Sect. 5).

2 Modeling Approaches of Networks and Ecosystems

Various approaches have been proposed to create a modeling language for firm interactions. In the view of Value Network, different modelling approaches have been proposed, as the e3-value model [6], the c3-value [7] and the value network's model of intangibles [2]. In the view of business ecosystems analysis, we found some first works all based on agent-based modelling [8], such as the Business Ecosystem Analysis Methodology (BEAM) [9]. The following table (Table 1) shows a synthetic description of such methodologies and the elements of critique overcome by our methodology. The methodologies for business ecosystems are very few. The main problems that we highlighted are that these methodologies often over-simplify the problem and limit potential for strategic analysis.

Table 1 Modeling approaches of value networks and business ecosystems

Model or methodology *Object investigated*	Critiques
e3-value modeling *Value network (theoretical basis: industrial view)*	Lack of a clear strategic focus in the model weakens its ability for prescriptive strategic insights
c3-value model *Value network (theoretical basis: resource-based view)*	It focuses on the direct competitor and the direct customer; It neglects the inter-dependencies and the potential given by the network perspective
Value network model of intangibles *Value network*	Analysis is mostly visual; It assumes that value is created through exchanges; It is focused on intangibles exchanges; It does not assign a purpose to the network; It assumes that the network is not manageable; It limits potential for strategic analysis
Agent based methodology *Business ecosystem*	Focused only on tangible exchanges
BEAM: business ecosystem analysis and modeling *Business ecosystem*	Lacks of a strategic focus

3 Research Strategy

The present work is meant to help widen the knowledge basis on management of ecosystems and proposes a methodology based on network analysis and foresight. This research attempts to answer to the following research questions: *How is it possible to systematically study the structure and fluxes of a business ecosystem?*

Increasingly, the technological innovations headed by ICT and TLC go beyond the value chain where they have been originated to attract the interest of other value chains which are so far remote, with different actors, interests and market objectives. Therefore actors interact now in a business ecosystem. In this new context, previous business models can change and latent or even not existing markets (and consequent business models) can emerge. That is why we decided to focus our research on the TLC industry. Moreover, we took an exemplar case: the most important TLC company in Italy, Telecom Italia (and in particular its unit focused on economical studies and investigation of the future, the Telecom Italia Future Centre). Among the ecosystems studied by the Future Centre, we chose to focus on the digital imaging ecosystem. The research methodology includes an analysis of literature on Strategic Management, Network Analysis and Foresight, from whence the theoretical proposal of the *methodology of business ecosystem network analysis (MOBENA)* was born. The case study design is opportune for presenting a relevant overview of the importance and applicability of the methodology [10]. *The object of the case study is the test of the proposed methodology of business ecosystem network analysis.* The case study research design can be used to describe an intervention and its context [11]. Some authors refer to this as a "field experiment". In the test in this study, the intervention is the application of the proposed methodology, and the context is the company studied and in particular one of its ecosystems (the digital image ecosystem).

4 A Proposal of a Methodology for Business Ecosystems Analysis

The methodology aims to provide a theoretical and operational framework for analyzing the business ecosystems. It is designed to support the identification and understanding of the business ecosystems by providing the criteria to define its structure and analyze and evaluate the relevant behaviour. The methodology is based on four steps. Table 2 synthesises the four phases, giving a brief description of objectives, contents and deliverables.

Table 2 MOBENA phases

Phase and objectives	Content	Deliverable
	Identify the seed – the actors' attractor and the leverage for business	
	Identify the elements and their connections. Elements: players, technologies, products/services and environment (market, constraints and regulation forces)	
Ecosystem perimeter, elements and relationships	Players: (1) revenues, employees, EBITDA, investments, cash flow, (stock, trend, cagr, expected trends) (2) share trends, market capitalization (3) geographical presence (4) current market positioning and strategy (5) research strategy	1. *Technology workbook*
Define the meaning of the ecosystem, decide what identifies it and identify what defines its boundaries	Technologies	*2. Players informations*
	Products/services: (1) service concept (2) biz model (3) economics: users, revenues, margins, Cagr, ARPU	
Detail the information to be collected as regards the constitutive elements and their relationships	Environment	*3. Connection matrix*
	Relationships among actors – different kind of flows through the ecosystem: exchanged information	
	Transactions	
	Connection matrix: per each couple of variable it will be indicated: 0 – no relationship is on 1 – if a link already exists and is intangible, 2 – if a link already exists and is tangible, 3 – if a possible relation can be formed in a near future	
Ecosystem model representation and data validation	Translate in a graphical way the connection matrix: oriented graph; links and nodes characterized in a quantitative way; weight to each kind of relationship	4. *Ecosystem representation model*
Develop a representation model Obtain criteria to validate the model	Brainstorming; existing literature; research conducted by specialists from reference markets; official documents (budgets, communication to the financial community, business plans, etc.); direct contact with the actors that belong to the potential ecosystem; consulting experts in modeling complex systems	5. *Ecosystem representation model validated*
Ecosystem analysis	Ecosystem value analysis	6. *Ecosystem analysis*
	Revenues: quantify the economic dimension of the ecosystem	

(continued)

Table 2 (continued)

Phase and objectives	Content	Deliverable
Evaluation of the ecosystem's behaviours (last, current, future) and relevant key indicators	Economic structure: understand how this value is shared among the various players: physical structure, revenues attraction, attractivity, relationship, assets & technologies	
	Ecosystem control point analysis Identification of control points ("points at which management can be applied" – business strategy, regulation, and/or technology); control points constellation: put control points in a logical sequence, represent integrated control points as joined together; check for lock-in; show multiple offering outcomes if applicable	
Ecosystem evolution Simulation of different scenarios aimed to perform what-if analysis, trend analysis, classification, forecasts	List of trends and uncertainties; early signs; scenarios graph; scenarios narrative; definition of possible scenarios; list of implications and options of responses	7. *Ecosystem scenarios analysis*

4.1 Ecosystem Perimeter, Elements and Relationships

The objective of this first step is to identify the perimeter and constituent parts of the ecosystem. In the digital imaging ecosystem, the seed is the service, based on the psychology of the "management of the memories" and the "digital translation" of the reality, that permit new possibilities and functionalities for the personal sphere of the individual. Another important point for the decision about the borders of the object of observation are the constitutive elements of the ecosystem and the relationships among them. For the digital imaging ecosystem, the team[1] preliminarily identified two macro-classes of actors in the ecosystem and for each one listed the component actors and the main players:

- *Manufacturers*: class of actors connected to the consumer-electronics production, in other words the hardware part of the ecosystem; they are typically constrained to obtain cost-efficiency through scale-economies and realize high production-volumes. They are: *camera and camcorders manufacturers*, *storage manufacturers*, *printers manufacturers*, *cameraphone manufacturers*
- *Service Providers*: their offer is connected to services and not-tangible functionalities for users. They are: *on line storage providers*; *photoalbum providers; social network providers; on-line printing providers*; *mobile applications providers*; *software vendors providers*; *telco operators providers*; *retailers providers*

As regards the enabling technologies of the Digital Imaging Ecosystem, we identified these categories: *Computational photography, Sensors resolution and quality*, *Still/motion convergence, Barcode/QR Code, RFID/NFC, GPS*, *Wireless/Mobile, Metadata Exif, 3D, Digital pictures and video playback*.

The next step is the construction of the *Connections Matrix* which has the purpose to highlight the links between the constituent parts of the ecosystem. The connection matrix of the Digital Imaging Ecosystem is in Table 3.

4.2 Ecosystem Model Representation and Data Validation

The objective of this step is to develop a representative model of the ecosystem. For *nodes,* a color code is used to differentiate players who have a different role, and a code volume to differentiate the weight of each actor. A parameter for the weight factor could be the size (turnover, number of employees) where applicable. For *links*, it is necessary to classify the different types of relationships with the criteria used in the connection matrix (see Fig. 1).

[1] Examples of Digital Imaging ecosystem are taken from the workgroup in Telecom Italia Future Centre led by G. Piersantelli, www.telecomfuturecentre.it

Table 3 Digital imaging ecosystem connection matrix

	Manufacturer				Service provider								Technology									
	Camera camcorders manufacturers	Storage manufacturers	Printers manufacturers	Cameraphone manufacturers	On line storage	Photoalbum	Social network	On line printing	Mobile apps	sw vendor (editing,applet, plug-in)	Telco operator	Retailers	Computational-photography R & D player	Image recognition R & D player	Sensors resolution and quality	Still/motion convergence	Barcode/ QR Code	RFID/NFC	GPS	Wireless/ Mobile	Metadata/ EXIF	3D	Digital pictures and video playback
Cam & camcorders manuf.	–	1	2	2	1	1	1	1	3	1	3	2	3	3	2	2	0	0	2	3	1	1	3
Storage manuf.	1	–	1	1	2	2	1	1	0	0	3	2	0	0	1	0	0	0	0	1	1	0	2
Printers manuf.	2	1	–	3	0	1	0	2	0	1	3	2	1	0	1	0	1	0	0	1	0	3	1
Cameraphone manuf.	2	1	3	–	1	1	1	3	2	2	2	2	3	3	2	2	2	3	2	2	2	0	3
On line storage	1	2	0	1	–	2	1	1	1	0	3	0	0	0	0	0	0	0	0	2	0	0	2
Photoalbum	1	2	1	1	2	–	2	2	2	2	2	0	0	2	0	1	0	0	1	1	1	3	1
Social network	1	1	0	1	1	2	–	1	1	3	2	0	0	1	0	3	0	0	1	1	1	3	3
On line printing	1	1	2	3	1	2	1	–	3	1	3	2	0	0	1	0	0	0	0	1	1	1	0
Mobile apps	3	0	0	2	1	2	1	3	–	2	2	0	1	2	0	0	1	1	1	1	1	3	1
Sw vendor	1	0	1	2	0	2	3	1	2	–	0	2	1	1	1	0	0	0	1	0	1	1	1
Telco operator	3	3	3	2	3	2	2	3	2	0	–	2	3	1	1	1	2	2	2	2	2	1	1
Retailers	2	2	2	2	0	0	0	0	0	2	2	–	0	0	1	0	2	2	0	0	0	0	0
Comp. phot. R&D player	3	0	1	3	0	0	0	0	1	1	3	0	–	2	2	2	0	0	0	0	1	3	1
Image rec. R&D player	3	0	0	3	0	2	1	0	2	1	1	0	2	–	1	1	2	3	2	2	1	1	1
Sensors resolution	2	1	1	2	0	0	0	1	0	1	1	1	2	1	–	1	1	0	0	0	1	0	2
Still/motion convergence	2	0	0	2	0	1	3	0	0	0	1	0	2	1	1	–	0	0	0	0	0	3	2
Barcode/QR Code	0	0	1	2	0	0	0	0	1	0	2	2	0	2	1	0	–	1	0	0	0	0	0
RFID/NFC	0	0	0	3	0	0	0	0	1	0	2	2	0	3	0	0	1	–	1	1	1	3	3
GPS	2	0	0	2	0	1	1	0	1	1	2	0	0	2	0	0	0	1	–	2	2	2	1
Wireless/Mobile	3	1	1	2	2	1	1	1	1	0	2	0	0	3	0	0	0	1	2	–	0	0	2
Metadata/EXIF	1	1	0	2	0	1	1	1	1	1	2	0	1	1	1	0	0	1	2	0	–	3	1
3D	1	0	3	0	0	3	3	0	3	1	1	0	3	1	0	3	0	3	2	0	3	–	1
Dig. pic. & videoplayback	3	2	1	3	2	1	3	0	1	1	1	0	1	1	2	2	0	3	1	2	1	1	–

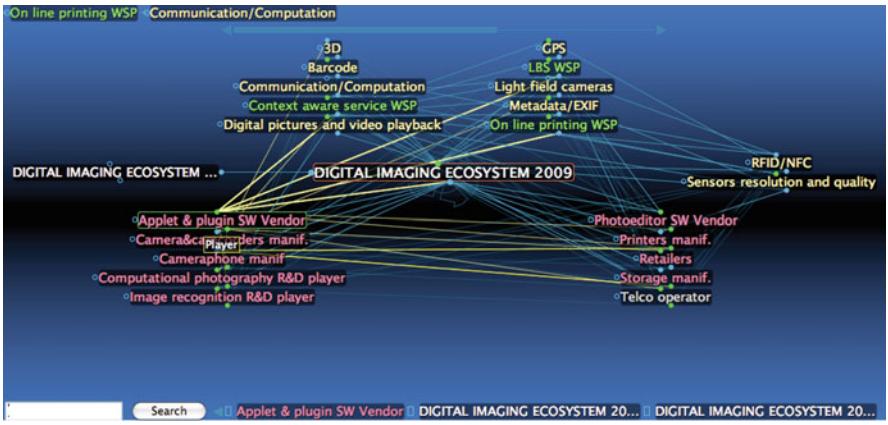

Fig. 1 Digital imaging ecosystem model representation [screenshot]

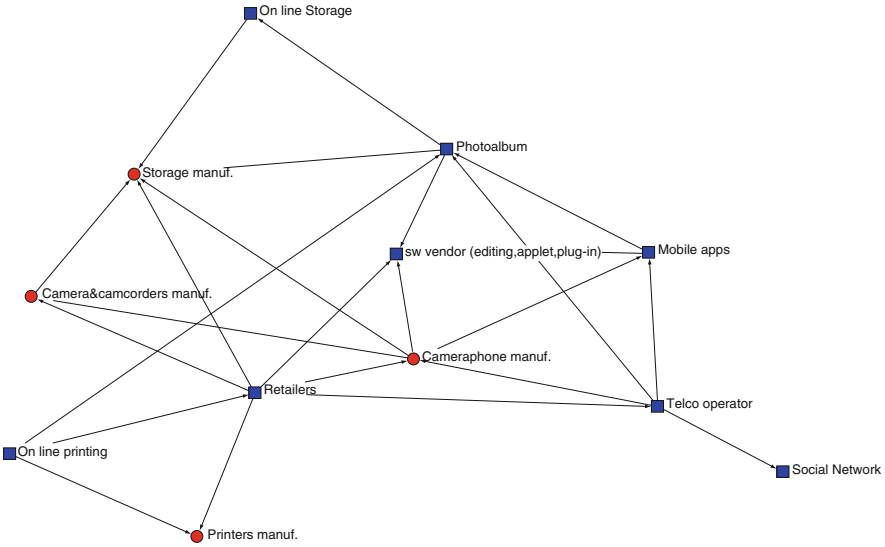

Fig. 2 Digital imaging ecosystem relationship structure

4.3 Ecosystem Analysis

The aim of this step is to analyze the behavior of the ecosystem in the past and in the present. This involves understanding how the value is distributed in each ecosystem and the best places to target the positioning strategy to capture part of this available value. This requires two separate steps: *Business Ecosystem Value Analysis* and *Business Ecosystem Control Point Analysis* (Fig. 2 shows the relationship structure

of tangible relationships. The low values of density and centralization mean a high dispersion of the money fluxes in the ecosystem and low values in the relationship structure of intangible relationships show that a attractor role with all the knowledge and the information does not exist in this ecosystem). The control point analysis identified the PC and the smartphones and mobile applications as control points of the digital imaging ecosystem. They connect and control the ecosystem in two levels: between creation and storage/modification and between storage/modification and services (online printing and online storage).

4.4 Ecosystem Evolution

In this step the possible evolutionary scenarios are studied via a foresight analysis [12]. For the digital imaging ecosystem we built a scenario analysis and a roadmap for future evolution. There are two main uncertainties (service ubiquity and information sources) that identify four main scenarios (Real Time Sharing, Image Recognition, Mobile Augmented Reality, On line backup & Sharing).

5 Conclusions

As businesses become more and more modularized, characterizing entity relationships and understanding how business decisions or actions taken by one entity impact all of the interrelated entities, both within and among enterprises, become a key challenge. Ignoring these interactions can lead to unexpected and potentially undesirable outcomes. Tools that help to systematically characterize the business ecosystem (or network) and analyze the potential impact of different business decisions on each entity in the network are essential for improving business design. The knowledge of a phenomenon is the basis of its evolution. The MOBENA is a first step to build a tool that can facilitate the knowledge about the business ecosystems, with a first improvement toward the standardization of the procedure for different contexts and the reusability of data and information.

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Knowledge Sharing and Innovation: The Contribution of Innovation Intermediaries

Raffaella Coppolino and Tindara Abbate

Abstract Innovation intermediaries are a heterogeneous phenomenon with a relevant role in innovation processes as they are considered facilitators of the match of supply and demand in uncertain contexts. Their tasks are focused on: promoting new solutions that derive by combinations of knowledge; supporting technology development activities and trying to reduce the gap between the business and research communities. In recent years, several studies have analyzed the most important functions of intermediaries, their role in innovation process, but only few studies have focused on the rationale of innovation intermediation. The purpose of this paper is to investigate how innovation intermediaries can contribute to knowledge sharing. The intermediation processes will be compared to explain how innovation intermediaries can contribute to the creation of knowledge and the development of innovation. The paper will consist of three steps. First, a literature review will be carried out to define the intermediaries' main functions; subsequently, the method for analysing this phenomenon will be described; the third step will discuss findings.

1 The Contribution of Innovation Intermediaries to Knowledge Sharing

Firms need to adopt novel business practices to share technology-based knowledge in support of different innovation processes, to exchange resources and competences over time and to build alliances [1, 2]. To survive, it is vital that

This paper is the result of a theoretical effort of both the authors. However, Tindara Abbate wrote paragraph 1 e 3, while Raffaella Coppolino wrote paragraphs 2 e 4.

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firms interact not only with internal actors, but also with other subjects beyond organizational boundaries. The opening up of the innovation processes determines opportunities to access knowledge by external resources, to create better products at a faster rate and to enhance incremental innovation performance [3–5]. This approach is progressively adopted by those organizations that are shifting from their internal R&D centres to collaborative innovation processes, thus fostering the transfer of knowledge by creating links among researches, policy makers and practitioners. A growing number of firms -Procter&Gamble, Kraft, Siemens, 3 M, Kimberly-Clark, among others – make use of the services offered by innovation intermediaries [6–8]. For example, Procter & Gamble has considered the use of NineSigma as an "*open network*" intermediary.

Howells [7] highlights that innovation intermediaries are an overarching class of organization "*that acts as an agent or broker in any aspect of the innovation process between two or more parties*". Indeed, they facilitate encounters of different actors (defined as *innovation seekers and innovation solvers*), probing to accelerate the knowledge flows and to capture value in two-sided technology market.

According to many authors [6, 7, 9, 10], these subjects have an important role in innovation processes and are responsible for knowledge sharing because they support the transfer of knowledge. They contribute to innovation through the identification of solutions to problems by the combination/recombination of old and new ideas with knowledge, linking subjects globally distributed, supporting technology development activities and trying to reduce the gap between business and research communities. Intermediaries, therefore, offer firms the exploitation of external technologies; as a result, firms may find technology transfer opportunities and, then, conclude a higher number of transactions. By contrast, an incorrect or insufficient identification of technology transfer opportunities may reduce the benefits related to external technology exploitation, considered a strategic activity to obtain and maintain competitive advantage.

The core activities of intermediaries can be classified into three categories: inter-organizational networking activities, technology development activities and other activities [7, 11–13]. Additionally, intermediaries may help firms choose quality technology transactions because they have heterogonous sources and tend to the standardization of tasks. Firms often have difficulties to recognize technological applications or perspective customers. The decisions in technology exploitation may, thus, be taken in a non-ideal way. In this case, innovation intermediaries may help to integrate their information, making decision processes easier.

2 A Framework for Analyzing the Innovation Intermediaries

Available literature on innovation intermediaries consists of contributions from different fields: innovation management [14, 15]; brokerage [16, 17]; technology transfer [18]; networks [19, 20]. In this work we focus our attention on the rationale behind the recourse to innovation intermediaries. With regard to such needs, it is possible to discuss a theoretical framework that focuses on four different perspective (Fig. 1).

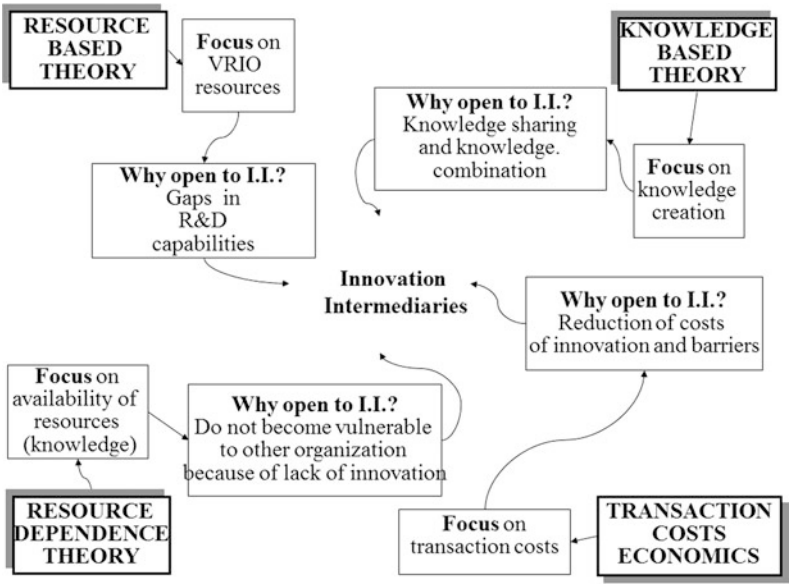

Fig. 1 The framework to analyze innovation intermediaries

2.1 Transaction Cost Economics

This perspective takes for granted the minimization of transaction costs as the main problem in the organization of economic activities [21, 22]. Transaction costs rise in the presence of some determinants such as frequency of exchanges, resources specificity, uncertainty, bounded rationality and opportunistic behaviour. The policy options regarding the organizational structures affect the choice along a continuum between two extreme forms: hierarchy (i.e. internalisation of transactions within the firm boundaries) and market (i.e. exchanges between atomistic firms coordinated by the use of leverage in the price). Alongside these extremes, several transaction management configurations can be positioned and the recourse to innovation intermediaries can minimize the costs of resource acquisition to develop sustainable innovation.

2.2 Resource Based Theory

According to this theory, to generate a sustainable competitive advantage, resources must be unevenly distributed among the firms. Such resources, embedded in organizations, are protected from competition both before and after the realization of the value they generate, to ensure the functioning of business processes [22–24]. Teece, Pisano and Shuen [25] talk of "*dynamic capabilities*" to refer to the "*ability*

to integrate, build and reconfigure internal and external expertise to adapt to environmental changes". From the resource-based perspective, the recourse to innovation intermediaries should consider skills and competences. In brief, the lack of internal capabilities in the field of R&D leads companies to fill the gap by encouraging the acquisition of what they need from the outside. In the meantime, firms can focus on activities that generate higher added values, i.e. core competencies. In such cases, when innovation is not an integral part of business, investing in R&D skills is often seen as a misallocation of those rare resources in areas not essential to the sustainability of competitive advantage.

2.3 Resource Dependence Theory

While a resource-based vision of the analysis focuses on the internal point of view in terms of "*resources*" and "*capabilities*", this theory focuses on the interdependence among organizations to reach needed resources [26, 27]. The level of dependence is connected to the environmental resources, the number of potential suppliers and the costs of switching from one supplier to another [27]. In that perspective, firms are asked to adopt strategies that ensure the access to those critical resources by establishing relationships with the external environment to ensure their own survival [27]. Therefore, the recourse to innovation intermediaries is influenced by the level of dependency on innovation that the firm perceives. In fact, to control the necessary resources to be competitive in terms of innovation, firms foster interdependent relationships with (or with the aid of) these organizations to lock the necessary resources in.

2.4 Knowledge Based Theory

This perspective considers knowledge as organizational resource, shared, enriched and regenerated through cognitive learning processes [28]. The knowledge improvement takes place dynamically through organizational learning processes that update information. In these processes, the *dynamic capabilities* increase core competencies [29]. However, the limit of dynamic capabilities is evident when the level of organizational analysis entails inbound and outbound relationships. Following Kogut and Zander [30], it is possible to identify the *combinative capability* focused on the inter-organizational dynamics of creating knowledge. That capacity is an organizational process by which innovative firms combine know-how to co-create knowledge or to seize market opportunities. Firms that activate combinative capabilities can be considered "*knowledge brokers*", i.e. an intermediary between new ideas and marketplaces which, pervaded by a culture of change and networking, are able to develop combinations of know-how among network nodes [16, 31].

Analyzing innovation intermediaries with the lens of such perspectives, the following research questions are formulated:

1. *Can the use of innovation intermediaries bridge the gap in R&D, thus providing access to a variety of resources that would otherwise not be achieved?*
2. *How does the recourse to innovation intermediaries reduce transaction costs?*
3. *Can the recourse to innovation intermediaries foster the creation of innovative networks focused on combination/recombination of knowledge?*

3 Research Approach and Findings

The exploratory nature of our research required a selection of innovation intermediaries that represents the "*visibility*" of observable facts [32]. Therefore, we conducted a field study using qualitative data and the choice of the data-sources has been realized through a *snowball technique* [33]. The following steps were followed. First, we collected indirect data about innovation intermediaries gathering information from scientific publications, reports and books. This information provided a knowledge-base to describe this phenomenon, the main players in this business system and their role in the innovation processes. In the second step, we defined a sample of 15 innovation intermediaries and we developed tables for each subject including the following critical items: *main activities; stakeholders; processes; mechanisms; rationale; rewards*. Although each of the analyzed subjects is not explained in detail in the paper, findings from the exploration of the websites are used. The empirical research was conducted from June 2010 to June 2011, when the evolution of the open innovation model and intermediaries were also analyzed.

The results show that innovation intermediaries are involved in several levels of relationships. On a vertical perspective, they can limit their contribution to the mere matching of innovation seekers and solvers or they can support firms on the formulation of licensing proposals out. In the horizontal view, they can promote several types of projects to enhance innovation and to offer the interaction with like-minded people on innovation topics through web 2.0 tools. Focusing on the brokerage mechanisms, the different types of intermediaries can be divided in two categories:

1. *Match Provider;*
2. *Match Supporter*.

The answers to our questions are almost different depending on the analyzed typology of intermediaries.

The first category focuses on demand articulation, considered as a key task for this intermediation [18, 34], because, without understandable demand mapping, it is very difficult to assume a market oriented approach [35]. Match Providers clarify the demand/supply peculiarities and create linkages between seekers and solvers,

facilitating the flow of information and, consequently, the knowledge sharing across geographical, industrial and disciplinary boundaries at lower costs. Referring to the first question, these subject can bridge the gap in R&D, because they proceed to analyze problems, to organize platform or meeting places [7, 34], to facilitate the use of specialized resources (researches, universities, R&D institutions) and to find appropriate solutions.

As regard the second question, the recourse to Match Providers can reduce the risk of transaction costs. In fact, the intermediation process is characterized by a substantial standardization of input-request and the "almost" neutrality of the providers in the matching of seekers and solvers. These subjects will often create a platform in which, through web 2.0 tools, demand and supply are matched in an environment as close as possible to a real market. Here, informational asymmetries are resolved through information sharing so that market access barriers are removed. The use of crowd eliminates the risk of opportunistic behaviours. This class of intermediaries can facilitate the development of projects or the diffusion of open innovation business models.

The second category of intermediaries is represented by Match Supporters that act as organizers and managers of social, industrial, scientific and technological 'networks' [3, 36] to foster knowledge sharing and, then, innovativeness. These actors enhance communication between parties by fulfilling the following functions: implementation, intellectual property activities or contract research services, commercialization of innovation process outcomes [7], the optimization of the links between different domains and industries, the diversification of the interactions among innovation networks and the broader innovation systems. In this context, Match Supporters stimulate strategy and vision development providing learning and experimenting platforms [34]. The Match Supporters influence the process of problem identification, the request formulation and the generation and/or the combination of new knowledge for decision making; they operate as specialists, coordinating the activities and supervising the relationships between firms (*seekers*) and innovation solvers. These subjects operate with an established network of innovation solvers or, in other cases, enroll experts to help firms to innovate, removing blockages in the process and re-forging their networks. Besides the mere activities of intermediation, the supporters have a relevant role when cooperative relationships are created. In such cases, on one hand, innovation intermediaries proceed to the selection and control of external resources (sources of innovation), on the other, the interactions between stakeholders can foster the building of innovative capacities within the organization, by mitigating external constraints.

4 Conclusion

The contribution of intermediaries in the innovation process has some broad implications. First, the study of these categories enhances the mechanisms of knowledge creation and transfer in highly complex and uncertain contexts. Second,

innovation intermediaries can adequately contribute to increase firm productivity, reducing costs referred to the identification of alternatives, and face the scarcity of information. Their involvement allows firms to achieve exhaustive knowledge by supporting external knowledge acquisition to develop ideas/products/services. In that context, firms can benefit from an articulate network of scholars and research organizations. Furthermore, these subjects can promote the exploration and commercialization of specialized technologies not easily reached by smaller organizations.

The examined sample has highlighted some differences between two innovation intermediaries categories characterized by different contribution to knowledge sharing and support to innovation. However, this work presents clear limits related to the exploratory analysis and to the exiguous number of identified categories, because of the risk of oversimplification of a complex scenario that also presents significant problems related to data security traded on online platforms.

The further step of this research will be an inductive, multiple case, embedded-study to highlight the diversity and the distinctive value creation model of innovation intermediaries.

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Value-Co-creation Through Multichannels Distributions: The Nike ID Case

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Abstract Information Technology (IT) development, in recent years, deeply changed the relationship between firm and customer, leading to an important shift in their respective roles. Nowadays, the customer has to be seen as a key player of this relationship, carrying out an active and important contribution in the phase of product development. Despite a growing interest for this topic, the importance of how and why some specific organizations seem to be more effective at executing channel interactions and co-creating value with customers remains underspecified. To address this gap, we try to explain, through a case analysis, the multi-channel strategy that Nike developed with the so called "ID service" in the Italian market scenario and how its basic principles can be a foundation to generate value over time through customer collaboration. In particular, this study explores the role of IT-enabled value co-creation in this domain.

1 Introduction

In today's volatile economy, organizations use a variety of different distribution channels to interact with costumers. These channels include the Internet, kiosks, call centres, direct marketing, catalogues, and bricks and mortar stores. The phenomenon of concurrent channels owned by one company and providing similar services simultaneously requires managers to combine these resources in new ways and to gain additional resources [9, 16, 25, 30]. From this perspective, co-production, or co-creation, is becoming the cornerstone of marketing and design practices

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and a sort of managerial mantra that is rapidly gaining momentum both at professional and academic levels [28, 29]. Co-creation refers to collaboration with customers for the purposes of innovation and has become a foundational premise of the service-dominant logic [12]. Lusch and Vargo [12] proposed service – dominant (S-D) logic as a new perspective for marketing. They assume that marketing has moved from a goods-dominant view, in which tangible output and discrete transactions were central, to a service-dominant view focused on intangible resources, co-creation of value, and relationships.

Despite a growing interest in the above-mentioned topic, the importance of how and why some specific organizations seem to be better at co-creating value with customers and executing channel interactions remains unknown. To address this gap, we try to explain, through a case analysis, the multi-channel strategy that Nike developed with the so-called "ID service" in the Italian market scenario and how its basic principles can be a foundation to generate value over time through customer collaboration. In particular, this study explores the role of IT-enabled value-co-creation in this domain.

The article is organized as follows: First, we review the literature on marketing channel strategies and IT-based value co-creation. Second, we present the methodology and the case study. Third, we examine the study's findings. Finally, we discuss our case and present some implications for research and practice in this area.

2 Literature Review

A distribution channel has been described as the exchange relationship between the organization and its customers that creates customer value in acquiring and consuming products and services [18, 19]. In recent years, many firms have adopted new channels in addition to their traditional ones [7, 8]. The addition of new channels has increased the complexity of customer management [31] because it has opened up new areas of the organization to customer contact and created significant challenges in relation to staff roles and existing processes for interacting with customers. Channel integration is a strategic issue potentially requiring structural changes to the organization and changes in the behaviour of customers [10]. In particular, the task of coordinating and integrating multiple channels that operate at high levels of efficiency has forced managers responsible for channel management to address a variety of challenging issues. These issues include defining the role of e-commerce in the multi-channel structure, developing an optimal channel mix, creating synergies across channels, building strategic alliances, creating sustainable competitive advantages, managing more complex supply chains, resolving conflict, and providing the leadership necessary to obtain well-integrated multiple channels [21].

There are various channel management strategies that established companies can adopt. A synthesis of the literature suggests the following generic strategies

[2, 3, 13–15, 20, 23, 24]: offline focused, online focused, isolation, and integration. In the first strategy, the online channel supports an existing distribution network, acknowledging the range of services offered by offline channels. In online focused strategies, "the offline channel is configured to guide customers to a corporate website or similar online offering" [15]. The online channel operates in a parallel and non-integrated way compared with existing channels. An isolation strategy is pursued when online and offline channels are managed as separate or independent entities. Neither activities support customers switching between channels. In contrast, some companies adopt the integration strategy, integrating their online channel with existing physical operations in order to leverage the benefits that arise from potential synergies between the two. Despite companies recognising the benefits of the interactions between different distribution channels, this deployment strategy is the least used. In addition, not all companies that have made this distributive choice have achieved the same results in terms of performance. Moreover, there are few theoretical and empirical studies that seek to explain these differences.

The IT (Information Technology)-enabled value co-creation perspective is a potential framework for augmenting the theoretical basis of channel interactions and for understanding how and why specific organizations seem to be better at managing and executing this strategy [4, 6].

While many past studies have demonstrated a relationship between IT and some aspects of firm value [5, 22], only recently have some researchers focused their attention on the co-creation of value through IT rather than on IT value alone.

The notion of IT-enabled co-creation of value emerges from the realization that organizational boundaries are increasingly permeable and that novel arrangements are emerging that enable previously unattainable value propositions [11]. Based on service-dominant logic [26, 27, 29], value is always co-created by customers and firms, and IT enables such arrangement of the actions and offers the potential to reshape how much value can be created in collaborative relationships.

3 Methodology

Case study research is the most common qualitative method used in information systems [1, 17]. In particular, the research presented in this paper attempts to follow the guidelines suggested by Yin [32], which includes specifying as much information about the organization, the participants and the experiment as possible, in addition to the complete experimental results. We chose to focus on the case of a firm in the sports industry, Nike, because we argue that the sports industry must develop new key capabilities in order to leverage customer heterogeneity and attend to all aspects of customer interactions.

We collected Nike data for approximately 1 year, starting in early 2010. We relied on two primary data sources: archives and interviews. We began data collection by gathering extensive archival data from both internal and external

sources. The internal sources included internal reports and presentations. The external sources included media articles about Nike.

We continued data collection using semistructured interviews with Barbara Montanari, Deputy Marketing Director and Head of Retail Brand Management at Nike Italy Srl and Marcella Fauci, Digital Commerce Marketing Manager at Nike Italy Srl. We used these interviews to identify the major decisions associated with the launch of Nike ID, which we then matched with those identified in the archival material, thus triangulating the data. The interviews ranged from one hour to two hours in length.

4 The Nike Case

Nike is primarily engaged in the design, development, and worldwide marketing of footwear, apparel, equipment, and accessory products in the sport industry. The company has operations in over 180 countries spanning the Americas, Europe, the Middle East, Africa, and South East Asia.

Nike was founded in Oregon in 1964 with the name of Blue Ribbon Sport, due to decennial friendship between Phil Knight and Bill Bowermann, with the commercialization of sport shoes from the Onitsuka Company, Kobe, in the US market. The company's Swoosh trademark and the Nike brand name were created in 1971. BRS launched Nike shoes for athletes in 1972. The company established its first US track and field training club for athletes in 1977.

Since the 1970s, we have witnessed an increase in the development of the brand based on innovation, which allows the ability to differentiate target markets with dynamic advertising and through athlete sponsorship. In this regard, athlete sponsorship became similar to using sports events as an interaction channel. From a strategic marketing point of view, the first years of the new millennium resulted in advances through technology utilization and IT developments. Since 2002, we can observe the beginnings of a multi-channel approach by Nike, wherein through the first integrated marketing campaign, there was a synergy between various levels, such as the web, public relations, sales and the consumer. In March 2006, Nike and Google jointly launched Joga.com, an online community for football. In April 2006, Nike and Maven Networks introduced JogaTV, an internet TV channel focused on football.

Nike and Apple entered into a partnership to launch Nike + iPod products in May 2006. The first product developed through this partnership was the Nike + iPod Sport Kit, which is a wireless system that allows Nike + footwear to connect with the iPod Nano.The company has several celebrity brand endorsements, and the Nike swoosh sign is one of the most widely recognized company logos worldwide. The company's leading market position and brand name facilitate strong product recognition, customer loyalty and a significant edge over its competitors.

5 The Nike Multi-Channel Approach

The Nike multi-channel approach is based on quite a simple structure that is composed of two main channels: the traditional channel and the web channel.

The traditional channel of Nike Store operations, supplies the products in the Italian market. Nike varies its offerings depending on the target areas. The web channel completes the offerings through websites, such as nike.com and nikestore.com. The websites provide the possibility to deliver the whole Nike store supply, sale, and distribution information by integrating their online channel with existing physical operations in order to leverage the benefits of potential synergies between the two.

This approach by Nike, as stated by Montanari, "was created to meet business needs" that can be distinguished based on external and internal factors. The former are represented by technology developments, such as the Web, which currently represent a channel that is very relevant and therefore should be explored. As stated by Montanari, "Nike's direct competitors were also laying the foundations for a multi-channel approach."

With regard to the internal factors, particular reference is made to the needs or demands that Nike were required to meet within the Italian context. The Italian market is characterized by high fragmentation, in which many small companies operate. This is an obstacle to the delivery of large supplies and to a better distribution of certain kinds of Nike products, such as products for basketball and golf. These are problems that required a solution in the traditional channel.

Nike's multi-channel approach, states Montanari, "provided the possibility to fill those competition and distribution gaps which could have proven very dangerous to the supply of Nike products in Italy. This is because an approach with two channels makes one the complement of the other, a strategy that allows an innovatively complete supply of all Nike products within the Italian market." The results for the year 2010 justify this strategic choice. Indeed, as mentioned by Fauci, "Nike's digital commerce shows a growing trend with averages over 50% and peaks of 150% for certain kinds of products. It is an essential strategic asset for Nike that, thanks to the presence of multiple channels, can offer the whole range of its products and solve the distribution problems of the traditional channel."

6 The Nike ID Service: An Example of IT-Enabled Value Co-creation

Technology plays a key role in value co-creation at Nike. One key dimension of technology is that the Nike ID service represents the possibility for the customer to customize the product. Customers can change the standard product they are going to buy according to their needs and tastes. The service provides a simple online interface to modify the architectural, material and aesthetic features of the product.

The Nike ID service has been in operation for 10 years and has evolved along with the company. As stated by Montanari, the ID service "was born merely as a marketing campaign but, through the exploitation of technological developments, rapidly became an important strategic asset to Nike."

Nike's mission, through the ID service and the whole product range, is to fulfil the needs and desires of athletes, who are Nike's target customers, and is based on the notion that "If you have a body, you are an athlete."

The main features of this type of service are represented by the fact that Nike ID is primarily a multi-channel service. Customers can exploit both channels – the traditional channel, Nike Studio, and the web-based channel, nikeid.com, which is directly linked to nikestore.com. In addition, there is an ongoing collaboration between the company and customers through various contact points in the multi-channel approach. Nike can generate and refine new ideas rapidly, accumulate understanding about the desires of customers and the ways in which they prefer to engage.

This type of communication between the parties facilitated important changes in order to co-create a product that can better meet the customers' needs. First, because of the development of a multi-channel approach, the communication is always active by means of laptops, smart phones and Nike Studios; this characteristic inevitably entails the establishment of a collaboration between the parts. Second, the development of this type of setting allows an open minded communication, which is the core foundation of value creation over time. However, it also entails a shift of the traditional roles. The customer (an athlete in this case) moves from a classic passive position to an active position through which they contribute to the development of the product with the company. The performance results for 2010 confirm the benefit provided by Nike's strategic choice of this type of service. The ID service, as stated by Ms. Montanari, "on the traditional channel, during the FIFA 2010 World Cup in South Africa, has seen an average of 60% in the customization of products sold in a traditional Nike Store." Fauci also pointed out that "the ID service provided by nikeid.com on the web channel, is increasing at the same rate as nikestore.com – more than 50% – and presents continuous growth". This confirms the ID service as an essential strategic asset with an enormous competitive advantage. This innovative service of performance customization is able to supply athletes shoes or other products such as t-shirts and is suitable to athlete's needs in addition to facilitating high sport performance.

7 Conclusion

Our study takes the initial steps to investigate the relationship between two issues that are of increasing interest: the value co-creation approach and the multi-channel distribution strategy. Despite the fact that there has been a lot of research that examines the value of creation mechanisms and multichannel distribution strategies, this study is one of the first to initiate academic and practitioners´

discussions on the relationship between these issues. This study has helped to develop our understanding of the value of co-creation as an outcome for conducting business based on a multichannel distribution system in the sport industry, which is a sector in which the lack of empirical academic studies is striking due to the novelty of the phenomenon. Our goal in this paper was also to explore the role of IT within a context of value co-creation. When considering the statements provided by the Nike Deputy Marketing Director, it appears quite clear that the same results could not have been achieved without the use of IT. The IT allows Nike to create ongoing customer dialog, absorb social customer knowledge, and scan knowledge of potential or competitors'customer.

The limitation of this study lies in its exploratory nature, with the present findings requiring confirmation in other settings by other researchers, including quantitative large-scale studies.

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Technology Intelligence: New Challenges from Patent Information

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Abstract Patent information can be used for strategic planning purposes. Conventional patent analysis has commonly focused on factual information and, in particular, on information extraction, visualization and assessment techniques. Less scholarly attention has been devoted to the strategic role of an integrated system of patent intelligence in supporting firm's decision-making. Since patents can be strategically used by firms to prevent competitors to strengthen their competitive advantage, patent information may be distort or insufficient. We accommodate the "dark side" of firms patenting by underlining pros and cons of patent information. We argue that technology intelligence should take into account such intrinsic limits of patent information.

1 Introduction

Over the last decades an intensification of firms' patent activity has been observed in several countries and technological fields. During the 1980s and the 1990s, the number of US patent applications has grown from a range of 40–80,000 in the 1980s to at least 120,000 patents in 1995 [1]. An in-depth examination of the phenomenon [2] has revealed that the growth of patent applications has been discontinuous and a structural break in the time series of the number of patents occurred in the mid-1980s: the growth rate boosted from an average of 0.3% before

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the break in 1984 to an average of 6.9% after 1984. Such an explosive growth of patent applications has led to a dramatic increase in data sources for technology intelligence.

Technology intelligence has been defined as "the capture and delivery of technological information as part of the process whereby an organization develops an awareness of technological threats and opportunities" [3]. Thus, it plays a key role in nurturing firms' competitive advantage by providing relevant information in order to minimize the risks of inappropriate technology investment or non-investment, due to misperceptions within the key developing technology areas. However, to perform effectively this role, technology intelligence should pay attention to a large amount of technology data, originating from disparate sources outside the organization. In this scenario, patents represent one of the most helpful sources to exploit. Several methodologies and tools have been developed to facilitate patent search and analysis. Software packages as well as publicly accessible patent databases (i.e. WIPO, USPTO, EPO, JPO) are available for data mining, text retrieval and classification, semantic analysis and document summarization, patent searching, webpage tracking, and Internet monitoring using syndication technology.

The growing interest towards operational processes of patent analysis emphasizes the relevance to provide technological information which is *valuable, reliable,* and *suitable*. Accordingly, in this paper we focus on patents as source of information and address the following research question: *to what extent do patents offer valuable, reliable and suitable information?*

We suggest that technology intelligence should take into account intrinsic limits of patent information and include qualitative information that allows for the systematic identification and assessment of externally developed disruptive technologies. Since firms may use patents for strategic purposes, patent information should not be distorted to avoid revealing the real sources of a firm's competitive advantage or to prevent competitors to strengthen their own advantage. This and other limits to patent information have to be considered in performing a patent analysis and have been therefore discussed in this study. Overall, given its focus and structure, this paper represents a partial attempt to close the gap between the conceptual knowledge arising from the academic disciplines of management and strategy and the practical implementation of that knowledge by professionals [4–6].

2 The Relevance of Patents Within the Technology Intelligence System

Over the last decades, promoting innovation, exploiting technological opportunities and facing global competitiveness has become increasingly crucial in gaining and nurturing competitive advantage in high-tech industries. Firms need to monitor both current and potential future technological advances that can affect their

products, services and processes. As a consequence, most firms are investing in technology intelligence systems to 'identify' promising technologies, to show their potential as well as their limits and to take advantage of technological change. In other words, technology intelligence is conceived as a managerial tool bridging technology and market. To do so, technology intelligence mainly performs two tasks:

– *Data handling*, including collecting, categorizing, storing and retrieving technological information;
– *Data communication,* which include analysis, interpretation and dissemination.

A technology intelligence system can effectively be described by a three level model consisting in: (a) a Framework level; (b) a System level; and, (c) a Process level [3]. While the System level clarifies the specific operations that have to be implemented to make the technology intelligence system effective as well as the Process level refers to all the tools and metrics needed to conduct the various activities pertaining to the previous level, the Framework level defines which information is required and knowledge gaps of the decision-makers. Accordingly, this level shows a strategic view of who "intelligence consumers" are (i.e., decision-makers in organizations) and, on the other side, who provides this intelligence (i.e. "intelligence brokers"). More in detail, the technology intelligence framework consists of four layers which describe how intelligence brokers satisfy consumers' needs and highlight new information areas they need to know (Fig. 1).

The decision-making process promoted by 'intelligence consumers' outlines the relevant strategic, tactical and operational challenges that the organization has to face and, subsequently, brings out the needs in terms of *what* information is needed, *where* and *when* is required, *why* is it relevant and *how* should it be provided. In addition, it is relevant to know the balance or mix of economic, social, technical, legal and environmental information that should be provided by the technology intelligence activity.

These needs require proper actions taken by the intelligence brokers (layer 2), namely: (1) identification of opportunities; (2) awareness of threats; (3) assessment of state-of-art; (4) profile of trends.

The technology intelligence system will generate a reporting focus for each of these actions, by analyzing primary and secondary data gathered mostly from secondary sources. Patents fall into this category. They represent a publicly available, external source of information that intelligence brokers can exploit to provide support to intelligence consumers, according to the specificities outlined by the Framework level. As such, patents allow intelligence brokers both to monitor the development of new technologies that intelligence consumers have identified as relevant for the future competitive position of the organization, and to scan the external environment in search for any new technological development that might represent a threat or an opportunity for the organization. In both cases, as revealed by several empirical studies [7, 8], patent information (and its collection, categorization, storage, retrieval and analysis) is key to the effective functioning of a technology information system. However, patent information has also some

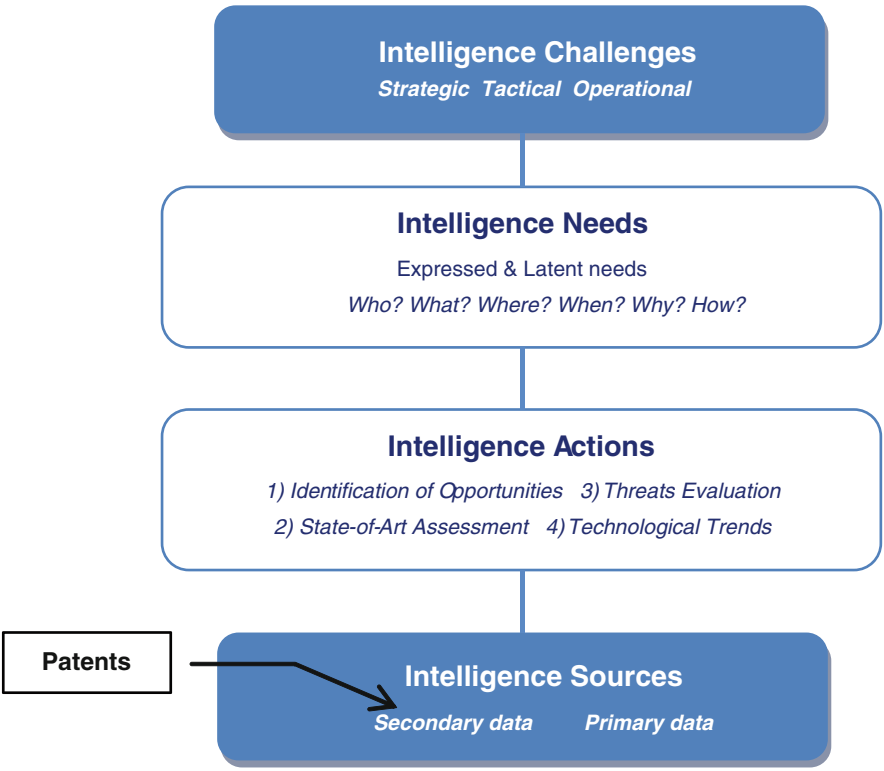

Fig. 1 The technology intelligence framework (Source: our elaboration)

specific drawbacks that make its use less effective than expected and its interpretation potentially biased. The following sections describe both benefits and limits of patent information and how a technology intelligence system should account for them.

3 Benefitting from Patent Information

The variety of patent data and the wide range of web tools for patent search highlight the potentialities of patent information in supporting R&D decision-making of both policy makers and firms. As regards policy makers, analysis of patent data has long been considered to be an important method of assessing various aspects of technological change. Most studies have used patents as a proxy of inventive and innovative activity in order to analyze patterns of innovative activities at the technological and country levels and it was found that while these patterns differ systematically across technological classes, they are very similar across countries [9]. Besides patent counts, patent claims data have been explored and claims were found to be a better indicator of national technological capacity [10].

As regards firms, some studies have analyzed patent information from the perspective of a firm's strategy for assessing the level of technology development in a particular sector, taking patent statistics as a technology indicator [11, 12]. Patent analysis has also served as a basis for assessing technological strengths and weaknesses of competitors [13], and exploitation of foreign markets [14]. In several competitive situations, patents may support managers in analyzing potential partners' profiles, in identifying relevant technological trajectories, in revealing the technological content of successful products, and in detecting the technological source of main competitors' competitive advantage [15]. Patents can be used in the processes of product diversification or of development of new product lines, in order to define which technologies the company needs to develop or acquire. In the case of merger decisions, patents can provide information needed to assess potential targets' technological profiles. Furthermore, in the case of businesses whose growth rate is slowing down, profits are falling, and products have become commodities, patents can mainly be used to identify potential targets for a patent licensing program aimed at generating new revenues. Finally, in the case in which a business is no more profitable and has to be abandoned, patents can provide information on those companies that would find one's patents of value.

3.1 The "Dark Side" of Patent Information

In conducting a proper patent analysis, the limits of patent information and the consequent limitations of patent intelligence cannot be neglected [16, 17]. Such limitations of patent data as a valuable information source arise from several factors. First, patents represent an effective protection mechanism only in some industries. Other means (e.g., trade secrets or investments in complementary assets such as marketing and production facilities) may offer a stronger protection to technological knowledge and know-how [18–20]. In particular, patents have revealed to be an effective appropriability mechanism in those sectors where the knowledge base from which technological innovations arise is less tacit, context-dependent and firm-specific. The chemical industry represents an emblematic case in point [21]. As a matter of fact, chemical is one of those few sectors showing the highest propensity to patent. In turn, patent data are clearly biased towards a few technological and manufacturing areas, while patents do provide less comprehensive information in many others.

Second, also in those sectors with the highest patent propensity, the economic value of patents varies greatly. For a patent to be granted, patent legislation imposes three conditions to be met: novelty, non-obviousness and utility. The requirement for utility only presumes that inventions must have capability of commercial viability and "industrial applicability". However, such a condition does not provide any evidence of the real (that is, economic or commercial) value of the invention. Thus, an effective patent analysis should be able to discriminate between valuable and less valuable patents and allocate greater importance to information arising from the former.

An element that influences the value of a patent is the real strategic intention that patent owners had in the moment of patent application. As recent studies reveal [20], only a half of patents granted to firms are actually used as a protection mechanism of technological knowledge embedded in products introduced into the market. Apart from licensing and cross-licensing purposes (that cover less than 14% of patents granted), the remaining fraction of patents (around 36%) respond to strategic needs and are not employed in current business operations. Most of them represent a tool to block competitors or to limit their technological developments, by covering some portions of the technological space that entail their businesses. In turn, such patents are unused in practice by patent owners and it is reasonable to suppose that their intrinsic value is lower with respect to that of used patents. In turn, also the relevance of related patent information should be negatively affected.

An indirect consequence of firms' strategic behavior concerning patenting is that the risk of incurring in patent litigation costs may prevent other firms from investing in innovation or from making use of patents as a protection mechanism [22]. The paradoxical result is that this effect is more evident exactly in those industries where patent protection is stronger. Since small firms often lack the required financial resources to sustain long and costly litigation trials, this category of firms is the most invested from such a negative consequence of strategic patenting. Again, results of patent analyses should be handled with caution because a relevant share of technological information (mainly, that developed by smaller firms) might not be covered by patent data.

Finally, there are some limitations to the use of patent data arising from the intrinsic characteristics of the patent documentation and the formal process for obtaining a patent. On the one hand, the abstract vocabulary and the complex syntactic structures used in patent documentations make patent's text structures particularly difficult to read and interpret [23]. Such a complexity is especially evident in patent claims. Given that international regulation requires that each claim should be rendered in just one sentence, it is very common to find claims made of hundreds of words. In turn, methodologies that aim at performing patent analysis by means of automatic procedures have to face text simplification and syntactic analysis as a primary requirement.

The voluminosity of patent documentation has increased dramatically during the last decades. In the case of patents filed at the European Patent Office, the average size of applications has doubled over the past 20 years [24]. This result is mainly due to applications following the PCT filing procedure with US priority, in the biotech sector or with a large number of inventors. Again, apart from an impact on the patent offices' workload and the subsequent delay in patent examination procedures, a negative consequence associated to the increased voluminosity is that patent analysis is becoming a much more demanding task. More sophisticated analytical methodologies are thus required.

A final limitation affecting the use of patent information for strategic purposes arises from a procedure adopted by most patent offices, which permits the publication of patent applications (generally) 18 months after the earliest priority date or filing. Prior to publication, the application remains confidential to the patent office

and no patent information is disclosed to the public. In turn, even the most accurate and up-to-date patent analysis will suffer of examining a technological context that is more than 1 year old. If such a delay does not represent a serious problem in sectors characterized by slow technological dynamics, in those industries with short life cycles and fast technological change in may imply a major challenge [17]. In some extreme cases, patent analysis may provide results that are useless for strategic purposes.

4 Conclusions

Traditionally, patent analysis has been perceived in terms of information extraction, visualization and techniques, with no emphasis to the support of strategic decision-making in R&D setting. Nowadays, patent information is crucial to define firms' strategies and R&D decisions in the global and competitive environment. Accordingly, far from being a completely solved research domain, patent intelligence is currently attracting more and more interest, both for addressing old issues, such as database quality, and for tackling new challenges including:

1. The increasing amount of patent applications, in so many different languages;
2. The augmented variety of users that now include experts, occasional users, etc., with different backgrounds and interests ranging from pure science to business; and,
3. The focus shifts from traditional defensive IP approaches to the more recent idea of leveraging patent information for exploring new technical and business opportunities.

From a managerial perspective, we expect that retrieval and evaluation of patent data should become institutionalized processes within the organization in order to ensure the continuous and systematic use of patent information. To achieve this goal, firms might include patent analysis as part of the firm's strategic planning processes and, consequently, invest in new competences and skills, at the senior management level, in order to handle an increasing amount of available patent data and their complexity.

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Towards a Digital Ecosystem to Increase Effectiveness of Technology Transfer Services

C. Luciano Mallamaci and Domenico Saccà

Abstract The Competence Center ICT-SUD is carrying out an industrial research program, co-financed by the Calabria Region, aimed at building a digital ecosystem with some of its associate organizations for boosting technology transfer services. In particular, the program focuses on analysis, design, implementation and test of an innovative digital ecosystem architecture to effectively support complex business organizations involved in software applications development and distribution as well as service delivery. The digital ecosystem is meant to improve their production and organization processes, to increase their innovation levels and to reinforce their competitiveness, by enabling them to create business and social networks with partners, customers and research centers using the digital ecosystem. The first two steps of the program concern: (1) the analysis and specification of the innovation needs and requirements of the ICT-SUD's industrial partners involved in the program, and (2) the set-up of a cooperative platform for enabling advanced social network features and knowledge discovery on the digital ecosystem. The paper presents some preliminary results of the above two steps.

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1 Introduction

The main objective of the Competence Centre ICT-SUD (in short ICT-SUD) is to build a stable organization which aims at delivering technology transfer services in the ICT sector. To this end, after the completion of the Start-Up phase (i.e., the set up of the infrastructure and organization of the Centre, and preliminary strategy definition, see [1]), ICT-SUD has started the realization of a cooperative environment to enable researchers, academics and experts from the private industrial sector to collaborate in the exploitation of state-of-the-art technologies resulting from public and private research activities.

In particular, within the project named "Investment Contract" (IC, for short), co-financed by Calabria Region,[1] ICT-SUD aims to study, design and test digital ecosystems for complex business organizations involved in software development as a mean to provide methodologies and tools to its member companies for the sharing and integration of knowledge and expertise. The project involves 24 members of ICT-SUD, of which three are academic bodies and 21 are industrial partners (above all SMEs).

The IC is divided into two parts: (1) an Innovation Plan, which in turn includes a feasibility study and five research and development projects, and (2) a Training Plan, which consists of a number of specialist courses on innovative ICT technologies and platforms addressed to personnel of industrial partners.[2] The five research projects are briefly illustrated below:

- *Integrated logistics system for transportation services in urban areas*
  The project aims at building a platform for the management of urban mobility of people and goods providing a new organization of the transportation systems which integrates newest technologies in order to increase the movement of goods and/or people and, at the same time, significantly reducing the vehicles in circulation, leading to benefits in terms of road safety (accidents), environmental impact (CO_2 emissions, noise, etc.) and energy saving (fuel consumption).
- *Access control systems based on RFID and biometric technologies*
  The project aims at building an innovative platform that extends traditional presence management and detection systems. The authentication will be based on biometric data stored on RFID support. In addition, the presence detection systems will be integrated with a system for the electronic confirmation of the identity of the worker. Thanks to this, the presence will be validated only if at the same time, the individual to which it refers is actually present in front of a the terminal.
- *Health Knowledge Mining Suite*

[1] The Innovation Plan of the IC is co-funded by the European Regional Development Fund (ERDF), the Training Plan is co-funded by the European Social Fund (ESF).

[2] The Plan consists of 390 h of lesson provided to approximately 120 employees out of a total of about 645 people employed in the 21 companies involved.

The project aims at creating a suite of solutions for analysis, management, monitoring and optimization of health expenditure. The project will make use of data mining techniques to allow, for example, the monitoring of the behaviour of doctors//pharmacies over drugs manufactured by a given pharmaceutical company and to identify specific groups of doctors//pharmacies that provide// sell drugs produced by a specific pharmaceutical company. Through techniques of Outlier Detection it is possible to assess whether the behaviour of a physician is fraudulent. In addition, through predictive techniques, will be possible to predict health care costs concerning a specific physician on the basis of certain characteristics (e.g., number of patients, specialization, etc.).

- *Integration for Business Intelligence*
  The project aims at creating a platform for the integration of data and services. The platform will include: techniques for intensional and extensional data quality, methods for data cleaning through communication workflow with operational systems, methodologies and techniques for the design of dashboards, technological solutions for integrating dashboarding systems through Enterprise Service Bus and Grid Systems.
- *Digital Ecosystems and Virtual Organizations*
  This project, that plays a central role within the Innovation Plan whose ultimate goal is indeed the design and implementation of an innovative digital ecosystem architecture, is described in the next section.

The paper describes the main objectives of the Digital Ecosystem (DE) and the preliminary results of the requirement and specification analysis. In addition, we illustrate the cooperative platform that enables the digital ecosystem with social network features and knowledge discovery.

2 DE and Virtual Organizations

The overall Innovation Plan focuses on analysis, design, implementation and test of an innovative DE architecture to effectively support complex business organizations involved in software applications development and distribution as well as service delivery [3]. In particular, the DE is meant to improve the production and organization processes, to increase the innovation levels and to reinforce the competitiveness of the ICT-SUD's member companies, by enabling them to create business and social networks with partners, customers and research centres. The first four projects mentioned in the previous section represent the *components* of the DE meaning that each component includes infrastructure, methodologies and tools for the development of software applications in the respective application domain. The fifth project is focused on carrying out novel research on digital ecosystems and is aimed at effectively integrating the above four components.

Thanks to the DE, SMEs will have similar opportunities of large enterprises in terms of exchanging and combining knowledge and skills, producing and delivering new services and products, finding partnership and jointly promoting the market demand. ICT-SUD itself will exploit the paradigm of the digital ecosystems to

increase the effectiveness of its offer of technology transfer services. In particular, ICT-SUD aims at enabling itself to:

- Act as connecting and linking agent for companies, above all SMEs;
- Promote and support the exchange of knowledge, know-how, contacts, etc.;
- Create the conditions for establishing relationships between SMEs and clusters of excellence, at the local and the international level;
- Provide companies technical and scientific assistance as well as specialized support for the procurement of funding and/or venture capital;
- Support, through ICT tools, companies and organizations operating in highly innovative sectors;
- Monitor and analyze the innovation and training needs of enterprises with the aim of testing and developing new and possibly more effective technology transfer services.

Requirements analysis and specification description of the DE are illustrated in the next section.

3 Requirement Analysis and Specification Description of the DE

ICT-SUD plays the central role of "Regional Catalyst" [6, 7] within the DE, thus it is the subject which activates the local actors and promotes the construction of a cluster of firms at the regional level. Companies involved in the project will be "Adopters", each of which, in turn, can be a simple "User" or a "Developer". *Users* are firms that access and utilize services, methodologies and tools available in the DBE network, without being engaged in their technical development. *Developers* are users which, at the same time, are also actively involved in the development of new "digital species" [8] that populates the DBE. In particular, the *digital species* that could be part of the DBE to be carried out by ICT-SUD are: software components and modules, digital services, cloud computing platforms, software protocols, business processes, training modules as well as skills and knowledge.

Digital species evolve or die out such as organic species [2]. Those species that do not respond to the needs of the Adopters will eventually become extinct, while more species evolve to meet new demands and needs. At each given time, the complete list of services available is stored in the "Catalogue of Services" which contains the semantic description of services and models available on the network.

A "final service" is achieved through the composition of elementary services, which may in turn be broken down into more elementary services. The decomposition process is repeated until a service is achieved through the composition of "basic services", i.e. services that can not be further decomposed. The demand for a new service by the Adopters can be satisfied by the composition of available basic services, while in other cases this could require the intervention of the "Developers" to create one or more new *basic services*.

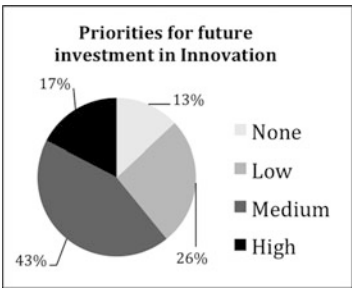

Fig. 1 Future investment priority

In order to identify services most needed by companies, the first phase of the project consisted in the analysis of the innovation needs of the partners involved in the project. Some preliminary results are presented below.[3]

Most companies claimed they have little or no need for traditional innovation services such as feasibility studies, technical audits, courses on innovation as well as newsletters and databases concerning innovations, and so on. The only service for which they have expressed a significant interest (at medium-high level for 65% of the surveyed companies) concerns the search for industrial partners for research projects. Instead, there were no problems with the relationship with the protagonists of the research. In this regard, companies involved in the analysis reported in 70% of cases to have a medium to high frequency of collaboration with Universities and Research and Innovation Centres. Moreover, 83% of them say that they should invest more in research and innovation; in particular, 61% assigns a medium-high priority to investment in innovation (see Fig. 1).

Also, the analysis showed that most companies do not have any particular problems with product (83% has no problem), process (78%) and organizational innovations (70%). In contrast, 83% of the surveyed companies declared to have problems with market innovations and, in particular, 61% declared that such problems are of medium or high level of importance (see Fig. 2). This reflects the fact that generally the member companies of ICT-SUD invest much in human resources devoted to technologies, but very often they underestimate the relevance of management and marketing areas. As a final remark, we report that 87% of companies said they need suitable tools for cooperation.

The last two results of the analysis suggested us that business social networking could be a key element to help local companies to expand their markets, improve customer relationships and optimize their relationships with suppliers and business partners. This will not be an easy task because it is well know that in

[3] Note that the companies involved in the Project are not a representative sample of local firms for at least two reasons: (1) the number of surveyed firms is small; (2) the propensity for innovation of the member companies of the Competence Centre is above the average.

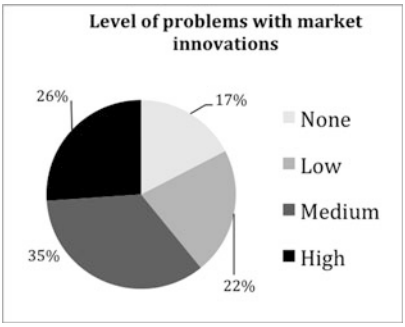

Fig. 2 Market innovations problems

Calabria companies are characterized by an individualistic business behaviour demonstrating a strong reluctance to cooperate with competitors.

Fortunately, by now local companies have realized that marketing has become essential for business survival. In fact, although until a few years ago the market strategy of a company generally was not influenced by that of other companies if these were located far away from its target market, today each enterprise, including niche companies, is increasingly exposed to market forces and tensions.

In such a context, ICT-SUD aims at supporting the local enterprises (and, in particular, its member companies) to increase their competitiveness by pushing them to adopt a model of cooperation considered as an evolution of the Business Ecosystem described by Moore in [4, 5]. In other words, we aim at building a Business Digital Ecosystem (BDE) based on an approach that is collaborative and competitive at the same time, allowing a cluster of firms to co-evolve through a dense network of relationships involving all actors in the value chain. This approach is an evolution of the concept of "networked" economy, which ensures the growth at system-level (and not at single enterprise level) thus guaranteeing long-lasting results. At the same time, benefits are evident for each company that, in fact, thanks to the cooperation, may overcome the limitations of its size and then move far beyond its technological and market boundaries.

Concerning marketing activities, an analysis conducted by Felzensztein and Gimmon [10] indicates that companies would like to have marketing collaboration with other companies mainly at an informal, social level. This consideration coupled with the results of our analysis suggested us that a suitable platform for social business cooperation could be very valuable for our member companies. Preliminary analysis on this topic is illustrated in the next section.

4 A Cooperative Platform for Social Business Network

The DE proposed by ICT-SUD allows each *Adopter* to easily create its own "operating environment" and to share (a part of) it with other *Users* and *Developers*. When a *Developer* creates, for example, a new software application and publishes it

in the DE, different users start to interact with each other. One of the basic ideas of our DE is that the platform should transparently support the *activation* of social cooperation and networking among the involved companies.

Generally each *Adopter* has its own set of Digital Species (i.e. a set of owned resources, that we call its *habitat*) and possibly a number of Shared Digital Species (i.e. a set of resources whose access has been granted to him by other users, that we call the *environment*). If an *environment* exists for a given user then the user is allowed to browse the shared resources, add notes and comments, ask questions, enter request for updates, possibly modify the resources and receive notification on any updates. All this enables and facilitates social cooperation among the users of the DE.

The social nature of our DE calls for a flexible management of access privileges to the resources. In our platform each resource: (1) is characterized by a rich set of privileges and (2) can be assigned to one or more owners as well as to one or more groups (of users). Privileges consist of actions that can be performed on a given resource; they can be simultaneously granted to a number of users or to groups of users. As an example, a user may edit a resource if she/he is an owner of the resource or is a member of a group owning the resource or has been granted the 'edit' privilege by some authorized user.

As the digital ecosystem evolves, the amount of information shared among the users increases. In order to support the users in their needs for information and service findings we will design and implement a platform that supports the Knowledge Management needs within the DE. In particular, the "Service Catalogue" will be organized as a *Distributed Knowledge Base*, also allowing users to save and share ontologies, business processes models, and so on. Moreover, users have access to a recommendation tool that allows them to recommend Digital Species and create relationships between them.

Finally, all the available information is used to activate a **knowledge discovery process** to infer new knowledge to be made available to users. The process consists of the three following steps: (1) identification of relevant relations among resources; (2) application of suitable collaborative filtering techniques [9] to improve accuracy of the prediction of user preferences: and (3) identification of new relations to be suggested to the end users. In this way, the system may propose to a end user a new resource, that is a resource not yet known to him/her but which have been experienced by other users with similar preferences according to the inferences of the above described knowledge discovery process.

The design of the software platform to be used as technological infrastructure for the BDE reflects the characteristic of Web to be an evolving system, which tries to adapt to the needs of users. The transition to Web 2.0, and, currently, to Web 3.0, are the expression of this trend: the goal is to focus on the leading role of the end user in Web browsing, which should be supported by adequate tools. The platform is based on Bore [11], an architectural paradigm for developing content-based Web applications based on cooperative interaction, whose foundations are based on the principles of the model Web 3.0.

The proposed architecture is extremely innovative in three respects. The first one is the possibility of defining, organizing, storing, querying and displaying the information as customizable objects and relations: a not-expert user can create the Web that he/she may prefer. A second aspect is the realization of social networks (social cooperation), which spontaneously arise, through user resource sharing. Finally, there is the possibility of analyzing users' browsing activities, through learning tools that enable the user to enrich his/her Web browsing experience with new knowledge.

5 Conclusion

This paper has illustrated an innovative approach of technological transfer carried out by the Competence Center ICT-SUD in an industrial research program co-financed by the Calabria Region, aimed at building a Digital Ecosystem (DE) for boosting technology transfer services. The paper has also described in detail the first two steps of the approach, respectively dealing with: (1) the analysis and specification of the innovation needs and requirements of the industrial partners, and (2) the set-up of a cooperative platform for enabling advanced social network features and knowledge discovery on the digital ecosystem. Subsequent steps currently in progress are devoted to the implementation of the four main components of the digital ecosystem, each developed within a specific research project, and to their integration using innovative DE technologies released by a fifth project.

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Part VI
Business Intelligence Systems, Their Strategic Role and Organizational Impacts

Business Intelligence for Supply Chain Management: Trends from Scholarly Literature and from the World of Practice

Isabella Maggioni and Francesca Ricciardi

Abstract The purpose of this paper is to better understand the possible role of Business Intelligence to tackle Supply Chain Management issues. We conducted a previous literature review on the basis of 122 writings selected thorough keyword search, backward search and forward search. This literature review revealed that Business Intelligence is taken into consideration by a minority, but growing, percentage of writings as a possible solution to tackle Supply Chain challenges. The main outcomes stemming from this literature search were identified and synthesized in a Concept Matrix. After investigating the state-of-the-art of scholarly writings on Business Intelligence in Supply Chain Management, we sought to collect some insights on how Business Intelligence is being perceived and implemented in the world of supply chain practice. We interviewed three practitioners from three important international consulting firms working in the fields of Supply Chain and Business Intelligence, and we collected institutional documents and several case descriptions. We found that the role of Business Intelligence solutions in Supply Chain Management is wider than that identified by scholarly literature. According to our field research, we also found that the adoption of BI solutions for managing the supply chain may be negatively influenced by a factor that has not been taken into consideration by literature so far, i.e. the previous implementation of ERP solutions.

1 Introduction

During the last few decades, supply chain management (SCM) has been one of the most investigated and discussed topic in international academic literature.

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Due to different forces, including markets globalization, mass-customization of production and shortening of product lifecycle, organizations are dealing with a growing complexity of supply networks, processes and information management [1]. Therefore, the focus of SCM studies gradually shifted from material flows to information flows moving up and down the value chain; as a consequence, Information Systems are considered a key factor to answer quickly to market challenges and to enhance supply chain performances.

Traditionally, both practice and scholarly writings have focused on ERP systems as key tools to manage information flows towards and from customers and towards and from suppliers, in order to optimize operations and logistics. Since Business Intelligence (BI) systems are emerging as powerful tools to support managerial decisions, there is also a minority, but growing, interest on how BI could contribute to decisions involving the design of, and the interactions with, the entire value chain.

Our research questions are the following: ***Could Business Intelligence (BI) be useful for Supply Chain Management? If that is the case, what types of supply chain problems could be more usefully addressed by a BI approach?***

In the next section, we will briefly present BI and we will show that there is a growing attention for the role of inter-firm cooperation and knowledge sharing in order to perform successful decision making. In Sect. 3, we will identify the emerging role of BI in SCM, according to the outcomes of a literature review on the topic. In Sect. 4, we will briefly describe the results of an exploratory study conducted in three international consultancy firms.

In the Conclusions, we will synthetically compare and contrast the outcomes from literature review and those from field research; we will present the answers we found to the Research Questions, we will underline the limitations of this study, and we will provide a brief Research Agenda for further studies.

2 Business Intelligence

There is not consensus on the exact definition of Business Intelligence, and in particular on the differences between Business Intelligence Systems and other systems such as Decision Support Systems (DSS) or Executive Information Systems (EIS). For an in-depth review of these concepts in literature, we refer to Clark, Jones and Armstrong [2]. Here, we adopt this simple definition:

"Business intelligence (BI) is a broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help its users make better decisions" [3]. Business Intelligence Systems can extract information from a large knowledge base, including for example Data Warehouse, Data Mining, Geographical Information Systems (GIS), ERP systems, Customer Relationship Management systems, Legacy Systems, but also including unstructured data, such as conversations or web pages.

In BI systems, data from operational IS are combined with analytical frontends "to present complex and competitive information to planners and decision makers" [4]. BI is often understood as threefold, in that it can provide past (historical), present (current) and future (predictive) views of business operations.

BI studies are becoming increasingly aware that the knowledge base needed to perform effective analysis includes information from external sources [4] such as, for example, other firms involved in B2B interactions. Consistently, some BI scholars are focusing their attention on the role of communication, cooperation and coordination to effectively exploit BI systems potentialities [5]. Inter-firm BI-oriented knowledge sharing and cooperation is a still under-investigated topic, but it is emerging for its rich potentialities.

3 Business Intelligence for Supply Chain Management in Scholarly Literature

As Simchi-Levi et al. stated, supply chain management (SCM) can be defined as "a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements" [6].

To get a picture of the emerging trends in SCM literature, we will use as a sample the 122 writings retrieved through a literature search described in [7]. This literature search considered the following databases: Business Source Premiere, Econlit, Google Scholar Beta version. The databases were investigated using "(supply chain) AND (knowledge OR intelligence)" as keywords in February 2011. We used "intelligence" as keyword, instead of "business intelligence", because some authors use the expression "competitive intelligence" instead of "business intelligence". The outcome of this literature review highlights that BI and DSS for SCM are considered by a minority but growing percentage (17.2%) of writings.

Given the interdisciplinary nature of the Supply Chain Management topic, Business Intelligence applied to this field tries to answer to multidimensional problems involving different processes and functional areas in a firm. It considers issues that occur along the whole supply chain, starting from the raw material supplier and getting to final customers. As stated before, the integrated view is dominant and lots of writings consider BI web-based applications as promoters of coordination and collaboration between organizations [8, 9].

On the basis of the outcomes of our literature search and considering the framework proposed by [10], we identified the following four different approaches to BI for supply chain management (Table 1):

1. ***Business Intelligence for Logistics and Operations.***
   It considers Business Intelligence solutions aimed at improving warehouse management, production schedules and transportation, focusing on issues

Table 1 Literature review outcomes on business intelligence for supply chain

Area of application	Activities	Knowledge base for BI
Logistics and operations	Warehouse flows optimization; inventory policy definition; transportation network management; collaborative planning and replenishment programs & VMI; scenario modeling	Transactional/integrated (with customers/ suppliers) information systems; RFID; ERP; GIS
Demand management	Demand entity, level and quality estimation and forecasting; demand and supply alignment; price optimization; bullwhip effect magnitude reduction; delivery of an higher service level to customers	Demand patterns; data mining/data warehouse; time series; CRM
Procurement and suppliers management	Supplier selection; information sharing with partners; support in procurement decisions	Integrated information systems; DSS for procurement; data mining/data warehouse
Opportunity/risk management	Identification of new opportunities; identification of improvement areas; uncertainty and risk management; supply chain re-engineering; enhancing relationships quality; scenario modeling	Integrated information systems; data mining/data warehouse: analysis of processes quality

related to the optimization of inbound logistics [11] and outbound logistics flows and concerning with inventory policies and transportation network management. Data analysis and forecasting systems allowed firms to generate different scenarios depending on the level of a court of variables such as final market location, product type, transportation network, number of actors involved and so on [10]. The integration of BI tools with ERP and RFID systems is essential in providing strategic information and data in order to optimize supply chain flows and to promote knowledge sharing among firms [12, 13]. Moreover, collaborative planning and replenishment programs and VMI (Vendor Managed Inventory) provide a wider database to BI analytics, empowering its potentialities [14, 15].

2. ***Business Intelligence for Demand Management.***
   Demand management considers different orders of issues: the first one is related to forecasting demand needs and its entity by analyzing customers behavior. Moreover, price optimization and promotions management represent another fields of BI application. Demand management must also try to align demand with supply, by forecasting properly demand peaks and in this way avoiding out of stocks. This area includes BI tools developed to forecast demand patterns [16] by considering consumers' buying trends and intentions [17], reducing the magnitude of the bullwhip effect [18], using data mining to plan demand [19].
3. ***Business Intelligence for Procurement and Suppliers Management.***
   This section is dedicated to BI tools developed for procurement management. These models require the adoption of a multidimensional view on data available through the firm and collectable from the market. BI applications give a

fundamental contribution to suppliers selection [20], help the process of knowledge creation about market partners [21] and represent a valid support system in procurement decisions [22].

4. ***Business Intelligence for Opportunity/Risk Management.***
   These types of BI tools allow firms to improve their business performances by delineating and picking out new opportunities, analyzing and taking advantage from uncertain conditions and risks in supply chain environment [23]. Through the analysis of the available data on supply chain processes, these systems are able to identify areas of improvement and re-engineering solutions for the supply chain [24, 25]. This can also enhance the relationship with final customers by minimizing failures and thus increasing loyalty and retention rate [26].

4 Business Intelligence for Supply Chain Management: Insights from the World of Practice

In order to investigate the application of Business Intelligence to Supply Chain Management in practice, we chose to conduct interviews, data collection and document analysis in three important international consulting firms.

The first firm is a leading international consulting firm focused on Business Intelligence (Firm A). The second one is a leading international consulting firm focused on Supply Chain Management (Firm B). The third one is a leading international consulting firm focused on ERP systems implementation (Firm C).

We conducted semi-structured interviews with executives in the selected firms and also collected several case studies and institutional documents from them. Moreover, we participated in a corporate conference/workshop organized by the consulting firm focused on Business Intelligence; during this conference and related workshops, we collected further experiences, comments and case studies on the role of Business Intelligence in real-world Supply Chain settings.

According to Firm A, supply chain is an emergent practice. Main application areas are demand forecasting and planning and inventory management. Business Intelligence systems, in this case, are aimed at enabling the tracking of customer buying behavior, product usage and demand patterns. These data are used to generate forecasts for products and sales in order to optimize inventory levels, to avoid out of stocks and to improve products availability, offering a higher service level to customers. These tasks can be implemented considering the single firm data or also involving retailers information systems in order to improve forecasts reliability and develop replenishment planning programs based on data integration that are very useful to set stock levels, sales goals and distribution policies. This growing attention towards the involvement of external firms (retailers mainly, for the time being) in order to build an effective knowledge base for BI confirms that typical supply chain problems are actually arriving at the center of business intelligence practice.

Less frequent application of BI tools are registered in the production area and procurement solutions. These tools mainly rely on demand planning processes in order to provide a clearer view of the future. Other tools are also helpful in analyzing data on manufacturing and procurement processes and in transforming them into information useful to quickly detect problems, to control consumption, to improve yields and to optimize performances.

Another interesting finding of our interviews is that BI consultants feel that organizations in which an ERP system is already present are often less likely be involved in BI development projects. In other words, whilst literature identifies ERPs as important component of the BI knowledge base, the world of practice witnesses a sort of competition between ERP and BI systems. The interviewee's interpretation was that ERPs tend to absorb so many energies that organizations, after implementing such systems, tend to avoid further important IT investments for several years.

This interpretation has been substantially confirmed by the interviews collected in Firm C: ERPs are sold as "global problem solvers", and many organizations expect that no further important Information System is needed after such an effort.

According to the interviewees, another important reason for possible "mutual jeopardizing" between BI and ERP systems is the fact that ERP systems tend to lead to strong process re-design. Therefore, when processes are finally consolidated in their new form, each innovation that could imply further process evolution (or criticism) is perceived by ERP users as "useless", "boring" or even "dangerous" and thus refused. Paradoxically, according to the interviewees, it is easier to sell a BI solution where there is a legacy system and process management is old-fashioned.

Firm B offered other interesting tips on the emerging trends in BI systems for SCM. The interviewee said that, to his experience, Business Intelligence can be very useful for supply chain management, but only if effective collaboration is developed within and between firms. In fact, a BI system cannot be better than its knowledge base, and in the case of supply chain the knowledge base is built in network interactions. Cooperation is perceived as an essential pre-requisite for the implementation of any Information System supporting SCM, thus "role games" are organized for Firm B's customers in order to develop cooperation capabilities. According to Firm B, the emerging challenges in SCM requesting complex decision-making (and then potentially addressable by BI) are related to issues such as Supply Chain strategic configuration (network design, transportation design, outsourcing choices, etc.); SC risk management (scenario analysis, redundancy positioning, etc.); SC sustainability (sustainability models, partnership design, etc.); New product development (inter-firm innovation synchronization, priority setting, etc.); Integration (management of unforeseen events throughout the chain).

5 Conclusions, Limitations and Further Steps

Our researches in scholarly literature and in the world of practice confirm that BI solutions are perceived as potentially very useful for SCM.

Both scholarly literature and practitioners agree that key SCM issues addressable by BI are: strategic configuration of the value chain (more precisely, this aspect is strongly stressed by SCM practitioners, but quite overlooked by BI/ERP practitioners) [24, 25, 27]; optimization of logistics and operations [12, 26]; risk management [19, 23]; demand management and forecasting [17, 19]. There are aspects, on the other side, that are considered important by practitioners, but are still quite overlooked by scholarly literature, and namely: SC sustainability management, new product development [15], "competition" between ERP and BI solutions for managing the supply chain.

Limitations of this work include the extent of scholarly literature search, that could be usefully extended to a more systematic journal search, and the choice of concentrating field research on consulting firms only. Further field research in manufacturing firms could usefully integrate the results of this exploratory research. After enriching literature and field research, we could propose constructs and propositions useful for developing quantitative theory testing on this emerging and interesting issue.

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Business Intelligence in the Taps and Fittings Sector: Organizational and Technological Aspects

Roberto Candiotto and Silvia Gandini

Abstract Effective management of business information has become mission-critical in most enterprises. Companies are increasingly realizing the importance of a flexible, scalable, and fully integrated infrastructure, i.e. the platform for Business Intelligence (BI) strategies.

In the latest few years, it has been proved that the effectiveness of processes for an efficient enterprise management led to a consistent realization of the business strategy. The application of the mentioned strategy in day-to-day activities became a crucial factor in today enterprise development.

Enterprises need correct information, where strategic, tactical and operational decisions are based on, in order to ensure the strategy aligned with execution. Furthermore, enterprises need to provide an intelligence system and insights into the business processes.

The main purpose of this paper is to demonstrate how organizational and technological improvements in controlling processes, might help companies to better understand their specific internal and external environment. The sector of the taps and fittings district of north-eastern Piedmont has been analyzed to display:

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– The degree of maturity of both processes control and information systems, especially referred to the BI systems;
– The most significant Key Performance Indicators (KPIs);
– How existing informative systems can support the introduction of KPIs.

The final objective is to build up a standard set of measures for this specific sector, useful for all companies willing to improve their processes management and, eventually, to implement the performance indicators in the BI system.

1 Introduction

The term Business Intelligence was coined in the 1990s by Howard Dresner, a Gartner Group analyst, with the aim of listing all technologies and methodologies used by companies for the strategically management of their data.

Generally BI systems saw their own evolutive process inside companies, introducing different functionalities and making business value creation possible for each evolutionary step. Both informative and organizational potential exploitation of this systems require a specific business culture based on workers' empowerment and knowledge sharing.

This paper is structured as follows:

– BI evolution and literature analysis;
– Characteristics and opportunities of the taps and fittings district of north-eastern Piedmont;
– Analysis of the information system of several representative companies, gathered in the Industrialist Association of Novara,[1] operating in the above mentioned district;
– Definition of a standard set of KPIs for the taps and fittings sector, determinant either to implement new BI systems or to improve existing Management Information Systems (MIS).

2 BI Systems: Evolution and Literature Analysis

The information represents the fundamental base for an aware approach to administrate the company. It is "produced" by the informative system.[2]

The production of information useful to support decisional activities at any level, is the main objective of MIS, which is constantly examined by both company

[1] The Industrialist Association of Novara represents a selected partner for ICT4LAW, thanks to its strategic role in making the most of Piedmont territory.

[2] Cfr. FERRERO G., *Impresa e management*, Giuffrè, Milano [3], p. 191.

managers and software houses. So far the evolution of Information Technology (IT) has led remarkably changes in projecting these systems, which turned from simple account reports to complex integrated systems.

The first considerations about directional information models led to the formulation of theories related to the analysis of single managers' decisional processes, rather than to the whole directional process [1, 2, 5, 10, 14].

The second generation of models is based, instead, on the analysis of the whole directional process, particularly referring to its informative needs. A new category of MIS, the so called Executive Information Systems (EIS), is designed to support the mentioned process development and represents the natural evolution of previous management accounting systems [4, 6, 7, 11–13, 15].

Finally, in the 1990s, MIS evolved toward the planning of BI application components. At this stage, the expertises' attention shifted from a merely application on technologies for data extraction to more sophisticated solutions to support the supervision and decisional processes or activities.

Our following investigation, carried out on the main excellent reviews,[3] has produced the following results:

1. Papers about BI represent roughly 5% of the total papers reviewed: it stands out the great potential of carrying out research on this specific field;
2. Dissertations addressed mainly to theoretical aspects of knowledge management, smoothing the focus on the actual impact on companies organizational structure;
3. The prevalence of theoretical papers (about 75% of the papers mentioned in point 1) suggest the importance of carrying out research toward the analysis of BI systems in a specific environment which, as said, has been identified as that of the taps and fittings sector.

3 The Taps and Fittings District of North-Eastern Piedmont

The district of north-eastern Piedmont embraces the province of Novara, Vercelli and Verbania, and is extended on about 47 kmq. It's composed by a substantial atomization into many little companies, which represent an important part of the whole productive cycle. Approximately 40% of the Italian taps and fittings production comes from this area. Their two typical products are:

– Sanitary taps and fittings, for delivery (chromium-plated) or for interception (yellow);
– Valves.

[3] According to the ranking of the *Association for Information Systems*, the top six excellent journals and reviews are: *European Journal of Information Systems*, *Information Systems Journal*, *Information Systems Research*, *Journal of AIS*, *Journal of MIS*, *MIS Quarterly*. The investigation analysed all papers published from 2000 to 2010.

Strengths. The demographic situation is quite propitious, thanks to the presence of a young and growing population; the local society is characterized by a strong cohesion, thus allowing the sharing of important and strategic goals. The entrepreneurial culture is highly dynamic and export-oriented,[4] positively open to innovation and to that range of research and development activities capable to create value for the territory.

Weaknesses. Problems derive from a difficult integration among all companies operating in the district. Although the official recognition of the district by Piedmont Region and the constitution of a District Committee, it persists a scarce capacity of common planning and action, predominately cause companies are localized in three different provinces, thus having different relationships with local institutions.

Products characteristics. In the latest 20 years, the district has affirmed itself both in national and international markets, keeping high quality standard, investing in product design and process innovation. Moreover, products are characterized by high competencies and qualified services, both in the sale and post-sale phases and, further periodic technological innovations.

Market trends. The latest few years have been characterized by a growing turbulence in terms of:

- Competitiveness on costs, particularly coming from China and affected the segment of low-price products;
- Market polarization in low-price and high-price products;
- Scarce predictability of raw materials paths;
- Narrowness of corrective actions, because of market frequent changes.

Opportunities for the future. Given the above mentioned aspects, it appears evident that companies operating in the north-eastern Piedmont district have a great margin of action to improve their specific internal processes and market relationships together with an increase in value of the whole sector for the Piedmont territory.

4 North-Eastern Piedmont Companies: Informative Needs

Analyzed companies: partner of the Industrialist Association of Novara with less than 100 employees (taps and fittings sector)

Research methodology: direct interview

Goals:

- To analyze the degree of maturity of processes control;
- To select strategic information;
- To determine attractive KPIs;

[4] The main markets are represented by Germany, France, East Countries, USA and the Middle East.

– To test the evolution of existing informative systems;
– To assess the receptiveness to implement a BI strategy/system (if not present)

The first step of the analysis was to focus on companies of the chosen sector belonging to the Industrialist Association of Novara.[5] Moreover, in accordance with the Association, it was decided to exclude business with more than 100 employees, cause already characterized by formalized internal processes and highly developed informative systems.

In the selected sector, the Association is so composed:

– Total partner: 58
– Partner with less than 100 employees: 26 (45% of total partner).
– Partner with less than 100 employees that produce only valves: 6 out of 26.

Companies that produce only valves has been excluded from the analysis, because not that significant for a possible implementation of BI strategies: these organizations are, in fact, characterized by extreme simplicity of internal processes and market relationships, and by a scarce inclination toward technological improvements.

The finding of the first survey over the tested companies displayed:

– Ten not interested;
– Ten interested (50% of contacted companies).[6]

Those interviews assessed actual internal processes, informative systems support and opportunities for feasible improvements, with the following results:

Actual situation. The prevalence of family business led to a high centralization of power; this is why information produced by accounting control have a high impact on strategic apex decisions. The control process is quite simple, based mainly on analytic accounting, although many companies desire to improve resources management through the implementation of a budgeting system. Moreover, control is seldom carried out *in itinere*, and is focused only on undertaking corrective actions, rather than on evaluating responsibilities; this aspects was observed also in the KPIs choice, mainly based on efficiency indicators. The KPIs adopted are useful to evaluate internal processes and past performance but are inadequate for the measurement of market opportunities, customer satisfaction and internal growth.

Informative systems. Although all the interviewed companies had already a draft of ERP system, none was truly satisfied of the support of existing applications; in fact, actual systems result inadequate in measuring both quantitative and qualitative aspects, particularly referring to customer satisfaction and capacity to create quality and efficiency. Furthermore in some cases, the extreme simplicity of control

[5] http://www.ain.novara.it.

[6] Fima Carlo Frattini S.p.A., Fratelli Fortis S.r.l., Fratelli Rossi S.r.l., Frisone S.r.l., Guglielmi S.p.A., Marco Mammoliti S.p.A., Neve Rubinetterie S.r.l., Nuova Diemme S.r.l., Rubitor S.r.l., V.A. Albertoni S.r.l.

processes and the need of more adequate setup, might cause a scarce exploitation of existing applications' functionality.

Opportunities. The analysis has pointed out that all companies are facing a transition phase: from one side, they should adopt a multidimensional approach, in order to measure economic, financial and qualitative aspects, to implement concomitant controls and to evaluate past performances together with future market opportunities. On the other side, this approach might be helpful to generate coherence across all organizational changes. Companies should indeed modify existing information systems and if needed implementing new ones, with particular interest on BI applications, able to improve effectiveness of data extraction and quality of periodic reports.

5 The Taps and Fittings Sector: A Standard Set of KPIs

Analyzed companies: choice among companies analyzed in the first step
Research methodology: direct interview
Goals:

- To develop criticalities analysis;
- To seek for new valuable KPIs;
- To implement a new set of KPIs in a BI system.

The second step of the analysis, actually *in itinere*, started with the choice of those realities more open to introduce new solutions or willing to accept changes of existing MIS applications (among the list of companies previously interviewed).[7] The analysis is based on the following model, inspired by the Balanced Scorecard (BSC) methodology ([8,9][8] and created by the authors (Fig. 1).

Identification of strategy. In this phase it is important to define strategic goals, considering, simultaneously internal criticalities and market opportunities. The analysis showed how customer satisfaction is directly influenced by internal efficiency, and how both of these aspects require a strengthening of human resources training for a proper handling. The analyzed companies have fairly consolidated relationships with their customer, nevertheless they may face turbulent aspects, as for instance, raw materials path. Thus they have to increase their ability to create efficiency, through a better formalization of internal procedures.

[7] At this moment, two companies are being analyzed: Fima Carlo Frattini S.p.A. and Rubitor S.r.l.

[8] In 1992 a new approach to implementing strategy has emerged, when the BSC, developed by Harvard professor, Robert Kaplan, and management consultant, David Norton, was introduced in a Harvard Business Review article.

The idea has spread rapidly: the BSC is a technique to translate a company's strategy into terms that can be understood, communicated and acted upon. A BSC clearly defines the meaning of strategic concepts like value, quality, customer satisfaction and growth: once a scorecard that accurately describes the strategy has been developed, it serves as the organizing framework for management system.

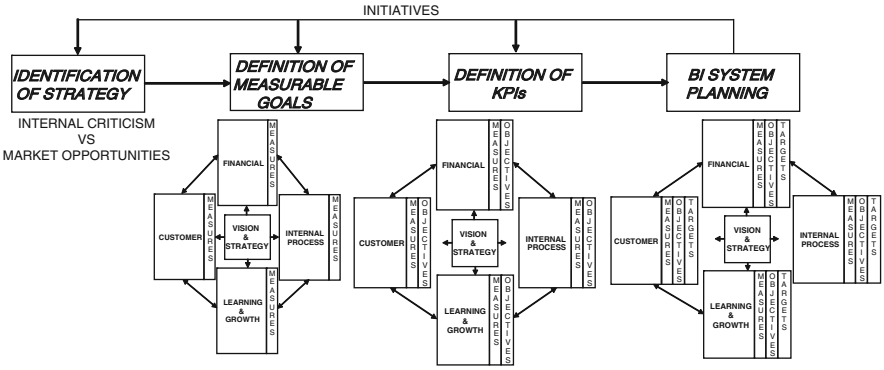

Fig. 1 Analysis phases

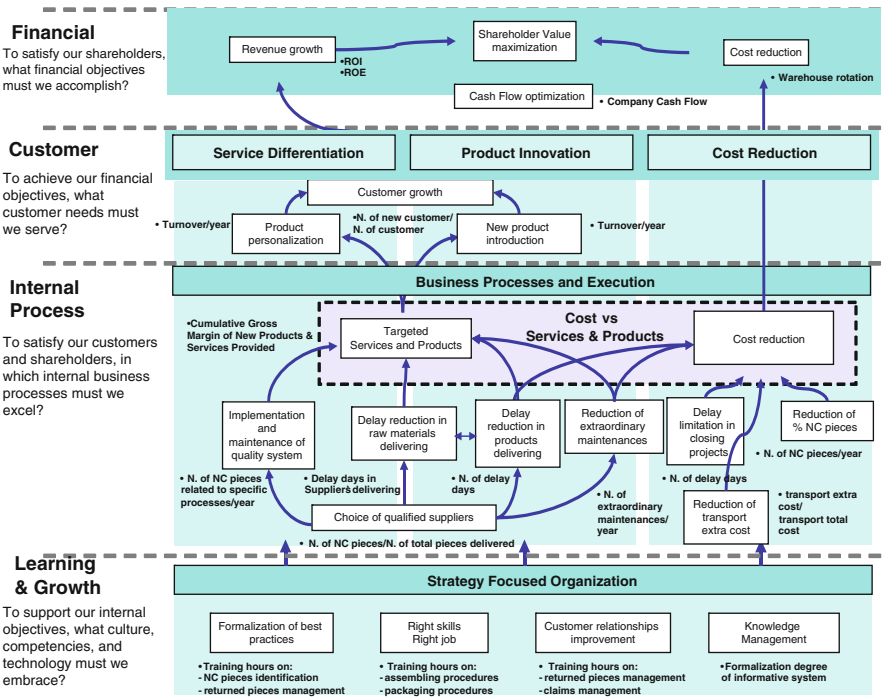

Fig. 2 Strategic actions and KPI

Definition of measurable goals. In this phase top management has to translate the strategy into specific actions, considering different perspectives of analysis and their reciprocal influences. The analysis displayed how financial aspects are influenced both by customer and by internal process perspectives, and how learning and growth activities represent the primary source for all other perspectives (Fig. 2).

Definition of KPIs. The map of strategic actions represents the input for the definition of KPIs, which will be implemented in the BI system. The comparison among the analyzed companies led to the identification of several common measures (Fig. 2).

BI system planning and conclusions. This phase hasn't already been developed. The existing model has allowed the definition of the informative content for the BI system. Next steps of the research will consider the following aspects:

– The improvement of the KPIs set, through the analysis of a larger number of cases;
– The implementation of the KPIs set, through the development of new BI applications, or by improving the use of existing systems.

Anyway, the KPIs set will be available for all companies operating in the taps and fittings sector, that will be willing to draw inspiration for the monitoring of their processes.

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Knowledge Generating Decision Support Systems: Managing the Trade-Off Between Generating Knowledge and Supporting Decisions

Carlo Caserio

Abstract The aim of the paper is to analyze the effectiveness of Decision Support Systems (DSS) in the business planning area, especially with regard to the trade-off between supporting decisions and generating knowledge.

The research hypothesis is that different conditions and approaches in managing the planning DSS may strengthen either decisional support or the knowledge generation capability.

Assuming that a DSS is generally composed of a database, a model and an user interface (Power D.J. (2002) *Decision Support Systems: Concepts and Resources for Managers*, Quorum Books, Westport), and considering that it can be classified as open or closed, the following main conditions for effectively manage an open DSS are discussed:

- The IT tools used;
- The formalization criteria which defines relationships between the variables;
- The interaction between the decision maker and the model;
- The interaction between the decision maker and organizational context, according to Nonaka's framework (Nonaka I. (1991) The Knowledge-Creating Company, Harvard Business Review, Nov/Dec, Vol. 69(6):96–104).

The paper also discusses the reasons why a closed model is more suitable for supporting decisions, and an open model is more appropriate for generating knowledge. In addition, the research hypothesis will be empirically tested with a panel of users.

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1 Literature Analysis

The literature on the Accounting Information Systems is composed of two main fields inherent the decisional support: knowledge based systems (KBS) and decision support systems (DSS) [1]. KBS are embedded into the expert systems and are usable for solving problems in well-defined domains. They are based on a set of decision making rules thus they are more suitable for structured decisions [2]. DSS, instead, are developed for supporting unstructured decisions towards an interactive approach that follows the user's non-linear cognition process [3]. Attempts to integrate the characteristics of a KBS with the interactivity of a DSS have been achieved in other contributions [1, 4] having the aim to measure the dynamic interaction in a KBS [1] or to propose an unified approach for designing and implementing a DSS based on a process of Knowledge Discovery from Data (KDD) [4]. The integration is needed to take into account the user's perspective, so that the development of the model involves the user's point of view in the logic of the system. By doing so, a sense of ownership and of trustiness in the solution is developed [5].

Further, Simon articulates the decision making process in three phases: (1) the search of information; (2) the design process; (3) the choice of a solution [6, 7]. Beynon shows some problems that affect the process mentioned above, related to the lack of expert capabilities in identifying the problem, in finding a systematic approach for finding solutions, in evaluating and selecting solutions [8]. For these reasons it is needed to develop synergies between human processing and "automatic" processing in order to align the decision making process with the real needs of the user. Many examples of integrated models are provided by the literature, all consisting in attempts aimed to achieve to enhance the capability of the models to manage unstructured decisions, bridging the gap between the automatic approach of the expert systems and the "judgmental" approach of the user. They include the so called agile models [9, 10], the UP/U model [4], the iterative expert systems, the advisory systems and the Web 2.0 Mash-ups [1].

In these contributions the role of integrated models is taking into account the user's opinion in the design and use of the model. Their aim is to propose the involvement of the user in order to improve the capability of the model in supporting the decision making process. When the users can express their point of view along the design phase, the support to decisions is improved since it becomes "able to tract with the user's iterative cognition process in solving unstructured decision" [1: 387]; also, the automatic processing of information, combined with the subjective analysis of the user, gains reliability and trustiness [3, 5]. Although the models described above attribute to the user a great importance, they do not deal with any concept of trade-off between supporting decision and generating knowledge. Analyzing the cited contributions, it seems that the involvement of the user could only lead to an improvement in decision making process, since he/she can enrich the model with his/her personal perceptions.

Our research hypothesis is that such involvement could also stimulate the user in analyzing the business environment, forcing himself/herself in seeking the best representativeness of the model, and hence in looking for the main business variables and the structure of the relationships among them, in doing so generating knowledge. The integration between the automatic and the judgmental part of the model can be managed following different approaches, which can be useful for improving the decisional support or for generating knowledge, according to the interaction approaches adopted.

2 The Interaction Approaches

Knowledge is even more considered as a source of competitive advantage [11] and it may affect the success and the failure of a company [12]. In agreement with Sanin et al., one of the most complicated tasks related to the knowledge is its representation, because such issue determines how knowledge is transformed from tacit to explicit and thus technology is needed to allow decision maker to explicit tacit knowledge, store the explicit knowledge obtained, and improve his decision making process [13].

According to Noble's theory, decision makers act on the basis of their previous experience rather than on their knowledge, applying the same solution for similar problems [14]; on this preliminary consideration Sanin et al. proposed a Knowledge Supply Chain System (KSCS) which manipulates sets of experience (variables, functions, constraints and rules) to help managers in taking decisions. On these bases, a decision maker can be involved in the use of the model and/or in its designing.

The first case occurs when a model is purchased and its utility depends totally on the ideas and the skills of the developer in defining the right variables, in using the most reliable functions, constraints and rules. This type of model may be called "closed model", since it does not allow decision makers to open the black box and change formalization rules (Fig. 1a) therefore the decision maker interacts with the IT just using database and models (i.e., the decision context and the set of predefined variables and relationships).

The second case takes place when the decision maker is involved in designing the model, and in doing so, it is achieved an effort to convert his/her personal judgments (tacit knowledge) in Information Technology language (explicit knowledge). In other terms, the decision maker is implicated in transforming the perceived conceptual model into a formal model, and thus in defining variables, functions, constraints and rules, or more synthetically, in setting variables and relationships. This type of model may be called "open model", whose meaning is the possibility to open the black box, in order to check variables and relationships' reliability, and even to revise them. In this case the HCI (Human-Computer Interaction) is performed between the structure and the results of the model,

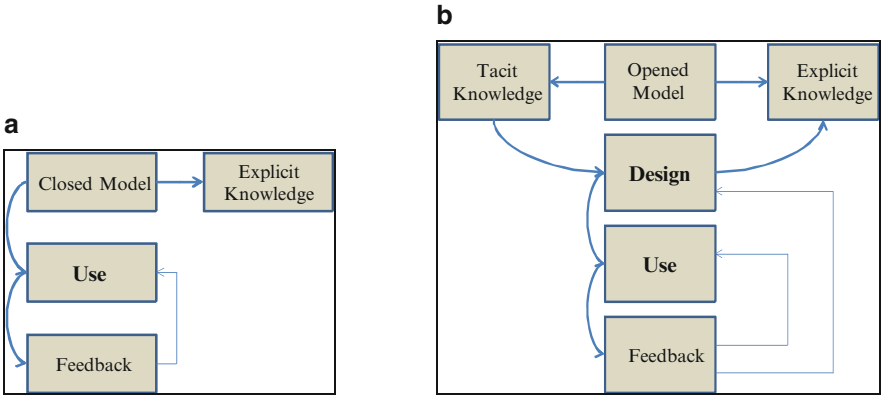

Fig. 1 Human computer interaction (HCI) in a closed and open model

being the decision maker allowed to iteratively define variables and relationships, in this case the mechanism is an heuristic feedback (Fig. 1b).

Such type of model combines the capacity of an expert system to automatically solve well-defined domains problems with the capacity to manage the unstructured cognitive process of the decision maker, allowing him/her to generate knowledge arising from the reasoning followed in defining variables and relationships and from the checks performed to validate the model. That is why we also call it Knowledge-Generating Decision Support System (KGDSS) [14].

3 Supporting Decisions and Generating Knowledge: Trade-Off in Business Planning Process

In this paragraph it is presented the result of a focus group methodology used to let emerge shared opinions within a panel of 15 Italian managers, operating in small-medium size firms in the industrial sector, using two different type of planning models: closed and open. Both models are based on financial statement data related to two past years and the aim of the manager is to interact with them for receiving support in the planning process. The closed planning model has already set variables and relationships, (formulas, rules, constraints) while the open is customizable. The final aim of the research is to demonstrate the existence of a trade-off between decisional support and knowledge generation.

The research methodology is based on two steps: (1) submitting the models to the managers for an individual use, related to their competence decisions and their personal vision of the reality; (2) a focus group interview having the aim to grasp managers insights about the perceived decisional support and generating knowledge capability of both models.

The choice of the focus group method is due to its capacity to focus upon a particular issue, to encompass the need for interactive discussion among participants, and to collect data resulting from group interaction [15, 16].

Both models have been based on a spreadsheet program. The closed one, composed of variables and relationships, allows the decision maker to assign values to the preset variables, according to his/her expected objectives, and obtain as a result a set of predictions based on preset formulas (relationships). Decision maker cannot mutate the structure of the model, either with regard to the variables or to the relationships.

The open planning model maintains the same characteristics of the closed model, but in addition the following issues are allowed:

- Setting of the variables (e.g. renaming, adding, substituting variables or constraints);
- Setting of the relationships (e.g. reading formulas, changing formulas, modifying rules).

After using both models, it is requested to the managers to discuss about the different approaches used for managing the models, and the perceived effects on decision support and knowledge generation.

3.1 Focus Group Results: Managing Planning Models and Trade-Off

During the focus group interview, some of the most shared elements emerged about the first issue:

- The relevance of the IT tool used.
  Both models are based on a spreadsheet program and managers find it very user friendly, especially in managing the closed model. Instead, with the open model, managers have more difficulties to face its higher complexity.
- The formalization criteria which defines the relationships between the variables.
  In an open planning model, managers are able to make modifications on variables and formulas, trying to formalize their own conceptual model, changing or even adding rules to the model. Some empirical examples can clarify these concepts: one manager proposes to insert the inflation rate as a new variable for rectifying the estimate sales development rate. Managers use different techniques for determining future values from the past, some of them propose to apply an historical trend, other ones a weighted average.
- The interaction between decision maker and the model.
  The interaction within an open model gives the possibility to obtain a more significant representation of the reality, allows managers to reason about the best alignment of their perception to the real world by setting the most significant

variables and relationships. In doing so, managers feel to be more stimulated in seeking the "real" representativeness of the model. They have to wonder which variables were significant, which sort of conceptual prediction is the best aligned to their expectations and which is the best function to express it.
The closed planning model only allows to acquire the feedback of planning hypothesis, and to look at the results. In this sense, it is able to produce results in higher timeliness respect than the open model, because it does not require any model customization or revise, any time expenses on reasoning, on technical modifications, on testing, on formatting sheets, on renaming variables, on resetting formulas, more in general, it does not need to "rethink" the model.

– The interaction between decision maker and the organization.
Although the individual use should be useful for personal reasoning, the different customizations proposed by the managers have to be discussed and shared together in order to recognize the effective usefulness of them. When a decision maker proposes his/her personal customization he/she is putting tacit knowledge inside the model, making it explicit through the formalization process. In this regard, this process allows to achieve the concepts of Nonaka's framework [17].

Regarding the trade-off between the decisional support and the generation of knowledge, some remarks of managers give evidence to some hidden difficulties, especially regarding the open model:

– "Modeling process led to ask, seek and test the best solutions" – "In creating my model I need to select variables, relationships and to develop a causal system. It was not easy to embrace all the variables" – "Initially the model had a lack of personalization. I spent a lot of time to get aware about missing variables and to define relationships for obtaining a satisfying representation of the reality".

As we can observe, when managing an open model managers had to face with some obstacles. On the other hand, opinions on the closed planning model reveal that its use makes easier and more timely the planning support and thus it could be effectively used for defining objectives based on an automatic estimation of the past. The main limitation could be that the closed model works like an expert system, and therefore it allows to obtain only the knowledge incorporated inside the model explicited by the vendor. However, since the closed model is generally purchased from professional developers operating with many customers, the purchaser can take advantage from the best practices hold inside the software.

This let emerge a real trade-off problem between the open model – able to generate knowledge and stimulate a learning process, but incapable to support planning decisions timely, efficiently and thus effectively – and the closed model – able to promptly support planning decisions showing immediately the effects of the planning hypothesis but unable to stimulate any kind of reasoning about the reliability and the effectiveness of the model.

The best solution for managing such a trade-off could depend on the possibility to combine an expert system model producing automatic results with a judgmental model producing reasoned results. Indeed, as the models have been based on a spreadsheet program, managers could have also the possibility to add even entire

rows and columns, so that where a variable is automatically calculated by the model, another column can be added referring to the same variable and containing another different value based on judgmental estimation criteria. This could allow a useful comparison between the automatic values, based on the expert system knowledge, and the subjective values, based on the personal point of view of decision maker. In such a model, the decision maker could decide which part of the integrated model has to be activated, according to his/her need: to stimulate a modelling for learning process accordingly with De Geus [18] or to have an immediate decisional support.

4 Conclusions

In this paper it is dealt the problem related to the trade-off between two opposite elements – support to decisions and the generation of knowledge. Many attempts to integrate expert systems with decision support systems have been achieved, almost all having the aim to improve the capability of the model to support decisions.

The aim of this research is to distinguish between two kind of models to be used for supporting decisions: a closed model and an open model. The first is based on the expert systems logic and it works on the basis of the knowledge explicited by the designer; the second one is closer to the DSS definition, because it takes into account the role of decision maker in the designing process.

Such a trade-off is empirically tested on a planning model through a qualitative focus group research. It is asked to a panel of managers to use a closed model and an open model, and after the practical session it is asked to discuss about their perceptions on the decisional support and the knowledge generation.

Interacting with the closed model, managers perceive a better capacity to make predictions, a higher timeliness and a very direct interaction, while in the open model they feel a lower effectiveness of interaction for making plans against a higher effectiveness of the interaction for generating knowledge, designing and better aligning it with their expectations. This higher efficacy seems to be confirmed by the De Geus' contribution related to the role of planning for learning [19].

However, even if the open model allows to adjust, substitute, add and manage variables and relationships, its complexity makes less effective the decisional support, because of the time expensed in analyzing the environmental situation, in converting the mental model into formal terms, in bringing and testing changes, in continuously managing and upgrading the model according to managers expectations. Also, it needs that managers have enough IT skills to apply all their modifications. For example, modifying a relationship is not always a simple task as it needs to have a holistic vision of the variables involved, the capacity to estimate the sensitivity of the relationships and the skills to translate the perception into a formula. However, as the model we proposed is based on a common and easy spreadsheet program, it is possible that some of these obstacles could be surpassed. Another result of the research is the role of the interaction between individuals.

Indeed, even if it is possible to generate knowledge by interacting with the model, it seems to be more important to share that knowledge within the organization by moving from an HCI to a HHI, that is Human-Human Interaction. In order to do so, it should be very relevant to produce at first an adequate documentation in order to record and share the main criteria adopted to build the model (what each variable represents, how it is linked with the other variables, which are the rules followed to translate the conceptual model into formulas) and then to hold collaborative discussions to develop an organizational decision support system.

The solution we propose for managing such a trade-off is an integration between the automatic and judgmental section. As empirical results show, the ideal model should take into account on one side the possibility to automatically generate values in order to fast obtain a prediction set, and on the other side, the possibility to integrate a judgmental part based on the personal managers' perceptions and representations, helpful to make explicit their tacit knowledge.

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Part VII
New Ways to Work and Interact with the Internet

Reducing Inertia and Forwarding Changes: Crowdsourcing to Reduce Uncertainty. A Theoretical Model

Riccardo Maiolini and Raffaella Naggi

Abstract Crowdsourcing is evolving as an instrument but also as a way to think and organize new companies. For this reason is interesting understand the new phenomenon within classical organizational theories and in particular, in this paper, the population ecology theory. In a evolutionary approach We suggest a theoretical model that can be useful to understand how companies arise with a web-based approach, considering crowdsourcing as a relevant element that characterizes their 2.0 new approaches, starting from the fact that companies that born with 2.0's characteristics have better chance to survive to radical changes than others.

1 Introduction

Today one of the most relevant challenges that firms have to manage is the continuous change in the environment, especially in the digital era where the contraction of property and the predominance of intangible capitals drive the economy [1] companies are often not able to rapidly understand and achieve changes because they react with a temporal lag as a consequence of information's scarcity. The development of web 2.0 and in particular the development of crowdsourcing can limit the behavioral inertia and forward decisions, in order to reduce the possibility of failure. The paper is still a research in progress, at its initial stage. Its approach is therefore exploratory, in that it aims at analyzing the topic, at providing a preliminary theoretical framework and at delineating propositions that will then guide future research by the authors.

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2 Inertia and Change

From an organization theory perspective, firms are always searching new organizational forms, the rate of change and what characterizes their diversity. Population Ecology in particular sets the focus not on the adaptation but on the selection process. The temporal dimension is therefore an important element that influences organizational survival. Carroll [2] distinguishes between three different levels of analysis in organizational ecology: the organizational level, the population level, and the community level.

The three levels have been studied as elements that explain the selection of organizational models looking at how differences in the three levels impact on the selection process. Organizations are both creators and prisoners of their environments [3]. Organizational survival depends to a significant extent on the adjustment and renewal capacities of strategy-making processes [4]. Selection and adaptation have sometimes been viewed as alternative explanations in organizational research [5].

In these theoretical models, selection and adaptation are consequences of changes that happen externally to the organizations. Change happens without the possibility to intervention on or prediction. The Hannah and Freeman model [6] is based on three phases: change, selection and consolidation. The alternative models preexist change and survive after the selection. There is no possibility that they can adapt and change after the initial change in the environment. This model is strongly linked to a sort of turnover between organizational models that are a consequence of different historical periods characterized by groups of elements that favor the selection of a model instead of another. The evolutionary view of population ecologists sees the change as a continuous and slow process that is based on the extinction of previous models that are replaced by new organizational forms and models.

Because environment changes, also organizations and their capability to learn change, especially in the last decades with the high development of web based knowledge and instruments that allow a more rapid exchange of information. The reduction of time needed to achieve information gives firms the opportunity to develop sequences of reorientation and convergence [7] before that changes enable the selection process of new organizational models. The Thusman and Romanelli model [7] implies that companies can explore internally new organizational forms trough the study and scanning process of experiments that can help them to predict future changes. The capability to predict changes implies that organizations have the possibility to adapt their model to new ones with characteristics that can be useful during the selection process. The firm mortality remains as a principle of organizational ecology but it depends on behavioral elements of firms and not from the inadequacy of their models. The selection depends on the organizational capabilities to change before that is starts; firms that cannot understand how to attend and arrange the relevant changes, will tend to be excluded. Organizational

selection processes penalize organizations with relatively inert structures, organizations that cannot change strategy and structure as quickly as their environments will tend to die.

3 Crowdsourcing and Organizational Adaptation

According to Chesbrough [8], in a context of open innovation, companies do not rely exclusively on their capabilities. They can use knowledge developed elsewhere as well as external paths to market in order to valorize knowledge developed inside. Organizational environment is not only seen as a menace, companies are able to use external pressures and changes to their own scopes trying to get advantages if they can predict or reduce the temporal lag. Crowdsourcing implies a firm or business organization (including public ones) relying on an explicit business model developed by the firm to fulfill an explicit strategic intention. Firms are not just searching new ideas, they are looking for new ways to develop and distribute ideas [9] and it is more interesting that companies can take advantage of crowd's opinion to anticipate future events and change rapidly before the selection process starts. It is true that firm mortality remains a principle of organizational ecology but, because it depends on behavioral elements of firms and not on the inadequacy of their models, the capability to predict changes before the selection process starts is a relevant element that characterize the survival of particular models. The survival depends on the organizational model as explained by Hannah and Freeman [6, 10, 11] and on the selection of the best model that fit with external changes. Crowdsourcing can help this process because it is not only an instrument that firms can decide to use or not, but is becoming a new model to define and construct relationships between companies and all the subjects that are relevant for them (suppliers, clients, customers and other companies). If crowdsourcing is considered as an organizational model and not only a tool, firms have the capabilities to modify their behaviors and adapt to radical changes.

4 Crowd Attitudes and Organizational Survival

From an organizational point of view, the differences that can emerge from these different ways to use crowdsourcing derive from the capability that firms have to change or not their organizational model. Crowdsourcing is seen as an instrument that companies use to reduce distances with their organizational environment and reduce uncertainty. The real challenge is that crowdsourcing cannot remain only a new channel of information distribution. Decision-making must be influenced strongly from crowd inputs. The development of a flexible organizational model is the reason why companies must understand the real power of crowdsourcing: it cannot only orient decisions but should anticipate trends and changes before the

selection. If companies understand the importance of forecast analysis of crowdsourcing they can work on the anticipation of selection and survive after radical changes in the market and consequent changes in their composition. To do this, it is important to consider the organizational behavior of companies that adopt crowdsourcing. Considering the web dimension of crowdsourcing, the analysis of distinctive models of companies that are based on it can start from the introduction of the Bambury's theoretical distinction of web business models [12]. In his model Bambury distinguishes between **Transplanted Real-World Business Model** and **Native Internet Business Model**. The distinction between the two models is given by the web dimension: in the first case he talks about companies that are born in the "hold economy" environment and try to adapt to the web model, in the second case there are companies that are born within the new economy and don't make distinctions between hold and new markets.

Starting from the same principle and considering crowdsourcing as the variable in the model, a distinction can be made between **crowd-born** and **crowd-user** companies. Crowd-born companies are organizations that take in consideration the development of organizational change and work to modify their organizational model to survive. Crowd-user companies on the contrary interpret crowdsourcing just as an instrument that can facilitate their decision-making process; they just receive suggestions and information from the crowd but they take decision internally. The main difference between the two categories presented in this paper is focused on the cultural approach that distinguishes crowd-born to crowd-user companies regarding the attitudes to manage radical changes. The tendency to change is a fundamental behavior that is strongly inserted in organizational culture. Every single member of the organizations must be ready and conscious of the necessity to change; otherwise a strong culture or existing technological capabilities, codified in the routines, procedures, and information processing capabilities of the firm, limit its adaptive capabilities and their propensity to change [13–15]. The culture is part of an organization from the beginning and is not easy to change. Is for this reason that crowd-born companies have a culture that permit them to introduce continuous and rapid changes to their organizational model because of the particular culture that is part of them. Openness and exploitation are art of the original culture of crowd-born companies and these elements permit the continual adaptation to external exigencies and changes. Because crowd-born companies are organized on the web, with a flexible structure that is opened to external contributions, the capability to adapt is higher that crowd-users companies that feel crowdsourcing as an instrument that can support their decision making, with a strong differentiation between internal capabilities and external information. Table 1 synthesizes the four dimensions of the Population Ecology framework, referred to the crowdsourcing phenomenon.

Crowdsourcing is in both of cases an instrument that facilitates the monitoring activity of the environment with two particular elements: the *monitoring of communities and the changes of their opinions and tastes* (used by the crowd-born companies to change their behaviors and find niches to launch new products or entry new markets) and the *anticipation of new products* (used by crowd-user

Table 1 Population ecology characteristics

Survival/Death characteristics	Crowd-born companies	Crowd-user companies
Level of change	Micro changes	No change
Temporal lag of change	Monitor-trends, research of real-time information	Alignments between behaviors and objectives
Replication	Research of new subjects	Orientation to problem solution
Culture	Born-change	Change is a choc

companies to test new products or services before it becomes official). In the first case companies adapt their model to the new requirements in search of survival, in the second case companies reduce uncertainty but don't avoid selection and mortality.

Prop1: When relevant changes take place, crowd-born companies have higher probability than crowd-user companies to survive to the change, because their attitude to achieve information faster and with a high quality of selection.

The survival probability depends on the capacity to develop an organizational model that can resist to the selection after change. There are some characteristics that facilitate companies in the development of survival models. First of all we must consider the level of change. Most organizations constitute replication – with variation – of existing organizational forms [16]. They change through micro-evolutionary processes that produce changes to their original organizational form [17, 18]. The emergence of new forms is a macroevolution that derives from a sequence of micro changes. The cultural capability to adapt to micro changes determines the organizational survival as a consequence of macroevolution and selection. The aptitude to interpret micro changes derives from a cultural capability that is part of the organizational model of companies. This is why a crowd-born company has the skills to respond to micro changes and modify gradually its organizational model. Crowd-born companies are based on the capabilities to hear their organizational environment and interpret information. They do something more, they don't just limit themselves to hear or translate information; they work, through the implementation of crowdsourcing platforms, to transmit requests and suggestions. The double communicative process of inputs and feedbacks is a sum of micro changes that are easier to interpret than macro changes. Companies forward macro changes interpreting and adapting to micro changes, using crowdsourcing platforms to develop a double communicative process. On the other hand, crowd-user companies interpret crowdsourcing platforms as instruments that serve them to test or explore their internal strategies or products and services. The communicative process in not a double process; it is a one direction communication that starts only after the formalization of a call. A call is described formal call when it contains specific requirements from the companies. This is true in the case of particular calls that ask for services, products or particular requirements (logo, branding activities, claims etc.). Another important element that impacts on the organizational survival is determined by the temporal lag that

divides change from organizational capabilities to understand the congruence of their model to future changes. The openness of crowd-born companies is a relevant element that permits the evaluation of their progress. The openness to the crowd is not only seemed as a tester of internal activities, but it serves to constantly monitor trends and fluctuations of tastes. On the other hand crowd-user companies interpret the relationship between their activities and the crowd as an element that helps, in terms of time reduction, the alignment between behaviors and objectives. The temporal lag depends from the presence of real-time information about a firm's operations or environment for which there is little or no time lag between occurrence and reporting. The reduction of temporal lags in the decision-making processes is an element that characterizes the competition and the performance of the companies. At the same time, the presence of real-time information give the opportunity to scan rapidly alternative solutions reducing temporal lags in terms of decision-making [18]. The presence of crowd born companies implies the possibility that managers can rapidly scan the environment through the use of the crowd and the web 2.0 tools to reduce the temporal lag, searching for real-time information.

Prop2: Crowd-born companies virtually explore the environment in search of real-time information to reduce temporal lag in the decision-making processes: the higher the presence of real-time information, the higher the probability to survive to organizational change.

The third aspect refers to the competition to scarce resources and the replication of the most efficient model that can pass the selection and survive. The concept of replication is however rather blurred in the Population Ecology literature. The actual meaning of replication is unclear: are we talking of technical or technology replication? Of human behaviors replication? However, if we talk about the capability to explore and study the crowd we can say that crowd-born companies exploit their environment through the analysis and benchmarking of the most relevant communities or markets for them. Crowd-user companies don't search new subjects to take in consideration but normally consider information that derive from subjects that they recognize (not from a legitimating point of view, but from a similarity of targets) as actors that provides solutions to specific requirement and don't break linear analysis with disruptive innovation or essential changes. The disposition of alternative and simultaneous solutions in the virtualization process that is implied in the crowdsourcing model reduce the temporal lag of decision-making processes through the usage of web 2.0 instruments. The evaluation of alternatives as explained by Fredrickson and Mitchel [19] is a process that can be partially expected in the web through the selection and the comments given by the crowd.

5 Limitations and Future Research

The aim of this work is mainly to outline preliminary propositions to be empirically tested and refined in future works. But, even if only with an exploratory attitude, the authors think that this might be a first step into the development of a more

complete theoretical framework for analyzing a contemporary phenomenon that is increasingly drawing attention. The expected contribution is therefore twofold: on one side the paper builds on – and hopefully helps expanding – one of the building blocks of organization theory, namely Population Ecology. On the other side it engages with a real-world phenomenon that is getting more and more relevance in practice, as a novel way of interacting via ICT-based channels, as a new form of inter and intra-organizational collaboration and as an unprecedented way of innovation. Moreover, in future works we would like to analyze the characteristics of crowdsourcing in terms of organizational survival looking at the open innovation framework and the permeability of the organizational boundaries and how this model of flexibility can impact on the adaptation of companies after changes.

Our research is at an initial status, so the main limitation lies in the exploratory approach the authors have decided to adopt. The second step of this paper will be the development of some pilot interviews inside crowd-born and crowd-users companies, to validate the propositions and develop, in a third phase, an empirical model that can be tested and verified. The pilot interviews will be also functional to explore which can be possible measures that will make sense to the framework used in the paper. A second limitation lies in the lack of empirical data, especially because crowdsourcing is a new phenomenon and the availability of data and cases to be studied in depth is still restricted. However, the authors intend to further develop the preliminary reflections here proposed to form the basis an actual model of crowdsourcing as an instrument to reduce organizational death. The planned research strategy foresees a first phase of observation through case studies in a specific industry, the results of which will allow focusing and refining the theoretical framework for completing the study.

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The Future of Work: Trends of Telework in Italian SMEs Between 2005 and 2009

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Abstract New ways of conducting the working activities are emerging among enterprises. In such a context, research have investigated only marginally the evolution of telework adoption even thought continuous investments in Information Technologies have allowed to develop telework practises especially for tasks that do not require physical proximity to the customer. Thus, this paper examines the telework diffusion among companies, trying to identify how technological, organizational and environmental contexts influence its diffusion. Drawing upon a large-scale sample survey conducted among firms in Italy in the 2005–2009 period, results show how technological and organizational contexts matter in each year investigated. Contrarily we have shown how with the progressive diffusion of telework practices, the environment influence over their adoption decreases of importance. Managerial implications are also discussed.

1 Introduction

Investments in Information Technologies (IT) sustained by firms have determine changes in their relationships with suppliers, customers and in the use of innovative work practises such as teleworking. In terms of definition, telework is a form of work that uses Information and Telecommunication Technologies (ICT) to allow workers to perform their job at a remote work site. This definition refers to both telecommuters working from home and "dispersed workers" spending part of their working time outside the physical boundaries of companies [2].

The fact that enterprise systems may favour use of telework by allowing the standardization and modularization of many business processes poses some questions on the Small and Medium Enterprises' (SMEs) capacity to exploit IT

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improvements in order to introduce telework practices in their workplace. Such questions are relevant as SMEs may be potentially interested in telework as a work practice allowing greater flexibility and a broader geographical reach at low costs. However, to the best of our knowledge, empirical evidence showing the diffusion of telework in SMEs is scant and not comprehensive. Indeed, in past research, several antecedents of telework diffusion have been identified in large companies and the diffusion of telework practices in SMEs was under-investigated. By contrast, today SMEs are expected to adopt telework practices given its lower costs.

Taking into account that this study may be considered a first step to understand a more complex phenomenon and motivated by the issues shown above, this paper analyzes two research questions. First, which is the adoption trend of the telework among firms? Second, what are the telework antecedents? To give answer to these questions, the paper formulates eight hypotheses that are validated on a sample of Italian companies.

2 Theoretical Background and Hypotheses

Managerial and organizational studies highlight how telework can bring several benefits especially in large enterprises and how changes occur in terms of organizational size, style of control, inter-organizational relationships and work-force management [4]. Based on a review of the literature we have taken into consideration three types of context that could affect the telework practices – the technological, organizational and environmental features – drawing on the so-called TOE framework [15], which has been often used to analyze diffusion of IT within firms. We have followed the conceptual framework shown in Fig. 1.

2.1 Technological Context

This context refers to the availability of Information Systems (IS) that make many occupations amenable to disaggregation from firm's physical boundaries [10].

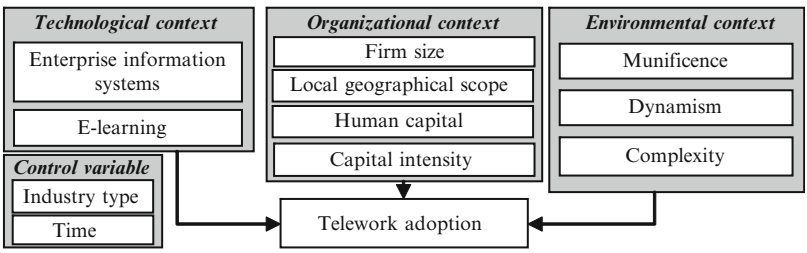

Fig. 1 Conceptual framework

Enterprise information systems. Past research on telework have under-investigated the IS role in enabling firms to adopt it. E-learning technologies is an important precondition for telework use, since supports knowledge management when employees are not located in the same company site [7]. Being ERP, CRM and e-learning good proxies for IS adoption, we hypothesize what follows.

H1: The adoption of enterprise information systems and e-learning technologies is positively correlated with telework practices.

2.2 Organizational Context

This context mainly refers to characteristics and resources owned by firms.

Firm Size. The relative advantage to adopt IT and telework is not clear for small businesses whose sales are geographically concentrated [8]. However, the commoditization of standardized information systems make telework affordable not only for large enterprises, but also for SMEs.

H2: The size of the company is positively correlated with telework practices.

Local geographical scope. Companies that operate in a local or regional market are less likely to take advantages of telework practices given that they usually have small dimensions and less necessities of managing commercial activities in a distant setting from their unit [10].

H3: Companies focused on "local markets" are less likely to adopt telework practices.

Human capital. Knowledge workers are more likely to adopt telework practices respect to employees performing routine tasks, as the formers are characterized by higher skills prerequisites and often do not have to be physically present in the place where business processes are executed [5]. D'Amours [3] showed how jobs more amenable to be performed in a telework modality need higher employees autonomy in performing their task.

H4: Telework practices are more likely in firms employing higher levels of human capital.

Capital intensity. Companies that are capital intensive are expected to have less interest in telework since their jobs are more likely to require a physical presence [11]. In such a context, Apte and Mason [1] showed how the information intensity of an occupation, the physical presence constrain and the need of customers proximity explain the potential disaggregation of an occupation.

H5: Capital intensive companies are less likely to adopt telework practices.

2.3 Environmental Context

Studies on IT diffusion mainly concentrated on competition intensity and uncertainty [1], environmental dynamism, complexity and munificence as environmental

variables. We focus on the latter three factors since they have been showed to synthesise various environmental characteristics [6].

Munificence. Environmental munificence refers to the extent to which the environment can support sustained growth. It affects the availability of financial resources that can be invested in IT and the timing of IT adoption since laggards are more likely in low munificent industries. Moreover, in munificent environments firms are more likely to face a stage of business growth, and they may be more incline to use telework to increase flexibility in sales, after-sales services and product development processes.

H6: High environmental munificence is positively associated with telework practices.

Dynamism. Environmental dynamism refers to the rate of instability in an industry (i.e. changes in customer preference) and it has been usually associated with higher IT investments and innovation propensity [14]. Moreover, similarly to the case of high munificence, companies that operate in turbulent environments are more likely to need flexibility and thus they may need to decentralize work to a greater extent (telework can be an instrument to achieve decentralization).

H7: High environmental dynamism is positively associated with telework practices.

Complexity. Environmental complexity depends on both the number of different products offered by the firm and product/service technical complexity. In complex environments two contrasting effects may shape telework diffusion. On the one hand, the standardizability and the codifiability of activities is more difficult in complex environments. On the other hand, the need of having differentiated units is greater and the disaggregation of work activities is needed. Thus, we cannot expect a priori any hypothesis.

As telework practises are expected to increase, being the technology an enabler of its use, environmental factors are likely to have a decreasing importance in determining their diffusion, inherently with innovation approaches [16].

H8: With the progressive diffusion of telework practices, the environment influence over their adoption decreases of importance.

3 Research Methodology

3.1 Sample and Data Collection

The data used for this study are the output of a survey carried out every year, from the 2005 to the 2009, on a population of around 6,000 companies located in Piedmont. We focused the survey on four industry groups: (1) traditional manufacturing industries (TMAN), (2) hi-tech manufacturing industries (HMAN), (3) material service industries (MSERV), (4) information service industries (ISERV). A total of around 428, 533 and 443 questionnaires were returned respectively in periods 2005–2006, 2007–2008 and 2009.

3.2 Measures

We have measured the adoption of ERP, CRM and e-learning platform using dummy variables (1 if the company adopts and 0 otherwise); the firm size through the number of employees in logarithmic form [9]; the local geographical scope is the percentage of sales made in Piedmont; the human capital has been measured considering the labour cost per employee; the capital intensity of the company is the logarithmic form of the tangible assets/number of employees ratio.

Concerning the environmental context, we followed the approach used by Dale Stoel and Muhanna [13]. Dynamism was operationalized as the variability in annual industry sales and was measured as the standard error of the regression slope coefficient of annual industry sales divided by the industry mean for the 5 year period. Munificence was measured as the growth rate in annual industry sales for 5 years, measured as the regression slope coefficient divided by the average industry sales. In line with Dess and Beard [6], we framed industry complexity as homogeneity-heterogeneity of inputs and outputs and we used input/output concentration as a measure of industry complexity. For each of the three industry characteristics, we ranked the values by year and split the industries into two sets (high and low), based on the median value for that characteristic. Each firm observation in the sample was then assigned three dummy variables (1 for high and 0 for low-value) to proxy the environmental factors.

For measuring the telework adoption, we asked directly to companies if they adopt the telework (1 for adoption, 0 otherwise). Finally, we controlled for industry type (TMAN, MSERV and ISERV industries) aimed to capture industry' technology characteristics that environmental variables could capture only in part, and also we controlled for the period in which the company has replied to the survey (dummy09 if the company has replied in the survey wave of the 2009 and dummy0708 in case the company has replied in 2007 or 2008).

3.3 Findings

The empirical analysis followed a two stage process. First, descriptive statistics are provided (Table 1) and correlation matrix was computed (on request authors will provide it). Second, we searched for the determinants of telework adoption using the logit model $Y = b_0 + \Sigma i = 1{,}3 b_i\,(TC) + \Sigma i = 4{,}8 b_i\,(OC) + \Sigma i = 9{,}11 b_i\,(EC) + \varepsilon$, where Y represents the telework adoption; the i term indicates the type of technological (TC), organizational (OC) or environmental (EC) variable; b_i are the parameters to be estimated and ε is the error term.

First, descriptive statistics highlight two key facts. First, the telework adoption increases from the period 2005–2006 (T1) to 2007–2008 (T2), but remains stable from 2007–2008 and 2009 (T3). Second, except for e-learning practices, the diffusion on technologies enabling telework has not been increasing over the

Table 1 Descriptive statistics

Variable	Min	Max	Mean			Standard deviation		
			T1	T2	T3	T1	T2	T3
Telework	0	1	0.19	0.35	0.33	0.40	0.48	0.49
ERP	0	1	0.30	0.34	0.33	0.47	0.48	0.49
CRM	0	1	0.16	0.15	0.10	0.38	0.36	0.33
E-learning	0	1	0.18	0.31	0.27	0.57	0.66	0.48
Firm size	2.30	7.31	3.65	3.70	3.69	1.07	1.13	1.06
Local geographical scope	0%	100%	37.13%	53.65%	50.24%	38.19	41.26	38.93
Human capital	3.54	368.96	33.73	34.67	39.22	21.38	14.58	22.88
Capital intensity	5.33	14.04	9.84	9.79	10.14	1.42	1.48	1.50
Munificence	0	1	0.69	0.67	0.62	0.46	0.47	0.49
Dynamism	0	1	0.60	0.50	0.50	0.49	0.50	0.50
Complexity	0	1	0.48	0.46	0.44	0.50	0.50	0.50

Table 2 Regression model results for telework adoption

	Independent variables	Telework adoption
Technology context	ERP	0.634^{***}
	CRM	0.725^{***}
	E-learning	0.557^{***}
Organizational context	Size	0.354^{***}
	Local geographical scope	-0.007^{**}
	Human capital	0.026^{***}
	Capital intensity	-0.220^{***}
Environmental context	Munificence	1.122^{***}
	Munificence × Dummy09	-1.709^{***}
Control	Dummy09	1.709^{***}
	Dummy0708	0.988^{***}
	HMAN	−0.440
	MSERV	0.157^{***}
Variables	ISERV	1.482^{***}
	Constant	-3.175^{***}
	Nagelkerke R^2	31.70%
	Overall percentage correct	78.6%

$^{***}p$-value $< 1\%$, $^{**}p$-value $< 5\%$

time, despite telework shows a growth of adoption from the first to the second survey. This may suggest that telework adoption is a decision that comes after information systems have been adopted and routinized in firms' business processes.

Second, by looking at results of the logit regression model, Table 2 shows how enterprise information systems and e-learning platform were positively correlated with the telework adoption, all with a p-value less than 1% (H1 was supported). Then, organizational features influence systematically telework adoption. Specifically, firm size had a positive and significant effect (H2 was supported). Furthermore, companies focused on local market are less inclined to adopt the telework (H3 was supported). In addition, H4 (on the human capital effect) was supported, since the labour cost per employee was significant. We also found that companies in

more capital-intensive industries were negatively associated with telework adoption (H5 was supported). Furthermore, munificence had a positive influence on telework adoption, even though in 2009 it decreased (H6 and H8 were supported). Finally, no evidence on the influence of dynamism on telework adoption was found so that (H7 was not supported). The Nagelkerke R^2 was equal to 31.7% and the overall percent correct equal to 78.6%.

4 Conclusion, Managerial Implications and Future Research

The evidence on SMEs represents one of the most important novelty aspect of this paper, which allows to enrich a stream of studies on telework that have been mainly focused upon its use in large enterprises. First, we have shown how the telework adoption increased from 2005 to 2008, even though its diffusion has stopped in 2009. We believe that this standstill in 2009 could be due to the economic crisis that has negatively affected IT investments and innovation projects in many industries. This aspect could be also explained by the fact that telework is approaching most of potential adopters of this practice, which can be significantly lower than the whole samples analyzed in the three surveys. Unfortunately, this issue cannot be easily investigated in this type of study. Second, our contribution provided a foundation for a better understanding of how technological, organizational and environmental variables may influence the adoption of the telework. We have found that the adoption of enterprise information systems systematically affects the use of telework practices. Furthermore, the size is still a discriminant in the telework trends as the occupational attributes. Finally, in dynamic and munificent environments the telework adoption is more likely.

In terms of managerial implications, our findings suggest that by investing in infrastructures and organizational changes at the right time, managers can create the appropriate conditions for teleworking. Moreover, increase the knowledge of workers and also of the management can lead to an higher telework adoption and to consequent saves in terms of time and costs.

Overall, this study contains some limitations. We did not analyze the telework diffusion according to the departments where it is used, and we did not conduct any case studies in order to understand the motivations of its usage. Furthermore, the investigation of how social and cultural contexts in terms of mimic and normative pressures, as pointed out by Powell and Di Maggio [12], may influence telework practises is needed.

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Communities of Practice and Practice Preservation: A Case Study

Francesco Schiavone and Rocco Agrifoglio

Abstract Several studies stressed that communities of practice support organizational learning, innovation, and the development of members' capabilities. People engaged in a technology-based community of practice do not just "use" a specific technology and its artefacts in order to achieve a given purpose or exploit a function. They recognise themselves as community members and share common values, ideas, knowledge, and opinions about the technological artefacts around which their community is built. The literature agrees that technological change might produce innovative dynamics within these communities by affecting the routines and practices of their members. However, technology change could encourage some people to build a community of practice in order to preserve the practice that took place before technological substitution. In this regard, people community as an instrument to preserve knowledge, rather than to create new. This study offers a preliminary delimitation of the concept of "practice preservation" and reports a study based on inductive approach in order to investigate this phenomenon: the case of MAME community.

1 Introduction

A community of practice (henceforth: CoP) is a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly [1]. Several studies stressed that CoPs support organizational learning, innovation, and the development of members' capabilities [1, 2]. Typical examples of CoPs are groups of practitioners of craft and skill-based activities (e.g., developers, photographers, snowboarders, etc.).

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The notion of CoP is much deeper than a generic social system or group of technology users. A CoP overlaps, in some extent, the notion of market niche. The main difference between these two concepts is the role of knowledge is critical in CoPs, as it binds together their members, but it is less powerful in defining the boundaries of a market niche (whose boundaries are defined by firms' market analysis). Therefore, individuals engaged in a CoP, therefore, do not just "use" a specific technology and its artefacts solely in order to achieve a given purpose or exploit a function. They recognise themselves as community members and share common values, ideas, knowledge, and opinions about the artefacts around which their community is built.

A phenomenon like technological change might produce innovative dynamics within this type of social group. Technological change is the social and economic process by which an invention becomes a novel technology (innovation) which diffuses within an industry [3]. The shift towards a new technological paradigm starts when a technological breakthrough occurs [4] and new technological trajectories, technically more advanced and based on different scientific notions, stem from it. The changes caused by industry technological change outside a technology-based CoP imply some changes also within the social group [5]. On the one hand, its members will have to renegotiate and define new shared procedures and routines in relation to the process of technology substitution occurring in the industry. On the other hand, these internal changes should not modify the "core" of knowledge and other key features of the community in order to keep its key practices. The management of the trade-off between tradition and innovation is, thus, a key issue for the members of this type of communities.

The main aim of this paper is to investigate the motivations that lead people to join CoP. The literature identifies the knowledge creation and knowledge sharing as mainly reasons that lead individuals to join CoPs. However, empirical evidences show some communities for which the main aim is to preserve their "core" practices over time. In this regard, people could join to CoP in order to continue in doing their activities, preserving their old knowledge rather than to create new old. Practice is defined in this paper "the coordinated activities of individuals and groups in doing their 'real work' as it is informed by a particular organizational or group context" [6, p. 386].

The paper reports a descriptive study based on inductive approach in order to investigate this phenomenon. The case selection is based on specific technique of case study research named deviant case study, which aim is to cast light on the exceptional and the untypical phenomenon [7]. We analysed the community of arcade videogames players developing and using the software MAME (Multi Arcade Machine Emulator). Our study offers a preliminary delimitation of the concept of "practice preservation", the process by which CoP defends its core practices over time from extinction and obsolescent risks due to external factors (e.g., technology changes, institutional changes, etc.), and extends the rising empirical evidence about the phenomenon.

2 Literature Review

A CoP is an informal coming together of people bound together by shared expertise and passion [1]. Within these communities, people share their experience and tacit knowledge in free-flow, improving their abilities and skills, and fostering learning. People join CoPs for several reasons, such as education, professional issues, and hobbies. Their main goal is to share information and interests only with other members. Within these communities people discuss about their identity, conflicts, and other topics spontaneously. In this regard, many scholars and practitioners have focused on communities, investigating manly the role of situated practice in the process of learning and creating knowledge [1, 8].

CoPs often evolve into virtual communities. In this case, members interact and exchange information and experience using ICT and online collaborative tools rather than face-to-face meetings. Internet and ICTs allow individuals to link up across distance, time, culture, and organizations, providing an environment that can facilitate collaboration and interaction. Some authors [9, 10] have argued that CoP cannot be dissociated from a common physical space, highlighting the role of face-to-face interactions to share experience and tacit knowledge among members. On the contrary, other scholars have assumed that virtual CoPs exist and play a key role in fostering the socialization process as well as knowledge creation and knowledge sharing among the people who join to them [11–14].

Within CoP, members develop common sets of codes and language, share norms and values, carry out critical reflection, and dialogue with each other at a professional level, generating an environment characterized by high levels of trust, shared behavioral norms, and mutual respect and reciprocity [13]. This environment has been directly linked to knowledge creation and sharing processes. Katzy and Ma [15] argued that both the community and the professionals (e.g., developers, teachers, lawyers, doctors, academics, and consultants) themselves could add value to the "*status quo*" in terms of knowledge creation, knowledge sharing, and identification. These people join a community to develop knowledge and specific expertise about a particular issue, which could not be obtained otherwise. Thus, literature suggests that the most frequent reason for joining a virtual community is to get access to information [16, 17].

However, despite the literature identifies knowledge creation and knowledge sharing as mainly reasons that lead individuals to join CoPs, there are communities for which the main aim is practice preservation. We define it as the process by which CoP defends its core practices over time from extinction and obsolescent risks due to external factors. One critical external factor for the survival of some CoPs over time could be technology change.

Technological change evolves through long periods of incremental change punctuated by revolutionary breakthroughs [4]. It is characterized by a socio-cultural evolutionary process of variation, selection, and retention [18]. "Technological advance may, then, be driven by the combination of chance or random events (variation), the direct social, political action of individuals and organizations

in selecting between rival industry standards (selection), and the incremental, competence-enhancing, puzzle-solving actions of many organizations that are learning by doing (retention)" [4, p. 606].

Within CoPs, the changes caused by revolutionary technology breakthroughs could affect in more ways the routines and practices of community members who use technology for their practices. Technology substitution drawn from extinction and obsolescent technology itself could encourage community members to renegotiate and define their procedures and routines. However, they could also not modify the "core" of knowledge and other key features of the community in order to preserve their practices. Moreover, technology change could encourage some people to build a CoP in order to preserve the practice that took place before of technological substitution. For example, despite CD has replaced vinyl, some people may choose tradition rather than innovation, remaining anchored to prior practices.

In this regard, practice preservation is important for two reasons. Firstly, practice preservation allows saving and capitalizing knowledge and technical skills about technology that otherwise might be lost over time. Technological and scientific knowledge is never acquired once forever; to achieve new interesting knowledge does not mean that this knowledge will be preserved [19]. For example, since Hellenistic period people used knowledge to build new technologies, such as "Antikythera mechanism" (about 150 BC) and "stream turbines" (I century AC), to improve both social life and working activity, forgetting sometimes those previously built. In both cases, the scientific and technological knowledge that made these constructions were lost few decades after, while people became able again to build similar mechanisms only a few centuries ago.

Secondly, practice preservation allows creating new knowledge and technical skills about the same technology. The social learning theory highlights the link between practice and knowledge, assuming that social practice is inherent in learning process of community members [1, 8]. From this prospective, knowledge is inseparable from practice, and learning is directly tied to community membership; the potential for learning lies in empowering members with the ability to contribute to the community [20]. Within CoPs, the leaning process is characterized by bi-directional influence and reciprocal exchange, fostering the transferral of learning from the community to its members and from the members to the community [21]. In this regard, community members create, hold, and share knowledge collectively because of their practice [22]. Thus, the practice preservation is critical for both knowledge preservation and knowledge creation.

3 The Case of MAME Community

Informatics is a technological field rich of examples about the self-organisation of COP in order to preserve their body of knowledge and practices. An interesting case is the emulation software of old videogames for modern home PCs. In 1968, the first

videogame was patented. Videogame industry had a great expansion over the last three decades. In 1980s were the start of the modern videogame era with the release of many popular and successful games (e.g., Pac-Man, Tetris, and Space Invaders) which were played by users in both public game centers and, after the widespread of home computers, private houses. It is difficult to identify a clear and univocal milestone of technological change in this industry due to its great orientation to innovation and the continuous development by firms of new videogame genres and gaming modalities.

Nowadays arcade videogames and videogames centers still exist (although they are not anymore the exclusive and dominant solutions for videogame players) but what mainly changed over time is the technical nature of videogames. In this light, a critical advancement in videogame industry has been the transition from 2D and 3D videogames to "virtual reality" games, running only in PCs equipped with more sophisticated and powerful hardware (e.g. video cards, sound card and RAM memories). In other words, technological change in videogame industry is related to the shift (in both public game centers and players' private homes) from old "bit-based" platforms to the "new generation" of more powerful computers [23]. Nowadays virtual reality is the leading design in videogame industry. Since at least 10 years, virtual reality videogames replaced quite easily old videogames at both game centers and homes' players. Home gaming increased largely (due to the diffusion of home videogame consoles as Playstation or X-Box). Nowever a community of old arcade videogames fans emerged.

To date, MAME is one of the most famous emulator software running old arcade videogames on modern home PCs [24]. The first version of MAME was released in by an Italian developer in 1997. Users of this free software download old arcade videogames (zipped in one file named "rom") from the web. Many of them are abandonware and are freely playable by users without any copyright issue (abandonware is old and abandoned software for which the producer does not claim anymore the property rights). MAME runs roms and executes them as normal PC videogames playable via keyboard. Although MAME offers an experience simulated and, thus, totally different from the original emotion of playing an arcade videogame in a game center, users can recover and exploit another time their expertise, achieved with much effort many years before.

The success of this software is based on two different sub-communities. The first is the restricted community of developers sharing a strong passion for old arcade videogames. Developers contribute actively and without remuneration to the software update and increase the amount of games freely downloadable by users, which constitute the second virtual community related to MAME (MAMEWorld). Communities of old arcade videogames existed already before MAME's first release but this software contributed to their enlargement and reinforcement. Their members manage many websites (not solely focused around MAME) in which they share information and suggestions about old arcade videogames and their emulators, additional utilities and hardware (e.g., joysticks). Indeed, MAME is not the only emulation software of old videogames.

A key feature of this community is interaction. Its manifesto clearly reports that MAME is: "*. . .not a cemetery of game news. We have a number of busy forums, chat, and we encourage the contributions and co-operation of our visitors with regard to all aspects of MAMEWorld. Check out the Fanstuff Page, the Rips Page, the Tunes Page, the reviews Pages, MameTesters,* etc.*, and all our hosted sites. Many visitors contribute regularly and share their enthusiasm for MAME, the games and MAMEWorld. It is one of the most rewarding experiences about running this site to receive so many enthusiastic contributions and to see the pleasures which MAME creates for so many people. And we respond personally to all requests, proposals or questions we get.*" [25].

There are many other cases of emulators (e.g., WinUAE for Amiga 500 videogames) establishing a collaborative relationship between old arcade videogames and PCs with hardware designed for new generation videogames. In all these cases, these software are not just reactions to an existing community need but also drivers of further development of the community.

4 Discussion and Conclusions

The main aim of this paper is to investigate the motivations that lead people to join CoP. We investigated the case of "MAME community". It is formed by two CoPs: (a) MAME developers community who developed an emulator software (MAME) running old arcade videogames on modern home PCs and contribute actively to software update; (b) MAMEWorld community is formed by fans using emulator in order to play with arcade videogames.

Previous research investigated CoPs focusing on the reasons that lead people to join them [16, 17]. The literature argued that knowledge is the basing motivation of this phenomenon. In fact, people do not join a community to satisfy self-interest, but are motivated to develop their knowledge. In this sense, the community considers knowledge as a public good and contributes to its development and preservation. The members contribute to increasing the knowledge provided, while the community contributes to increasing the individual knowledge of its members. On the other hand, the literature also investigated the link between technological change in industry and community members' routines and practices [5]. A phenomenon like technology substitution could affect in more ways the routines and practices of community members. On the one hand, technology substitution could encourage community members to renegotiate and to define their procedures and routines. On the other hand, they should not modify the "core" of knowledge and other key features of the community in order to preserve their traditional practices.

Some empirical evidences, such as MAME community, show how communities could be aimed at preserve the practices rather than modify them or develop new one. The MAME community represents a rare case of CoP because its members decided to create community to save their practices and preserve knowledge and

technical skills, rather than to obtaining new knowledge and skills. In fact, MAME was designed to recreate the hardware of arcade videogame in software running on PCs and other modern platforms. The technological change in videogame industry caused the shift from old "bit-based" platforms to the "new generation" of PCs and other modern platform, removing game players the possibility to play with arcade videogames. In 1997, the Italian programmer Nicola Salmoria released the first public MAME application and, shortly after, a community of old arcade videogames fans emerged. The MAME community's aim is to preserve gaming history by preventing vintage games from being lost or forgotten [24]. About this, the MAME official site stresses that "*MAME is done both for educational purposes and for preservation purposes, in order to prevent many historical games from disappearing forever once the hardware they run on stops working*" [24].

The case of MAME clearly shows as technology change encouraged developers and game players to build an ad hoc community due to preserve their practices that took place before of the technological advancement. The MAME community allowed game players to save and to capitalize the knowledge and the technical skills about arcade videogames that otherwise would be lost over time. On the other hand, it also allowed game players to acquire new knowledge and to develop more technological skills about arcade videogames. Basing on social learning theory, the literature agrees that community members create, hold, and share knowledge collectively because of their practice [8, 12, 22]. CoP constitutes environment favoring social participation and the exchange of ideas and experiences, supporting the learning process. It encourages the acculturation of its members by actively participating in the spread, reproduction, and transformation of knowledge in practice about agents, activities, and artifacts [20]. Similarly, we believe that members can preserve knowledge and technological skills because of their practice. The MAME official site also stresses that "*Of course, in order to preserve the games and demonstrate that the emulated behavior matches the original, you must also be able to actually play the games*" [24]. These statements clearly emphasize the role of practice in knowledge preservation and they highlight the awareness of the MAME community founders on how to hold the set of knowledge acquired. Thus, this case shows that both the knowledge preservation and the knowledge creation are supported by practice preservation.

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ICT and Judicial Administration: A Model for the Classification of E-Justice Innovations

Luigi Lepore, Lara Borrello, and Federico Alvino

Abstract The objective of this study is to propose a model for classification of e-justice innovations based on two variables (intensity of technological innovation and impact on organization and management), which could be useful to systematically address problems related to the implementation of innovations and to the evaluation of their effectiveness. In particular, we have conducted a case study on the court of Naples trying to classify the innovations implemented.

1 Introduction

Disappointing performance of Judicial System (JS) of many countries, coupled with the awareness of crucial role played by these systems for social and economic development [1], led the legislator and doctrine to rethink logics of organization and management. Attention has mainly focused on the causes of inefficiency in production and supply of judicial services [2, 3] and on the possibility to introduce tools and new models of management to improve JS performance [2–7]. In particular, the interest of scholars has focused on the use of Information Systems (IS) and Information and Communication Technologies (ICT) as a means to control and evaluate the courts performances, to organize the case-flows management ant to generate new ways of working and interacting in order to improve efficiency and effectiveness [3, 8, 9].

Starting from these considerations, the aim of this study is to propose a model for classification of the e-justice innovations based on two variables: intensity of technological innovation and impact on organization and management. This model could be useful to systematically address problems related to the implementation of innovations, taking advantage of the opportunities associated. The second

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paragraph examines the supporting role of ICT to judicial activities (core business of courts) and to organizational and managerial activities. The third shows a model for classifying the e-justice innovations. The last paragraph was devoted to analyze the case of court of Naples.

2 ICT and Judicial Administration

The JS reform is part of the wider modernization process that involved all sectors of public administrations (PA). In Europe, only recently this process has also affected judicial institutions. Among the reasons which led to the realization of the reform process there were the mostly steady increase in the workload of courts and the chronic slowness of judicial procedures. In this context, the objective of the reform was to improve efficiency and effectiveness of JS also through the introduction of new ICT. In fact, it seems to have spread the idea that the use of ICT can be a very important factor to improve performance of JS. In Europe the term "e-justice" was coined to indicate those projects aimed at enhancing the use of computer applications in the field of justice, in order to improve the quality of judicial services, making them more accessible, faster and less expensive [8, 9].

To understand how the availability and the exchange of information between actors involved in legal proceedings can be positively affected by the development and the diffusion of ICT, it is first necessary to distinguish the various components of the technological infrastructure of judicial IS, that are [10]:

1. Basic ICT resources;
2. Technologies to support typical activities of judges and prosecutors;
3. Technologies for automation of administrative tasks;
4. Systems for electronic exchange of data, documents and communications.

Basic ICT resources are primary resources that allow the spread of new ICT. Therefore belong to this category the basic hardware and software, including internet and intranet, e-mail, newsgroups, office automation suites. Among the second category there are legal IS and decision support tools that produce information that are available to the judges along with the information contained in typical paper documents. The third category includes all applications used for automation of records, for chancellery activities and for court administration and control. The technologies described above always have the aim of producing paper documents. In fact, information exchanges among actors are related to the paper.

The last category of elements included in the technological infrastructure of judicial IS aims to overcome this limitation by making "electronic" all communications in legal proceedings. These are ICT for electronic exchange of data and documents between courts, judges, prosecutors and lawyers and e-filing systems that allow on-line registration of cases, payment of court fees, on-line access to documentation filed during the proceedings, etc. The implementation of this type of resources profoundly changes the ways of working and interacting of

everyone involved in the JS. Therefore, seems possible to observe that the development of ICT affects the judicial activity in the strict sense (core business of courts) and the organizational, managerial and financial activities (support activities). In other words, the use of innovative ICT can involve different subjects and areas of the JS. In fact, systems used at central level (Ministry of Justice) for the overall governance of JS (e.g. applications that support the functions of planning, budgeting, control, administration of human resources) are joined by the innovations used at peripheral level (courts) for the storage, distribution, management and archiving of cases, recording of evidence, etc. Moreover, applications used to improve the "internal communication" among judges and other subjects (e.g. databases about national and international legislation and judicial decisions, systems for knowledge sharing) are accompanied by systems that facilitate the "external communication", improving public access to judicial information and transparency for stakeholders.

In summary, it seems possible to conclude that the introduction of ICT in JS impact on production and distribution of information for the internal and external communication, improving interaction of all actors involved. These systems are characterized by different levels of invasiveness with respect to existing IS. In fact, there are technologies that can be used individually (e.g. legal research systems) and without elimination of paper-based documents, but also there are much more ambitious projects that aim to completely transform procedures for managing communications. Beyond those who are the subject (Ministry, court, etc.) and the object (external or internal communication) of the innovation process, the e-justice innovations seem to be characterized by different levels of technological intensity and equally varied organizational and managerial implications, so it might be useful to classify them on the basis of these two variables.

3 A Model for Classifying E-Justice Innovations

The phenomenon of innovation has been analyzed by the literature of business management, both in its technological dimension than managerial [11–16]. There are also contributions that analyzed the relationship between organization and technology [17, 18]. However, the theoretical discussions seem to have not fully addressed the definitional aspects. In other words, it seems that there are few studies about the classification of innovations, although it has been noted that the classification could facilitate the understanding of similarities, areas of overlap and complementarity between the innovations implemented [19].

In this paragraph we propose a model for the classification of e-justice innovations on the basis of the two aforementioned variables (Fig. 1). Research and definition of a taxonomy may help to address in a more rational way problems related to the implementation of ICT, such as problems related to processes of acceptance, and evaluation of their effectiveness, for example, issues related to IS success.

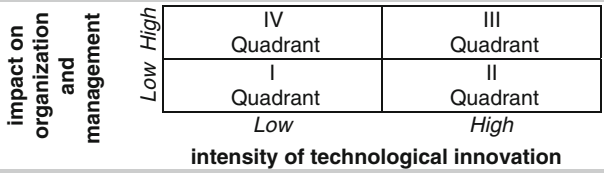

Fig. 1 Classification of e-justice innovations (Source: our elaboration from [19])

The horizontal dimension of the matrix refers to the intensity of technological innovation. It is a variable already considered in those studies on innovation that have the purpose of classification [19, 20]. This intensity can be estimated using complexity of the technology as a measure. The complexity is understood as "amount and nature of the knowledge that it incorporates" [20] and that are necessary for its utilization. All those interventions to equip staff of basic ICT resources and which require elementary knowledge can be considered "low-intensity". Instead, interventions designed to support specific tasks or procedures and which require more elaborate skills and knowledge can be considered "high-intensity".

The vertical dimension concerns the impact of innovation on organizational structure. This is an independent dimension from the first, consisting of the importance of organizational and managerial implications arising from application of new ICT. Such importance depends on the number of actors, functions and business processes involved in the innovation and on the depth of the change following the adoption of new technologies [19]. We can define "low-impact innovation" technologies that only (or mostly) affect intra-organizational relationships, basic organizational structure, structure of organizational units and operating systems used (for strategic planning, human resource management, IS). Instead, we can consider "high-impact innovation" ICT that also impact on inter-orga-nizational relationships (between court and prisons, Ministry, other courts, etc.).

By crossing the two variables we obtain the matrix presented above. In the first quadrant are placed interventions characterized by limited complexity and intended to affect a defined number of business within the organization, and the intra-organizational relationships. These are innovations to equip staff of a PC, standard Microsoft applications, internet access, e-mail, etc. (primary ICT resources).

The quadrant II contains systems with higher complexity and involving intra-organizational relationships, impacting in particular on a limited variety of procedures within the organization. This category includes all applications supporting administration and control activities of the court as accounting, budgeting, human resources management, etc. This quadrant also includes systems for the automation of chancellery activities (e.g. applications for digitalization of records) that sometimes allow the replacement of paper documents with digital documents. In this family we can also include those applications designed to digitalize significant aspects of the core business of judiciary, as systems that

support the decisions process, software for the automated assignment of cases within the courts, etc.

In the quadrant III are placed systems characterized by high intensity of the two variables. These systems allow electronic exchange of data and documents between individuals inside and outside the court and require more sophisticated skills than systems located in the quadrants I and II. Compared to the applications already seen, these projects help overcome the "bond" represented by the production of paper. In fact, software included in the quadrant II are often used to produce paper documents and so using these technologies the exchange of records and documents relevant to the resolution of legal proceedings is still paper-based. Instead, systems placed in the quadrant III allow not only the possibility of on-line access to records and archives, but also they make real the opportunity to inscribe on-line the cases, to record and transcribe documents through applications accessible remotely, to pay registry fees on-line, etc. Finally, in the quadrant IV there are those interventions that, although characterized by low technological intensity, involve not only the intra-organizational relationships, but also the relationships with actors outside the court. In practice, all the technologies implemented to support typical activities of judges and prosecutors and for the automation of administrative tasks (chancellery activities), characterized by low technological intensity, are included in this quadrant. Also portals available to citizens and public institutions containing general information on the court, its functions, legislation and case law could be included in this class. Moreover, in some cases these websites allow users to use services provided on-line, through a high level of interaction.

It seems appropriate to point out that it is possible to identify interventions that are located at the intersection of different categories. In the next paragraph we analyze a case of introduction of ICT in an Italian court, trying to make a classification of innovations adopted by using the matrix built.

4 E-Justice Development in Italy: The Case of the Court of Naples

As happened in other European countries, the introduction of ICT in Italian PA have become more systematic after a first moment in which it has represented isolated responses to specific problems. In particular, regarding the JS the Italian legislator has promoted the testing and subsequent implementation of a variety of technological, organizational and managerial innovations that have involved different activities carried out by the institutions of the JS. In this regard, the creation of the "Directorate general of automated information systems" (Direzione generale dei sistemi informativi automatizzati – DGSIA) by the Ministry of Justice appears to have played a significant role. The DGSIA is divided into 13 "Inter-district centers for automated information systems" (Centri interdistrettuali per i sistemi

informativi automatizzati – CISIA) that have the task of stimulating and encouraging the use of ICT in the courts.

As mentioned above, the objective of this study is to propose a model for classification of e-justice innovations. We have chosen the court of Naples as case study because this court is characterized by bad performance in terms of efficiency and organizational effectiveness (low speed resolution of pending cases, high caseload, etc.) and, therefore, ICT could play a very important role in stimulating processes to improve efficiency and effectiveness. The court of Naples, as well as being home to 1 of the 13 CISIA that operate nation-wide, currently is the only court in Italy with an ICT section responsible for implementation and maintenance of new ICT. This fact seems to emphasize what has been said above: this court shows a particular interest in ICT to eliminate or at least reduce inefficiencies.

The study was conducted following an exploratory approach and using the methodology of case study. We used ethnographic interviews (unstructured and semi-structured) and document analysis. In particular, we have conducted two unstructured interviews with an IS manager to obtain general information on the organization and management of the court. Subsequently, we have carried out two semi-structured interviews with the same manager and another to obtain information about the ICT implemented. Therefore, using data acquired we have placed the ICT innovations within the matrix created.

Intensity of technological innovation was evaluated considering the amount and nature of knowledge necessary for the use of the ICT. Instead, the impact on organization and management was evaluated by considering effects of innovation process: if ICT impacts exclusively (or mainly) on the intra-organizational relationships, the impact is considered low; if innovation also has effects on inter-organizational relations, the impact is considered high. The judges, clerks and administrative staff were considered internal actors, instead, lawyer, other public authorities and citizens were considered external. The figure below shows the major applications used by the court of Naples, and their collocation in the matrix (Fig. 2).

As shown in the matrix the court has applications that are mainly concentrated in the quadrant II, therefore, characterized by high technological intensity and not relevant managerial and organizational implications. These applications involve a

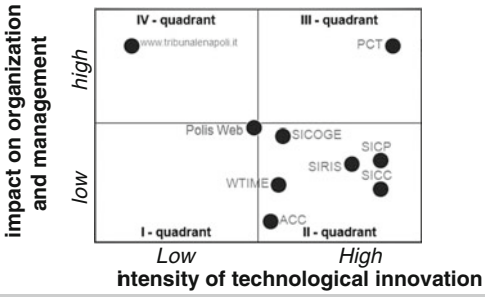

Fig. 2 E-justice innovation in the court of Naples

variety of procedures and automate the activities of clerks and judges without impacting significantly on the organization and management. SICOGE (Sistema Informativo di Contabilità Generale), for example, is the accounting software that manages issuance of payment orders and the semi-annual reporting to be submitted to the Central Accounting Office; WTIME, instead, is the software that handles automatic detection of the presence administrative staff and all related operations. These applications, exclusively dedicated to administrative activities, are associated with systems that support judges' activities in criminal and civil sector.

Regarding the criminal sector, Naples is one of five pilot sites for the activation of SICP (Sistema Informativo di Cognizione Penale). This application, active since December 2009, currently is used to manage criminal cases from the inscription until the discharge. In addition, the court uses SIRIS, directly interfaced to SICP, for data extraction and processing of statistics and reports in criminal matters. Regarding the civil sector, PCT (Processo Civile Telematico) is active since October 2008. It make digital all exchanges of documents and information between actors involved in a judicial proceeding. PCT is linked with SICC (Sistema Informativo di Cognizione Civile) and Polisweb: the first is an archive of all information about national civil procedures; Polisweb, instead, is the application that allows lawyers to access on-line to general register of civil proceedings. Unlike most of the innovations implemented which were collocated in the quadrant II, the PCT is in the quadrant III, because it is characterized by a higher organizational and managerial impact. In fact, PCT not only impacts on internal organizational structure, but also on inter-organizational relationships, changing traditional ways of exchanging data and documents between internal and external actors of the court.

5 Conclusions and Future Perspectives

Italy has been one of the Countries in Europe that has spent the most on ICT implementation to improve efficiency and effectiveness of its JS. The Italian legislator, through considerable investment, is trying to develop an "e-government approach" in the JS (e-justice). The expected result is that e-justice will allow full on-line transaction between courts, lawyers, and the other actors. Despite Italy having been one of the biggest spenders in this field, to date the results achieved have been very few: Italian JS is still characterized by bad performance [13].

As pointed out earlier, the objective of this study is represented by the creation of a taxonomy of innovations implemented in the Italian JS. According to literature [19], such a classification could be useful to address in a more rational way problems related to the implementation of ICT and evaluation of their effectiveness. So, when Italian JS pass by the current phase of testing of those applications (in the court of Naples and in some other pilot seats) to the deployment phase in all Italian courts, could be useful to know in advance characteristics of innovative interventions in terms of technological intensity and organizational and managerial impact to prevent, and possibly resolve, potential implementation problems.

The analysis we carried out on the court of Naples has shown that "technology-intensive" innovations (quadrants II and III), to be effective, often require the availability of appropriate skills and knowledge in the staff who will use the applications, the involvement of the same staff in implementation process and the alignment of values. The study found, for example, that the high average age of staff in service and, therefore, the lack of computer skills contributed to slowing the spread of new ways of working. Likewise, the little involvement of staff in the implementation process had a dampening effect. The introduction of ICT was conducted in a coercive and top-down manner, acting on an organizational system that was unprepared, not involved and for that reason less inclined to change. This has reduced the effectiveness of innovations introduced. With reference to PCT, for example, although it was found that ICT greatly reduces the time necessary to do an injunction, after 2 years from the activation of PCT, electronic injunctions are only 500 for year (5% of the total). Furthermore, only 1,000 and 500 lawyers (of a total of 7,000) use PolisWeb.

Starting from these considerations, in the later phases of this study we will try to test the classification model in other courts to see how the taxonomy developed can help to avoid or resolve any critical issues emerging in the implementation phase of innovations. It will be useful also try to determine if the innovations placed in each quadrant are connected in a systematic way to some implementation issues linked with the new ways of working and interacting generated by the e-justice innovations.

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How Does the Management of Multiple Stakeholders' Interests Influence Decision-Making Processes? Exploring the Case of Crowdsourced Placemaking

Riccardo Maiolini

Abstract Considering the difficulties that concern the stakeholder engagement, there is a strong debate on the opportunities that web 2.0 and crowdsourcing platforms can arise to resolve decision-making and facilitate alternative choices. The paper is based on the analysis of two companies that use a platform of crowdsourced placemaking trying to engage multiple stakeholders to construct and discuss about the most relevant solutions. This is an explorative paper that tries to understand the new phenomenon.

1 Research on Multiple Stakeholder Theory

The debate on stakeholder literature is recently moved from studying how to manage singular sets of interests [1], to understand relations among multiple subjects associated to complex organizational environments [2]. Considering multiplicity of interests [3], organizational complexity is part of what is called the stakeholder multiplicity [4, 5]. The classical model adopted in stakeholder theory studies looks at the relationship between a central subject (normally a single organization) and hits stakeholders considering the power needed to control and influence decision, from external to internal decisions. The hub and spoke perspective suggested by Frooman [6] looks at the different typologies that stakeholders use to influence companies' decisions. This model is effective when the direction of influences goes from outside to inside: from a group of external stakeholders to internal decisions into the organizations that hedge and try to resolve conflicts. In the hub and spoke perspective, the interests are shared among stakeholders and the target is inside the hub, because the direction of interdependence is from multiple to single: from a group of stakeholders to a single organization. This perspective does

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not explain the potential complex interactions within the network of stakeholder relationships or when there is not a subject strong enough to be perceived as a hub [4]. Taking into account the concept of multi-stakeholder networks [7], stakeholders groups compete against or complement each other as a cumulative activity of congruence or diversity of interests. Starting from these considerations, I suggest the following research question: **In the presence of a multiple stakeholder network, where is not evident the clearness of the hub and spoke relationship, how can crowdsourcing be used to facilitate decision-making among different sets of interests?**

2 Methodology and Research Context

To address the nature of the research problem a qualitative approach using in-depth semi-structured interviews and secondary data (as archival data and online reports), is the most appropriate methodology to take into account the context specific elements, and respect the uniqueness of the case [8]. The study is based on the analysis of two companies that developed online placemaking services. The first source of data is based on the analysis of Internet sites and their relative on line reports. In a second phase I developed interviews inside the companies. The setting of the study is based on the network of different groups of stakeholders and other subjects that get part to the discussion of placemaking projects, looking at the mechanisms that favorite or limit the decision-making processes. The two cases have been chosen because they are extreme exemplars and are opportunities for unusual research access [9], especially considering the novelty of the phenomenon. Considering the explorative approach of this paper, two cases are not enough to provide a stronger base for theory building [9], but considering the strangeness of the topic, the choice is based on the uniqueness of a given case, and the contribution to theory develops within the set of the cases [8]. The two companies are web-based companies that provide different services (general crowdsourcing services, consultancy and other innovative products based on a general 2.0 approach). Because the innovativeness of their services, I didn't access to all the information (especially to the technical aspects of the internet platforms and I am not allowed to report in the study the names of the companies and direct information on the placemaking projects that I have analyzed). For this reason, I will synthetize generally the two companies and talk about the single projects from a very broad perspective. From a methodological perspective, the lack of specific information on the projects are not essential elements that can negatively impact on the development of my research, considering that the stakeholders' categories that I have analyzed are general and can be applied also in other contexts, as general subjects interested in the development of their interests.

3 Research Context: The Crowdsourced Placemaking

From a decision-making perspective, crowdsourcing produces changes from a knowledge generation model to a knowledge brokering model [10]: knowledge generation is a process that raises from multiple sources considering divergences, conflicts, relationships and operations among different subjects [11]. The strengths of this model are based on the open centrality that means: "participation is non-discriminatory" [12]. The crowd provides access to a multiplicity of competences, ideas and resources much more significant than what every single subject can find internally [10, 12, 13]: this openness brings advantages in terms of participation but increases the level of decision-making complexity.

According with the American PPS: "Placemaking is a multi-faceted approach to the planning, design and management of public spaces. Put simply, it involves looking at, listening to, and asking questions of the people who live, work and play in a particular space, to discover their needs and aspirations. This information is then used to create a common vision for that place. The vision can evolve quickly into an implementation strategy, beginning with small-scale, do-able improvements that can immediately bring benefits to public spaces and the people who use them". From a technical perspective, placemaking consists in a decision-making tool that provides instruments to plan better decisions [14]. Placemaking works as taxonomy for communities based o social, economic, infrastructural and natural issues, where all the parts are engaged within the three distinctive phases of (1) communication, (2) design and (3) analysis (Table 1).

Based on the Triple bottom line approach [15] placemaking is an interesting case to understand the dynamics of the stakeholders' involvement strategy [11] and how it serves to clarify the mechanisms that drive the social interaction processes of key organizational participants [16]. Crowdsourced placemaking highline and stress the mechanisms that facilitate stakeholders' balance [17] inside the multi-stakeholder network. Crowdsourced placemaking can be considered as a "participated model where there is a multitude of subjects that have legitimated interests or stakes in [. . .] how the objectives are reached [. . .] and a social and technical system where different stakeholders play a part" [18].

As explained in the earliest paragraphs, this study is based on the analysis of two companies that started to use crowdsourced placemaking as an instrument to develop specific projects within local communities trying to merge stakeholders'

Table 1 Placemaking Process

Placemaking phases	Description
Communication	Open promotion of alternative needs, agendas priorities and technical knowledge
Design	Implication of different development options
Analysis	Evaluation of multiple scenarios, provide quantitative and visual outputs

Table 2 Composition of companies

Company profile	Placemaking service's typology	Usage of the service	Stakeholders' identification
Closed	Based on the usage of an internal platform owned and programmed by internal computer programmers	Available after a registration. The company allows participating to the placemaking services only registered subjects	Stakeholders are identified by internal categories of the platform
Open	Developed inside the general organization of the Internet site	Every one can get part to the contests and give suggestions or comments to the placemaking projects presented on the site	There is not a structured categorization for different groups of stakeholders

Table 3 Crowdsourced placemaking projects

Company profile	Placemaking project	Goal of the project	Temporal duration	Progress
Closed	Community Playground project	Develop efficient services useful for the community	Six months	Concluded
Closed	Urban Alternative Design choice	Choose the best project that satisfy the highest number of subjects	One year	In progress
Closed	Urban Alternative Design project	Design and obtain suggestion for a second step: propone alternative models that the community will choose	One year	Concluded
Open	Urban Alternative Design project	Study the relation between "citizens and sense of place"	Not specified	In progress
Open	Transit Oriented development	Find new area to develop new infrastructures	Not specified	In progress
Open	Incorporate Sustainable Practices in a community	Renovate a Memorial Building to make it a more sustainable place to work	Not specified	Concluded

interests and find the best solution. From a technical perspective the two companies as organized in this way: the first company uses a specific tool inside hits own web site for the placemaking activities, based on a platform developed internally by their computer programmers; the second company, don't have a specific software to work on placemaking, but the entire internet site is organized as a user generated content application, where different positions and alternative solutions rise up from different places (Tables 2, 3).[1]

[1] For this reason an for a more rapid reading of the next paragraphs I decided to classify the two companies in this way: when I will talk about the once that uses their own program I will talk about the closed company, on the other hand when I will talk about the second one I will talk about the open company.

4 Crowdsourced Placemaking and Open Knowledge Marketplaces: The Development of Collective Mutual Decision-Making Approaches

According to Dushnitsky and Klueter [19] online knowledge markets are virtual marketplaces, which facilitate the listing, search and exchange of knowledge assets. The concept of Knowledge Market Place can be adapted also for crowdsourced placemaking portals considering that are instruments to share new forms of knowledge and that permit the exchange of innovative forms of information.

In online knowledge marketplaces every participant benefits from the sharing activities of knowledge, because of the openness of the user generated content approach. The participants, as self-interested entities, give their own point of view and explain their opinions considering their own goals and their perspectives: every one tries to achieve its own interests. The synthesis of opinions and the mechanisms that facilitate the exchange of information produce collective benefits, in terms of open dialogue and access to form of information that cannot be shared by singular communication activities, but only in a collective model. Another interesting aspect that link crowdsourced placemaking to the model of open knowledge marketplaces is the fact that online knowledge markets provide an alternative route to access complementary resources to find different forms of knowledge [20]. Also considering the dimension of contributions and the role of contributors, in crowdsourced placemaking and in open knowledge marketplaces, the fragmentation of solutions and competences is privileged as a source of innovation comparing to large companies that are concentrated on their own competences.

According to Tim O'Reilly[2] the evolution of web 2.0 is moving from considering Internet as a benchmarked platform, just where people get information, but they used it to participate, engage and interact among each other. What are interesting to underline are the differences in how 2.0 users participate and make contributions. What normally happens in user generated content platforms is that every single subject is part of the virtual arena, knowing that its contents are part of a general and overall contribution to the web, as single contents, opinions and other forms of contribution. The general goal of classical 2.0 users is to collectively expand the general amount of knowledge and information available in the web. There is a sort of non-single-utilitarian approach to this kind of contributions. On the other hand, what characterizes and distinguishes crowdsourced placemaking is the effort to persuade different users to underline their opinion and open a discussion on how do they consider differently the issue selected, explaining their opinion and giving example of their real life experience. As explained by Malone, Laubacher and Dellarocas [21] in the web and virtual arenas there are different levels of collective intelligence that born as (1) ***individual decision*** (based on voting and averaging decision about pre-elaborate information), move to (2) ***group decision***, because the

[2] References available on www.orielly.com.

possibility to exploit consensus as an elaboration and distribution of general information, gives as a result a compromise between alternative solutions and become (3) ***crowd decision*** when resources and information are not known in advance, activities cannot divided into small pieces and the best solution is a result of the activity of every one. Without the collaboration of the entire crowd the solution is not definitively.

The users' contribution into crowdsourced placemaking is the result of the entire collaboration of the users. The multidisciplinary approach of suggestions and comments that arrive to a specific call derives from the analysis of different perspectives to the same problem (as professionals or amateurs) and from alternative set of interests that can arise or decrease as an effect of a particular choice. The process is concluded only when the entire set of alternatives is exploited.

Every single stakeholder is interested in the development of the project but it has its own interests and goals that can also differentiate from the others. What every one is looking for "is the development of the project that has a plausible match between positive and negative externalities" (cit. closed company manager).

Because the openness of the discussion and a wide set of interests displayed. What arises from the analysis of the cases is what I called the ***collective mutual decision-making*** approach that starts from the exposition of different position and trough the development of a debate on single issues, trying to obtain set of interests that after, are voted by the groups of stakeholders. The process is organized to stress and underline differences among the stakeholders. After the explanation of all the alternative opinions, the subjects start automatically to suggest solutions. In this second phase, the subjects involved in the discussion know which are the main interests that must be achieved and when they propose solutions they give also explanations of why they decide to achieve some interests instead of others. As suggested by Pedersen [22] all the stakeholders cannot be satisfied simultaneously; this is a concept that arises automatically from the comments of the users and this is why they try to explain their choices searching for concrete justification to their choices.

I called the process collective mutual decision-making because it starts from different sets of interests that are selected by a dialogue among the stakeholders that try to justify why some interests are more significant than others. After the justification, they start to discuss on how the decision and the outcomes can impact in terms of externalities, trying to understand how to manage the negative externalities developing a compensatory strategy. In the last stage, the stakeholders that have convoyed to a specific set of decisions start to discuss about the concrete implementation of their choices. The most important part of this last phase is given by the fact that decisions arise from a sense-making perspective of the main characteristics that can favorite one decision instead of another one (Fig. 1).

To confirm the importance of considering the crowdsourcing process completed when the higher number of plausible and alternative solutions and explanations are discussed I would like to underline the differences between the two companies and the fact that in the closed company, because the limited access to the project, produces better results in terms of decision-making than the open company,

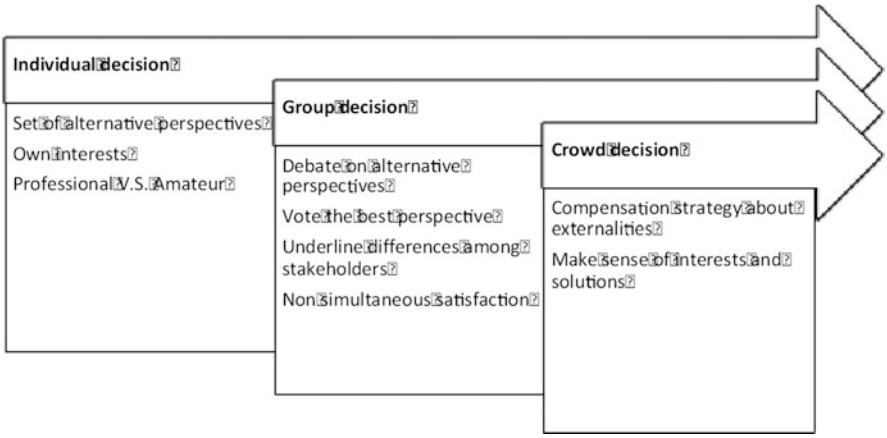

Fig. 1 Collective mutual decision-making process

considering the open-ended model and the infinity number of subjects that can take part of the discussion. From this consideration is interesting to underline that decision-making processes are sensitive to the number of stakeholders involved in the initiative.

5 Contributions Limitations and Conclusions

The expected contribution is therefore twofold: on one side the paper builds on (and hopefully helps expanding) one of the building blocks of organization theory, trying to understand the mechanisms that facilitate multiple stakeholders engagement and hits relative decision-making procedures. Considering decision-making and sense-making theories, this study propose a first analysis of the criteria that explain how different categories of stakeholders and differences in their number influence the outcome, in terms of decisions and alternative choices. Future studies should study, from a quantitative point of view, how differences in terms of number of stakeholders involved in specific initiatives can affect the final decision-making process. On the other side it engages with a real-world phenomenon that is getting more and more relevance in practice, when discussing about the heterogeneity of stakeholder groups and their relative interests within a complex organizational environment. The usage of the collective intelligence model to read and interpret crowdsourcing activities is an important framework that is helpful to better understand the differences between singular, collective and crow decision-making processes. In future steps of this studies I would like to stress the meaning of sense-making theory trying to understand how it can impact the crowd decision level and what differentiates it from the group decision model. Sensemaking can be affected by the quality of information and from the number of participants to the call.

The main limitation lies to the exploratory approach that I decided to adopt. However, I am working on the development of the case studies where each case serves as a distinct experiment that stands on its own as an analytic unit [23], central to building theory. In conclusion, crowdsourced placemaking is a new profession, but has potentials to assume a relevant role in the stakeholders' engagement theory and in daily activities that can help managers and practitioners to better undertake their tasks.

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Combining Exploitation and Exploration Through Crowdsourcing: The Case of Starbucks

Francesca Cabiddu, Manuel Castriotta, Maria Chiara Di Guardo, Paola Floreddu, and Daniela Pettinao

Abstract In this paper, we explore the concept of crowdsourcing as a driver of the ambidexterity innovations capabilities and as a strategic tool to combine exploitation and exploration strategies in the innovation generation process. In doing so, we focus on the case of Starbucks Corporation, an international coffee and coffeehouse chain considered the largest coffeehouse company in the world.

1 Introduction

How foster innovation within the context of a mature industry is, nowadays, one of the most challenge for established firms. Managing and growing the core business while concurrently nurturing and supporting new business opportunities, is the panacea for many big companies. Under such conditions, in fact, as some research on innovation has showed [1–3] to respond to hyper-competition, firms should not only explore new ideas or processes and develop new products or services for markets, but also exploit existing products or services and leverage current competences of the firm for existing markets. Firms thus are constantly faced with the challenges of two concomitant choices: exploration and exploitation [4, 5]. The capacity of firms to develop both types of innovation is known as ambidexterity [6, 7]. Despite its obvious importance to the ultimate success of a firm, to date, very little effort has been put into exploring the drivers of the ambidexterity innovations [8], and many researches have been omitted to analyse how it is possible to combine exploitation and exploration strategies in the innovation idea generation.

Thanks to recent technologies, including many Web 2.0 applications, companies can now use effective tools for integrating exploitation and exploration strategies,

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involving customers into the early stages of the innovation process and improving the idea generation phase. The underlying idea is to outsource the phase of idea generation to a potentially large and unknown population, referred to as the "crowd". In this vein, crowdsourcing is currently one of the most discussed keywords within the innovation community [9]. The different applications of crowdsourcing, in fact, are today in a phase of experiment and innovation and many firms leverage this application in different industries. Through Internet-based ideas competitions, companies attempt to collect innovative ideas from customers [10].

In this paper, we focus on crowdsourcing as strategic tool to combine exploration and exploitation strategy in the innovation process and leverage the firm ambidexterity capability. In particular, we address the following research question empirically: how a crowdsourcing strategy for idea generation process can combine exploitation and exploration? This attempt is novel, since it offers a new fresh perspective in the exploitation and exploration literature [8]. To investigate this area, we drew on an exploratory qualitative case study approach analysing the crowdsourcing experience of Starbucks Corporation, an international coffee and coffeehouse chain and the largest coffeehouse company in the world.

The structure of the paper is as follows: in the next section, we define basic terminology to clarify the concepts of ambidexterity capability and crowdsourcing. We then focus on the Starbucks case, explaining why we have selected it for this study, and how it has been used. Following this, the case study findings are presented and analysed. Finally, some conclusions are presented.

2 Ambidexterity and Crowdsourcing

The ability of firms to continually update their technological know-how and capabilities is an imperative for competitive survival. Researchers suggest that exploitation enables firms to engage in refinement, implementation, efficiency and production, whereas exploration attaches importance to mechanisms that call for experimentation, variation, search, and innovation. Moreover, in the exploration mode, the emphasis is on the dissection of the knowledge bases in their constituent parts, followed by the study of these parts in order to gather information that provides a deeper understanding of a given topic. Compared with exploration, exploitation requires a deeper understanding of specific problems rather than collecting and classifying general information. In other words, explorers perform deep searches in limited solution spaces [11].

Coherent with this view, in order to pass through technological transitions, firms must combine exploration with exploitation in an ambidextrous search approach [12]. Indeed, both theoretical and empirical works have suggested that ambidexterity will improve firm performance and survival [4, 13, 14]. According to Tushman and O'Reilly (1996) [12], a key characteristic of ambidextrous organizations is that separation and integration is the main rationale for their structural ambidexterity. Han (2007) [15] extended this view of ambidexterity by focusing on separation and integration in strategic choices and defined a firm's pursuit of paradoxical strategies

as strategic ambidexterity. Other studies suggest that firms need to balance certain paradoxical forces to achieve superior performance [4, 16, 17].

In sum, an ambidextrous firm can; (a) achieve higher performance and sustainability; (b) avoid major or sudden organization changes and the concomitant costs of switching governance modes; (c) divert organizational inertia; and (d) adapt to, and even benefit from, changes beyond its control, because it is always in anticipation and preparation mode, primed to take action to shape its own future [13]. Recent works developed the concept of strategic ambidexterity as a way of executing paradoxical strategies such as exploration and exploitation [16, 18].

Standardization, by design, focus on exploiting existing capabilities and aims to reduce variation through a series of quality control techniques and by streamlining a variety of processes. Such steps often lead to improved efficiency, better customer satisfaction, and shorter lead times. As a result, the organization pursues these steps even more enthusiastically, and gradually variation reduction methods get more stabilized and deeply embedded in the organization's routines [19]. The organization no doubt tends to become more efficient, but variation-increasing activities and information overlap or redundancies, that are considered important for novelty, are discouraged. Consequently, new products are not likely to depart very much from the organization's existing expertise [19, 20]. Novel products or services involve more uncertainty, are more difficult to quantify, and involve more expensive exploratory steps, which appear less attractive when the focus is on variance minimization, speed, cost reduction, efficiency and standardization [19]. As a result, those new products are likely to be selected that use existing capabilities and are closer to the existing products or services of the firm because such products are more predictable, have lower variation, and involve higher certainty. Thus, product development efforts are likely to produce less novel products or services.

Innovation, on the other hand, helps firms to develop new products and markets – a process that usually requires committing significant time and resources before it can expect to reap improved profits [20]. The high risk nature of innovation promises very high returns. Further, improvements in the environmental quality management will be lesser riskier because of the previous incorporated knowledge. Indeed, the highly risky strategy of innovation is the lifeline of the sustainable firm.

In this paper we show how the Internet Toolkits and Web 2.0 and in particular, the crowdsourcing tool can help a firm to combine exploration and exploitation in the innovation process and in this way improve firm ambidexterity capabilities.

The basic design rationale captured in the term Web 2.0 is the notion that the web should be used to buttress connections between individuals and provide them unfettered opportunities to express themselves, rather than attempt to curate all possible combinations of knowledge resources or attempt to censor individual contributions. The Web 2.0 tools cannot simply be distilled to a technology or set of affordances, but must be looked at in micro-level perspective (individuals interacting with ICTs) and a macro-level perspective (the social, cultural, and network by product of massive micro-level interactions). Through Internet-based ideas competitions, companies attempt to collect innovative ideas from customers.

3 The Case of Starbucks

Starbucks is the premier roaster and retailer of speciality coffee in the world.

Starbucks purchases and roasts high-quality whole bean coffees and sells them, along with fresh, rich-brewed coffees, Italian-style espresso beverages, cold blended beverages, a variety of complementary food items, a selection of premium teas, and beverage-related accessories and equipment, primarily through Company-operated retail stores. Through the Starbucks Entertainment division brand also markets books, music and film.

The Company's objective is to maintain Starbucks standing as one of the most recognized and respected brands in the world. To achieve this goal, the Company plans to continue disciplined global expansion of its retail and licensed store base, to introduce relevant new products in all its channels, and to selectively develop new channels of distribution.

The first Starbucks was opened in Seattle on March 30, 1971 and, at present, the company operates with 17,009 stores in 50 countries, including over 11,000 in U.S.A., over 1,000 in Canada and about 700 in the U.K. The group in 2009 has issued invoices for more than 9.8 billions dollars.

The Company employed approximately 142,000 people worldwide as of September 27, 2009. In the US, Starbucks employed approximately 111,000 people, with 105,000 in Company-operated retail stores and the remainder in the company's administrative and regional offices, and store development, roasting and warehousing operations. Approximately 31,000 employees were employed outside of the US, with 30,000 in Company-operated retail stores and the remainder in the Company's regional support facilities and roasting and warehousing operations.

Starbucks research and development teams are responsible for the technical development of food and beverage products and new equipment. The Company spent approximately $6.5, $7.2 and $7.0 million during fiscal 2009, 2008 and 2007, respectively, on technical research and development activities, in addition to customary product testing and product and process improvements in all areas of its business.

4 The Starbucks' Web Strategy: Combining Exploitation and Exploration

The virtual communication of Starbucks uses a variety of traditional and Web 2.0 tools. Alongside an institutional web-site showcase, divided in six areas related to their blogs, there are direct links to all major social media like Twitter, Facebook and Youtube. Also in the foreground is to detect the presence of numerous links to the community of co-creation called "MyStarbucksidea". Finally links to most recent apps of I-Phone, BlackBerry and Android are offered to customers.

The institutional web-site structure is deeply related to most important features of viral marketing theories. At the side of a vertical communication, which is typical of web 1.0, which provides information on products, menus and social responsibility, you must report the use of videos and user friendly software typical of democratizing innovation platforms.

Often communication is made through a video uploaded on Youtube, which of course can turn into other social media, sent via email or embedded in the customers sites.

In the section "card" there is a very user friendly software that allows the customization of credit and loyalty cards.

The search with the keyword "Starbucks" on Facebook has generated about 42 pages with 35 million fans scattered in all geographic areas in which the company operates. Official page has 23 million fans while the page dedicated to the most famous product "Frappuccino" has six million fans. Twitter page has 1,526,961 followers and about 7,271 tweet. The Youtube channel was born in November 2005. Nowadays has about 11,000 members and video uploaded have generated nearly seven million views. The most popular video deals with social responsibility and volunteering. It has had about one million views and contributes significantly to strengthen the company's image.

The company has a strong attitude to combine exploitation and exploration strategies in the innovation process. Despite Starbucks invests several million annually in R&D and possess many researchers and experts in marketing in their internal organization, the company has decided to ask to its consumers and amateurs an external support to increase the creative potential of new products.

MyStarbucksidea is a community founded on March 2008, where people propose and share their ideas, comment and rates those of others. In this way visitor who decides to write feel gratified to play an active role in the product creation and feel himself part of a community. Moreover community statistics represent a very powerful marketing tool for company's decision makers. This crowdsourcing strategy ultimately means, for Starbucks, continuing to oversee the core business while concurrently protecting the emerging venture as it evolves and grows.

The site is divided into three macro-areas: "Got an idea", "View ideas" and "Ideas in action". To propose an idea you must be registered, however the process is fast and then consumers could simply insert the idea description through a user friendly word processor interface. The area called "View ideas" is divided in "Popular", "Recent", "Top all time" and "Comments". This distinction allows new ideas to emerge. For every idea members can vote thumbs up or down. This make possible some ideas a score below zero. Finally the area "Ideas in action" in divided in four sub-areas as "Under review", "Reviewed", "Coming soon" and "Launched". All areas pages are linked with major social media and Rss feed tools.

Once a member propose an idea Starbucks offers a dedicated team of "Idea Partners". Usually they are Starbucks employees who are experts in their respective fields who read all ideas and comments. In this way Starbucks can use the ambidextrous organizational model to create team units for exploring and developing breakthrough innovations while at the same time keeping existing business units

intact. Project teams which directly interact with customers through the web site are encouraged to form their own processes, structures and cultures but they are still connected to the rest of the organization. They take a combination of the most popular and most innovative ideas that are the best fit for Starbucks knowhow and capabilities, trying, on the one hand, to improve the quality of their well know products and, on the other hand, to develop new products from idea sometimes very far to the industry knowledge base. These ideas are presented to key decision makers within the company to recommend how to put those ideas to work. Everyone helps decide by voting. Ideas posted to the Popular Ideas section of the website (determined by using an algorithm based on number of points, number of comments and recency of post) are considered, but Idea Partners may also choose ideas simply because they think they're promising. Finally partners communicate through the blog ideas which pass the evaluation and those that are stored.

The community generates a large brainstorming agora that empower creativity and assumes the typical type of Crowdstorming structure. It seems to be far from the dynamics of content creation and problem solving. In addition it does not exploit the collective intelligence of the typical weather in prediction markets. What the brand consider essential is the formulation of proposals, the voting process and the comments of members. The community can allow you to communicate the brand in innovative ways and at the same time exploit the firms knowhow.

Nowadays the web site had 450,000 registered users of which 65% women, mostly between 25 and 34 years old. According to Alexa.com, the site has seen an increase in its ranking over the past 3 months from 32,137 to 29,431 and the number of page views has decreased by 12% with a decrease in the ratio of page views and users by 6%. Decrease by 6% the average time spent on the site.

Regarding the qualitative analysis of efficiency, the community has proposed 112,331 ideas, the proposals were made mainly for product Ideas (61%). In particular 25,332 for coffee and Espresso drinks, 16,000 for food, 7,995 Starbucks cards, 7,779 tea and other drinks, 5,894 merchandise and music and finally 8,164 for others product ideas. The 23% of proposals concern "Experience ideas" like atmosphere and locations (11,130), ordering, payment and pick-up (6,340). Finally the 14% concern "Involvement ideas like social responsibility (7,123), building community (3,633) and other involvement ideas (4,724)".

Interestingly, the analysis of historical trends shows how proportion of contributions remains constant. Hypothesis is that this trend highlights a high consistency in the desires of the community members and for this reason a potential index with which to direct the management strategic choices about communication to the target areas. In any case the most relevant aspect about community contributions is that currently 640 ideas was "In action". In particular 333 are product ideas, 156 "Experience ideas" and 151 "Involvement ideas". The 33% is under review; the 41% is in the "coming soon" area and finally at present 150 new ideas had been launched on the market. Maintaining several types of innovation is necessary for an organization to compete and these new ideas generated by crowdsourcing are a perfect combination of an exploration and exploitation strategy.

5 Discussion and Conclusion

From our analysis, we believe that the Crowdsourcing approach adopted by Starbucks is currently particularly effective in combining exploration and exploitation and improving the ambidexterity of the firm. MyStarbucksidea model concern a powerful sample of how to manage co-creation strategies and web-communities best practices and allows the organization to share information and processes when needed while still maintaining separate units.

Thorough analysis of the results obtained from the platform it is clear that Starbucks has achieved very positive results in terms of collaborative marketing too. Moreover, thanks to crowdsourcing tools, Starbucks is adepts at pursing at the same time the operations to support activities that protect current market strategies alongside operations necessary to create new opportunities. They are able to reposition resources in order to respond to the community provide models of democratising innovation as tutorials, training and software to facilitate and improve the quality of the contributions of community members.

Idea partners seem to exploit some of the main reasons analysed in the process of Crowdsourcing such as competition, learning new skills and foster a better reputation. The structure of the process of research and development is absolutely horizontal. Consumers are really involved in the R&D process. The trend of the proposals, growing, shows that the community maintains a high level of motivation to contribute. This shows that the launch of 150 products in 3 years is a tangible demonstration of how their contribution is crucial and taken much into consideration by the company decision makers.

Starbucks was able to implement a market focused approach to consumers; consumers/customers seem to appreciate the direction the company has taken and this is underlined by the web-presence of users and by the cooperation in developing a B2C approach to market with a two-way communication in which is basic the feedback from the consumer which is valued, taken into consideration and adopted to start the production of the next product to be launched in the market.

Finally, through the analysis of the crowdsoucing experience of Starbucks, we argue that the capability of being strategically ambidextrous will lead firms in the service sector to superior success and sustainability.

Subject to potential limitations raised by the single case approach and the homogeneity and stability issues (homogeneity refers to the fact that each research field has its own peculiarities, so that the criteria for the selection of the case have to be targeted to the field and stability regards the unavoidable fluctuations in research analysis over time) our findings offer some interesting conclusions. In fact, this research makes a contribution to the limited literature in this field and will enable the development of more generalizable work.

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The Motivational Drivers in Open Innovation Web-Based Platforms: An Explorative Study

Cinzia Battistella and Fabio Nonino

Abstract The chapter deals with the topic of increasing integration of (external) individuals and companies in (originally internal) innovation processes by means of open innovation web-based platforms (OIPs). A very important issue concerns how to stimulate the users' participation and the knowledge-sharing inside OIPs. The literature focused on motivations, but a still important open question remains: what are the characteristics of the OIPs and the managerial actions that can be done inside the OIPs (i.e. the drivers for motivations) to enhance these motivations? We examine the interactions among specific drivers for enhancing specific motivations to collaborate and innovate. The methodology is an empirical qualitative analysis of 20 OIPs that led to a cause-effect map of drivers and motivations. The research results identify nine groups of drivers, classify them in three groups and suggest strategies for driving the motivations which could encourage users to play an active role in the OIPs.

1 Introduction

More and more companies are recognizing the potential of using their communities of customers, employees, partners and stakeholders, as a source of information and innovation. *Open innovation (web-based) platforms* (OIP) can be means for companies to *accelerate* the innovation process. OIPs are web-based service providers

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that favour open innovation, for example by helping client companies to find the solver for solutions and/or create communities that contribute to ideas and new products/services. In such platforms stakeholders contribute and collaborate around ideas, propose new concepts and trends, present solutions to win contests and to answer companies' needs. When used by a firm, the platform can be based on the contributions coming from: (a) internal communities which consist of local units and/or international units; (b) external communities which may be formed by several sub-communities, most notably stakeholders (industry experts, suppliers, customers, authorities. . .). Therefore, these platforms enable a *collective innovation* (open and collaborative innovation). The OIPs are the novel keystone for the aggregation and integration of different members (individuals and companies) in an innovation community. This permits an access to a large pool of experts and contributors, benefiting from proximity to customers and user innovations and avoiding a "local search bias" in innovation [1, 16]. New knowledge is often created and shared through interaction with the environment, as well as through social and collaborative processes [2]. It is then important to consider the *motivations* of individuals and companies to engage in knowledge-sharing and also the conditions and environments (*motivational drivers*) that facilitate and drive it. These points concerning the economics and dynamics of the cooperative systems for innovation are critical and, although literature and empirical examples support us from the individuals' motivations analysis viewpoint, the research related to companies' motivations and to is still a big challenge. Moreover, while recent literature has begun to discuss about the motivations for participation and knowledge sharing in OIPs, it does not support us from a motivational drivers point of view: the research identified the motivations but not the strategies (drivers) to push them. Finally, the extant research understands very little of the drivers for open innovation and/or collective innovation, especially in a context where there is little or uncertain, monetary return for the innovative efforts. Consequently a key issue concerns the identification of the most successful *drivers for motivations which could encourage the users* (users are both individuals and companies) *to share their knowledge, play an active role and collaborate in the platform*. The objective of the research is to understand how to stimulate the users' participation and reactive/proactive knowledge-sharing inside open innovation platforms for the company-centered crowdsourcing in the innovation process for new product/service development.

2 Theoretical Background

Summarizing the literature (for e.g. [3–6]), we propose the following framework of motivations for participation in collective innovation (rows in Table 1):

- ***Intrinsic motivations:*** (1) *Individual-driven motivations* concern the psychological-emotional sphere of individuals who choose to enter the community and to contribute in a project, (2) *Social-driven motivations* concern the collective sphere of the individual who joins a community of collaborative innovation.

Table 1 Classification of the motivations in the OIPs

Motivation			Name of the OIP																					
			Innocentive	Idea connection	Nine sigma	Innovation exchange	Preasans	Clickworker.com	Redesign me	Crowdspring	Guerra creativa	Idea bounty	Enterprise spigit	Big idea group	Shapeways	Ponoko	Quirky	Thingverse	Idea wicket	Why not	Innoget	Hypios	Frequency
Intrinsic	Individual	Entrepreneurial mindset							√						√	√	√	√			√		6
		Opportunity to express individual creativity		√		√			√	√	√	√			√	√	√	√	√	√			12
		Sense of membership	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	20
		Enjoyment, fun and entertainment		√					√		√		√		√	√	√	√	√	√			10
		Psychological compensation, sense of efficacy	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	20
	Social	Sense of cooperation			√	√		√		√							√	√					7
		Social responsibility	√	√	√	√				√		√				√		√				√	10
Extrinsic	Economic	Monetary rewards	√	√		√		√	√	√	√	√	√	√	√	√	√		√		√	√	17
		Free products (HW and SW)							√				√	√									3
		Free Services			√										√	√	√	√			√		6
	Professional	Learning							√	√				√		√	√	√		√			7
		Reputation	√	√	√	√			√	√	√	√	√		√		√				√		12
		Career benefits	√	√	√	√				√		√	√	√							√		9
		Reciprocity	√	√	√	√		√			√	√	√	√			√		√		√	√	14
	Social	Individual accountability			√	√						√			√		√						5
		Social capital			√								√							√			3

- ***Extrinsic motivations:*** (1) *Economic motivations* concern all the actions that lead, directly or indirectly, to economic advantages for the contributors, (2) *Professional motivations* concern all the actions that lead to professional advantages for the contributor and (3) *Social motivations* concern all the obligations and responsibilities arising from the social sphere of contributors and which have effects on community. Here the social dynamics [7] are fundamental.

Literature has considerably focused in understanding the motivations for knowledge-related communication *within organisations* [8–10] and the *drivers* that drive people to actively engage in it [11]. Several enhancers and barriers for knowledge sharing have been discussed also from an *inter-organisational point of view* [12, 13]. But the drivers that push collaboration and knowledge sharing inside OIPs can be different from those discussed by the authors above. This because the motivations themselves are different (for instance, some of the motivations are specific for an online context) and in the same way, the drivers can be peculiar for a knowledge sharing in an online context or for users motivated by the "sense of community" inspired by products/services such as Linux, Wikipedia, etc. Some first works [4–6, 14, 15] try to explain the motivations that drive people to share their knowledge and to engage in collaborative innovation inside the community of practices. But knowledge remains still incomplete on motivational drivers*: how can an OIP be designed in order to drive the right motivations?*

3 Research Strategy

This research aims to identify the drivers that can develop and increase the motivations which encourage potential contributors to collaborate in OIPs. It focused on the identification of the different drivers used inside OIPs to promote innovation and on the study of how to design a system of incentives referring to this peculiar innovation process. Consequently we aimed to answer to the following question: *Which can be the motivational drivers that impact on Open Innovation Platforms' motivations?* The research is an empirical study of OIPs positioning. The empirical setting of this study is a set of 20 open innovation platforms, deemed particularly relevant for the purposes of the study among a list of OIPs (http://www.openinnovators.net/list-open-innovation-crowdsourcing-examples).

We chose a differentiated sample in terms of seniority (to have an evolutionary picture), popularity of the site (to analyze important, successful and known OIPs) and ultimate objective of the OIP in order to have a comprehensive sample. Given the complexity of the research aim and the need of an explorative approach, we considered that a too small sample would not give us a complete variety of possible drivers, while a too big sample will not give the right depth of analysis. In the columns of Table 1 there are the 20 OIPs. We gathered data by empirical observation and an in-depth and systematic analysis of the websites. Moreover, we interviewed ten websites designers, maintainers of the communities and community members.

4 Results of the Analysis

For every OIP we went through a within analysis of the specific motivations, the specific drivers for them and their relationships. Table 2 shows the key motivations that are levered by the platforms' designers and managers in order to push people to collaborate and innovate inside the 20 OIPs considered for our analysis.

We collected all the drivers (about 50) impacting and influencing users' motivations in participation and collaboration inside OIPs. They are listed and categorized in first two columns of Table 2. All the causal relationships of impact between the motivational drivers and the intrinsic and extrinsic motivations are illustrated in Table 2. These have been mapped in order to identify the most effective in promoting the users' participation and collaboration inside OI platforms. Table 2 can help a specific OIP in finding the patterns of driver/motivation in its specific context: after identifying the most important motivations, the OIP can look for patterns that help it isolate the most important drivers for those motivations in the context of specific website. For example, the *entrepreneurial mindset* is favored by the possibility to share information about projects and potential solutions for the physical realization (Thingverse) or the possibility for the members to realize personal ideas otherwise unfeasible, to open personal shops and to sell products designed (and/or manufactured) through the site (Shapeways, Ponoko).

5 Discussion and Conclusions

Table 3 highlights particular drivers that are important because they are:

1. The *most frequent motivational drivers* (high frequency – first column). They represent the drivers that an OIP should have to be aligned with the most significant other ones. Starting from the most frequent, they are in these groups: drivers for accelerating innovation process; website structure and visual aspects; relationships with customers; website philosophy; social responsibility; personal profile development.
2. The *drivers impacting on the largest number of motivations* (high impact – second column). They can be seen as the most efficient ones (here we intend the efficiency as the ratio between number of drivers (input) and number of motivations (output)). An OIP should have them to be competitive. The most important ones are in the following groups:

    - Website structure and visual aspects: expressions present on the website in the various pages accessed during the visit (6), recognition of best solvers between those involved in the resolution of proposed challenges (6), list of winners and their explanatory interviews (5), reward centre organized to incentive the contributors' participation (5) and positive judgment on the network and on the site by external actors such as magazines, other sites, scientific journals (4)

Table 2 Synthesis of the impacts of OIPs' drivers on users' contribution motivations[a]

		INTRINSIC MOTIVATIONS							EXTRINSIC MOTIVATIONS											
		Individual					Social		Economic			Professional				Social		N of motivations impacted	Frequency (N of OIPS)
		Entrepreneurial mindset	Opportunity to express individual creativity	Care for community, sense of membership	Enjoyment, fun and entertainment	Psychological components and sense of efficacy	Sense of cooperation	Social Responsibility	Monetary rewards	Free products (HW and SW)	Free Services	Learning	Reputation	Recognition of the company and career benefits	Reciprocity	Individual accountability	Social capital		
WEBSITE PHILOSOPHY	Ideals of collaborative participation, crowdsourcing and open innovation	3,8,15 ,19	15	19	15		15											5	4
	Metaphor, as an incentive and stimulus to participation				9													1	1
	Objectives and philosophy of the site	6, 7, 16, 19	4,7,9, 10,15, 16	6, 7, 11, 16	15	16	16	16										7	9
ENTREPRENEURIAL & BUSINESS OPPORTUNITIES	Possibility to collaborate and to negotiate a trade agreement with companies	14							14						19			3	2
	Possibility to open personal shops	13									13							2	1
	Possibility to purchase existing ideas and product in the shop within the site	7, 14, 15								7	14, 15							3	3
	Possibility to realize personal ideas otherwise unfeasible	13, 14	13, 14		13, 14	13, 14					19							5	3
	Possibility to sell products designed (and/or manufactured) through the site	13, 14							13, 14		13, 14							3	2
	Word of mouth: the members themselves suggest potential successful innovators								4									1	1
RELATIONSHIPS WITH CUSTOMERS	Direct contacts with customers													3	3,9,10	3		3	3
	Ideas approved by client companies					10, 12, 15			10, 15				10, 15	10, 15				4	3
	Problem solving: issues and challenges are proposed from "outside" and entrusted to the members of the community		2,16			1,2,4, 5,6,11 ,12,16 ,20		1,2,4, 5,20	1,2,4, 5,6,7, 11,12, 17,20	7, 11, 12								5	11
	Satisfaction of specific requests from customers					8,19			8									2	2
WEBSITE STRUCTURE AND VISUAL ASPECTS	Creative structure of the site		2,7,8, 9,13,1 4,16,1 7,18	16	9										17			4	9
	Evocative images referring explicitly to the concept of group			2														1	1
	Expressions present on the website in the various pages accessed during the visit	6	2,4,7, 8,9,13 ,14,15 ,16	3,5,6, 7,8, 9, 16	15	8,9,16		16					3, 15		3			8	12
	Games as stimulus for an active participation			18								18						2	1
	List of winners and their explanatory interviews			2, 10	2	2, 10							2, 10	2				5	2
	Messages inciting fun launched directly from/to potential contributors				2,7,11 ,13,14 ,18													1	6
	Need of a personal account in order to view the most important information inside the site			1,9,13 ,14,20														1	5
	Positive judgment on the network and on the site by external actors such as magazines, other sites, scientific journals, etc.			3		3, 8							3			3		4	2
	Recognition of best solvers between those involved in the resolution of proposed challenges			10		1, 7, 10,12, 18, 20			1, 9, 20				1, 7, 10	1	20			6	7
	Reward Center organized to incentive the contributors' participation				11				11	11			11	11				5	1
PERSONAL PROFILE DEVELOPMENT	Opportunities of collaboration in relevant projects					8						8	8	8				4	1
	Opportunity to be promoted to a higher grade, as recognition of the effectiveness of a community member			9	9	9, 15	15						9, 15			9, 15		6	2
	Opportunity to become a moderator			13, 18	18	13, 18	13, 18						13, 18			13		6	2
	Opportunity to become leader within the subgroups of community			19	4	4 19	4						4			4		6	2
	Possibility to create a descriptive personal account explicating details and information about education, competencies and interests			4, 10, 15		16							10, 15					3	4
	Opportunity to enter in an elite community			19	4	4, 19	4						4			4		6	2
ACTIONS OF PLATFORM MANAGER	Collaboration between elite community and team of the site					15									15			2	1
	Direct contacts of the site's team with participants (bidirectional)			19, 20														1	2
	Messages with information, material, ideas sent by the site to the community members			10, 13, 14	15	15						15						4	4
FEATURES FOR CREATING AND DEVELOPING COMMUNITIES	Collaboration between the community of consumers and the community of experts			12					12			12			12			4	1
	Possibility to create and nurture professional relations with other members of the community and with employees of companies with which solvers comes into contact																3, 11, 18	1	3
	Possibility to choose team members from those registered to the site			4												4		2	1
	Possibility to comment and to evaluate other posts			13,14, 17, 18	13, 14, 17													2	4
	Project feasibility evaluated by the community			15		3, 8					3, 19					15		4	4

(continued)

Table 2 (continued)

FEATURES FOR ACCELERATING INNOVATION PROCESS	Choice of membership category based on interests and skills			3	13													2	2
	Exchange of information, ideas and knowledge inside special dedicated spaces of the site		4, 7, 8, 9, 10, 13,14, 15, 17	1,2,3, 4,6,7, 8,9,10 ,11,12 ,13,14 ,15,16 ,17,19 , 20		5, 17						7, 14			1, 2, 3, 4, 5, 6, 9, 11, 12 17, 19, 20			5	19
	Organization of brainstorming			5			5											2	1
	Possibility to choose the categories of interest during the research of themes and topics to share and discuss				2, 7, 14, 17, 18							7, 14						2	5
	Possibility to select materials to produce products		14															1	1
	Possibility to share information about projects and potential solutions for the physical realization	6					6, 16				16	16						4	2
	Presence of data on the product and on the market (even if the idea is not carried out)										15	15						2	1
SOCIAL RESPONSIBILITY	Clients committed in social issues, as humanitarian aid agency and no-profit organizations							3, 10										1	2
	Precautions for reducing wastes and pollution							14										1	1
	Presence of social issues within the challenges						5	1,3,4, 5,8,10 ,20										2	7
	Solutions for the common good regarding the social sphere							2										1	1
	Use of sustainable technologies and materials							14										1	1

[a]For space reasons, the OIPs are identified by numbers: Innocentive = 1, IdeaConnection = 2, NineSigma = 3, InnovationExchange = 4, Preasans = 5, Clickworker.com = 6, RedesignMe = 7, Crowdspring = 8, GuerraCreativa = 9, IdeaBounty = 10, EnterpriseSpigit = 11, BigIdeaGroup = 12, Shapeways = 13, Ponoko = 14, Quirky = 15, Thingverse = 16, IdeaWicket = 17, WhyNot = 18, Innoget = 19, Hypios = 20

- Website philosophy: objectives and philosophy of the site (6) and ideals of collaborative participation, crowdsourcing and open innovation (5)
- Personal profile development: opportunity to be promoted to higher grade (6), become a moderator (6), become leader (6), to enter in an elite community (6)
- Entrepreneurial & business opportunities: possibility to realize personal ideas otherwise unfeasible (5)
- Drivers for accelerating innovation: process exchange of information, ideas and knowledge inside special dedicated spaces of the site (4)
- Relationships with customers: ideas approved by client companies (4) and problem solving: issues and challenges are proposed from "outside" and entrusted to the members of the community (4)

3. The *drivers impacting motivations usually not pushed by the majority of OIP* (uncommon – third column) are the drivers that can reveal as a competitive advantage because they are the uncommon ones. An OIP can focus on these drivers to be the most complete one. Clearly these drivers can be also uncommon because are irrelevant, but this is evaluable only in the specific context of the OIP, i.e. if the motivation impacted is relevant for that OIP or not. They are in these groups:

   - Website structure and visual aspects: reward center organized to incentive the contributors' participation (free product)
   - Entrepreneurial and business opportunities: possibility to purchase (but also sell) existing ideas and product in the shop within the site (free product)

Table 3 Classification of drivers based on frequency and impact

	High frequency	High impact	Uncommon
Website philosophy			
Ideals of collaborative participation, crowdsourcing and open innovation		√	
Objectives and philosophy of the site	√	√	
Entrepreneurial and business opportunities			
Possibility to purchase (but also sell) existing ideas and product in the shop within the site			√
Possibility to realize personal ideas otherwise unfeasible		√	
Relationships with customers			
Ideas approved by clients companies	√	√	
Problem solving: issues and challenges are proposed from "outside" and entrusted to the members of the community	√	√	
Website structure and visual aspects			
Creative structure of the site	√		
Expressions present on the website in the various pages accessed during the visit	√	√	
List of winners and their explanatory interviews		√	
Messages inciting fun launched directly from/to potential contributors	√		
Positive judgment on the network and on the site by external actors such as magazines, other sites, scientific journals, etc.		√	
Recognition of best solvers between those involved in the resolution of proposed challenges		√	
Reward Center organized to incentive the contributors' participation		√	√
Personal profile development			
Opportunity to be promoted to a higher grade, become a moderator, become leader, to enter in an elite community		√	
Possibility to create a descriptive personal account, explicative details and information about education, competencies and interests	√		
Features for creating and developing communities			
Possibility to create and nurture professional relations with other members of the community and, in case, with employees of companies with which solvers comes into contact			√
Features for accelerating innovation process			
Exchange of information, ideas and knowledge inside special dedicated spaces of the site	√	√	
Possibility to choose the categories of interest during the research of themes and topics to share and discuss	√		
Social responsibility			
Presence of social issues within the challenges	√		

- Creation and community development: possibility to create and nurture professional relations with other members of the community and, in case, with employees of companies with which solvers comes into contact (social capital).

This research is a first attempt to examine the knowledge sharing motivations and drivers in the OIP. It highlights the interaction between specific drivers for enhancing specific motivations to collaborate and innovate. The role of the community manager and website designer is to create conditions for generation and dissemination of knowledge and to favor its sharing. This is achieved by promoting conditions for an open exchange of ideas and information and by supporting innovative thinking. Going back to the research question, we identified the main drivers to motivate and to foster collaborative innovation process in OIPs. Some drivers are more efficient than others and some ones are rarer, so we deem that they are the key success ones in terms of impact on motivations. The website structure and the visual aspects result fundamental. The more advanced but infrequent characteristics are the ones related to the selling and the building of professionals' communities and of supply networks. Many OIPs count on drivers such as creative structure of the site, messages inciting fun, possibility to create a descriptive account, possibility to choose the categories of interest or the presence of social issues, but they seem to not have a strong impact on motivations. Moreover, some sites forget very important drivers (the ones with high impact but not with high frequency), such as the objective and philosophy of the site, the possibility to realize personal ideas, the positive judgment on the network or the recognition of best solvers. Finally, the reward centre is an important driver both in terms of impact and differentiation: with high impact and also uncommon. The findings suggest to community managers and OIPs' designers which kind of choices of design of the OIP can impact on motivations to attract potentially innovative participants and sustain a high level of collaboration for innovation-related contributions. Further studies will be direct into more quantitative studies and in a broader view (i.e. business model) to develop this explorative study.

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How Internet Is Upsetting the Communication Between Organizations and Their Stakeholders: A Tentative Research Agenda

Tommaso Federici and Alessio Maria Braccini

Abstract A new phenomenon is already visible around us: the use of the Internet as a platform to gather and diffuse information has been deployed to the casting of official data about politics provided by unofficial subjects, like citizens, whistle-blowers and so on. The increased data availability on behaviour and decisions of governors and administrators may profoundly alter their agenda and the relationships with the citizens, introducing a broader public control. However this change may also encounter a lot of limitations, which can lower its strength and relevance. This paper is a first step of a research programme on such phenomenon, its characteristics, novelty, and limits.

1 Introduction

The number of Internet users has grown up to two billions, with a penetration rate of 28.7% of the world population, and a growth rate of 444.8% over 10 years [1]. In this period the Internet users have constantly seen their role of information consumer changing. Blogs, forums, chats, social networks, user generated contents, open contribution, peer production, and web 2.0 technologies are all phenomena that have contributed to turn the Internet user from an information consumer into an information producer. Internet users have nowadays the possibility to produce and share data and information using a plethora of different interactive Internet based tools with the intent to entertain, contribute, and participate.

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This new landscape can modify the communication of an organization with its stakeholders altering the current equilibrium between the two groups. For example citizens can put more pressure on politicians or on large organizations thanks to the availability of more information on their work, always accessible at low cost. Data intended to be confidential can be revealed, or incomplete data can be completed and integrated or confuted by similar data shared by Internet users. Several scholars studied the relationship between transparency and government, as a solution to reduce corruption [2], and improve accountability [3]. Rich and clear information improve the quality of the society, because more informed citizens demand to be better governed and governments are positively influenced by such pressure [4].

In this scenario, instead of having few central points from which data and information are broadcasted, several independent and unofficial agents cooperate and compete in a multicast fashion to share data and information. This emergent phenomenon has already provoked some changes and might require major revisions of management styles in the communications between an organization and its stakeholders. Not all the actors involved in this landscape are anyhow aware of this. At the same time, many constraints and hurdles could potentially impede the change in progress, like for example (but the list is not exhaustive): information difficult to be used (because of language, competence, and quantity); behaviour of media operators which may choose if, what, and when to publish; service operators which may close servers, connections, bank accounts of the subjects who expose information. For all such reasons we believe this to be a new interesting research problem to investigate.

This paper intends to outline a research agenda to study the role of the Information and Communication Technologies (ICTs) on the communication process of an organization (mainly a public one) with its stakeholders (mainly citizens). After the description of the research methodology, the evidences of some recent cases that will be described, and later discussed, support the research agenda outlined in this paper.

2 Research Methodology

With this paper we intend to run an exploratory study on a phenomenon that is currently taking place, therefore we have adopted Yin's multiple case studies methodology [5]. The rationale for cases selection was the presence of a relevant role of ICTs on the communication of an organization with its stakeholders.

The data analyzed for the case studies are gathered from several different sources: newspapers, websites of companies and institutions, private blogs, Facebook, personal and direct experience. In order to avoid biased or inaccurate sources, information for which confrontation with different sources was impossible was not taken into consideration. In all of the cases analyzed ICTs played a relevant role (different from those of traditional media like TV, radio, or press) in the communication process of an organization with its stakeholders. In

each case we focuses on the sequence of actions that shows the behavior of the organization, or that of its stakeholders, in the circumstance of a specific event, or in its aftermaths.

3 Evidences from Some Recent Cases

In recent events worldwide the role of Internet and its capability of turning users into data producers is clearly evident. To support this claim brief descriptions of recent cases are provided below. In these cases actors using the Internet have been able to produce and disseminate information in a way that was not possible through traditional channels (TV, radio, press).

3.1 The Major of Bari and Facebook

The major of Bari (Italy) is using his own Facebook profile as an open forum to communicate with citizens. On January 2011 a citizen sent him a picture of a group of dustmen chatting in the street during their working hours. From the picture it is not clear whether the dustmen are just messing around or organizing their work. The major immediately posted the picture on Facebook. The picture caught the attention of both citizens and trade unions: the former complaining about a poor efficiency of the sweeping service, the latter blaming the major for his possible will to run down the work of honest workers. On his side the major invited all of them to confront either on Facebook or anywhere else.

Other examples of this kind of usage of Facebook from the major of Bari are for instance the reports of protests related to town hall employers' cars being parked on pedestrian crossings or even double-parked.

3.2 L'affaires des quotas

On November 2010, during a private meeting of the Federation Française de Football (FFF), some managers and the coach of the national team discussed the problem of having too many football players originating from Arab or African countries. They were worried that due to salient characteristics of nowadays football players, dark-skinned players might have better chances to be part of the France national team, leaving less room for white ones. They then agreed to limit the number of such players in junior teams to 30% of the total components, without disclosing this decision to the public.

An anonymous whistle-blower went somehow in possession of a verbatim record of that meeting and eventually passed it to the newspaper Mediapart [7].

The latter published on May 2011 a set of articles accusing FFF managers of racism. The persons interested have immediately declared to be unrelated to the fact, blaming the contents of the articles to be not accurate nor true. The newspaper has then immediately published transcriptions of the record publicly unveiling the contents of the discussion.

3.3 WikiLeaks

WikiLeaks is an international no-profit organization that, warranting anonymity and integrity of information, receives and subsequently shares, through his website, confidential documents from large organizations or governments. On November 2010 it started to publish part of 251.287 documents containing confidential information on the work of the government and diplomacy of the USA in the world. The same documents were also sent to the daily El Pais, Le Monde, The Guardian, The New York Time, and to the weekly Der Spiegel. These documents contain information and comments on the habits and on the work of leaders of the most influent international countries.

The reactions of administrations and leaders interested by the disclosures showed unpreparedness (a European government even claimed to "deny WikiLeaks" [6]) and were of embarrassment, minimization, and contradiction. Right after that, attacks were moved against the WikiLeaks website (that was even obscured), and its founder (who was accused of sex crimes and eventually arrested).

3.4 The Fukushima Dai-ichi Nuclear Power Plant Crisis

Following the massive Sendai earthquake of March 2011, a sequence of events and incidents contributed to the release of nuclear radiations in the environment from the Fukushima dai-ichi power plant. The difficulties in restoring a safe condition in the reactors, along with the suspect that the government was not telling the whole truth on the incident, have created a big concern on the safety of the nuclear technology and also on possible local and global consequences of this incident. In response several individuals and organizations have started to publish on websites and blogs data on radiation levels around the nuclear power plant and Tokyo. These initiatives forced public authorities to detect and publish official data on radiations. At first the Italian civil protection measured radiation levels near the Italian embassy in Tokyo. Later both the Japan Ministry of Economy Trade and Industry, and the Ministry of Education, started to publish official data on radioactivity levels. Finally the International Atomic Energy Agency published regular and detailed reports on the evolution of the incident.

3.5 Ushahidi

Ushahidi (witness in Swahili) is a non-profit company that develops open source software for information collection, visualization, and interactive mapping. Ushahidi has created a website to collect reports and eyewitnesses of violence sent by e-mail and text massage and eventually placed on a Google map. The website was firstly created and used in the aftermath of Kenya's disputed 2007 presidential election when President Mwai Kibaki was declared the winner while supporters of his opponents alleged electoral manipulations. An increasing number of violent protests from the opposition supporters leaded to fights in several parts of the country. During these protests the police shots a number of demonstrators, including a few in front of TV cameras.

Ushahidi later became an open platform available for every group of citizens or associations who wants to report politicians misbehaves.

4 Discussion of Cases

The five analysed cases come from as many countries, involve diverse levels of government, face different problems and present various issues. Table 1 is a tentative classification of the representative cases on the dealt with phenomenon. The classification is based on the so far identified relevant characteristics for such topic. Even though quite different, all the cases regard an increased availability of original data (not comments nor opinions) provided by unofficial subjects regarding phenomena interesting central or local governments. Moreover, the cases involve a modification in the communication, which turns from a broadcast, highly controlled, to a multicast, substantially uncontrolled, form. Finally, in all the cases the possibility for citizens of interacting with institutions becomes larger.

However, also considering the public nature of the analyzed organizations, and their submission to the social control of the respective population, such change introduces a substantial alteration in the relationship between an administration and its stakeholders. We identified two groups of actors along the processes in question: politicians and citizens; and two groups of intermediaries, who might also turn in actors: media operators and services providers. We then chose to tentatively structure a research agenda using these four groups.

4.1 Politicians

The subjects probably most affected by a wider availability of data on their decisions and behaviour are the politicians, notably those in charge of some official role. Under this perspective, a possible approach to study this phenomenon is that of

Table 1 Analysed dimensions of the cases

Variables	Major of Bari	Affaires des quotas	WikiLeaks	Fukushima crisis	Ushahidi website
Year	2011	2011	2010	2011	2007 (to now)
Original source	Citizens	Whistle-blower	Whistle-blower	Citizens and institutions	Citizens
Disseminator	The major	Newspaper	WikiLeaks, TVs, and press	Private blogs	Ushahidi
Stakeholders interested	Citizens of Bari	Citizens sportsmen	Citizens, administrations, and international community	Japan citizens, international community	Kenyan people, international community
Type of administration interested	Local government	Federation Française de Football	Diplomatic institutions	Central government and private companies	Central government
Problem nature	Inefficient services	Racism	Diplomatic relations	Public health	Violation of rights
Size of data	Few pictures and comments	1 verbatim record	251.287 docs	Several tables of radiation levels	Map with several text messages
Difficulty of interpretation	Low	Low	Medium	High	Medium
Barriers to interpretation	Apparently none	Apparently none	Amount of documents, language	Specific knowledge, language	Language
Role of intermediaries	None	Disseminators	Selector, disseminators	Disseminators	None

Critical Management Studies, since many organizational constructs on which governmental bodies are presently based may be reversed or profoundly modified, asking for new management styles. We refer here, but the list is longer, to: a power which does not any more possess and distribute all the knowledge about itself [8]; the influence of a continuous, unpredictable control on the tendency of leaders to determine goals and use of resources with the aim of reinforcing their power [9]; and the consequences on leaders of more frequent judgements expressed by informed "citizens," instead of an only vote by possibly not acquainted electors every 4/5 years [10].

4.2 Citizens

Apparently, citizens seem to become more powerful because of the availability of more information about the actual behaviour of institutions and the opportunity to directly interact with their leaders. However to reach this increased power they have to be able to process and assimilate a lot of data in a while (for example the documents promised by WikiLeaks are 251.287), often having also the specific competence required or knowing a foreign language (e.g.: WikiLeaks documents are all in English): this issues suggest the recourse to the absorptive capacity theory [11, 12]. Moreover, citizens may (or may not) have the capacity to use the new available information in their own decision making process when choosing the candidate to vote: this point could be studied using the theories on decision making [13, 14]. They also may have to change their way of thinking and their behaviour as regards politics, which can be analysed starting from Bandura [15]. Finally, when investigating the role of the citizens, two aspects have to be taken into consideration: the digital divide, which may exclude elder or low ICT literate people from the participation to the emergent phenomenon, and the role of digital natives which can consider this upcoming change as normal [16].

4.3 Media Operators

Media operators, like newspapers, televisions, radios, websites, have always had a role in the political process: they gather, elaborate and diffuse information in a way accessible to the vast majority of people. Such role keeps being important when a lot of original documents, in a quantity never seen before, are suddenly free available. This amount of documents may be written in another language, and may ask for specific competences: they must then be read, interpreted, aggregated, and eventually presented in a more usable form to readers, who otherwise will not derive benefit from them. Media operators, like in any other circumstance in their action, have the great power of choosing *what to publish* (and what to bury), *in which form* (highlighted or distorted), and *when* (immediately or late). However,

this could cause a new singular condition: even when a lot of original documents, possibly relevant to address the political agenda in a country (or region), is available to everyone somewhere on the web, as they are not inside researchable (e.g. when scanned), too many, not easily interpretable, they would not produce any change until a media operator decides to work on them. The agent role of media operators then possibly increases in these cases (already at least partially happened), and the agency theory [17] would be useful to study it.

4.4 Service Providers

When reflecting on the presented cases we noticed the unexpected presence of the services' providers, like web hosts, telecoms, social networks, credit cards companies, and we see their role in the relationships between citizens and institutions greatly increased. Even though they are pervasively present in all the actions of our life, differently from media operators, we are not used to think to them as important actors in conditioning the relationships with central or local governments. Nevertheless, in some examined cases they played a relevant role, often with blocking activities. For example, in the case of WikiLeaks documents, once some US politicians had claimed about the betrayal and the threat of having exposed such documents, operators like Amazon (web hosts) and PayPal (payment system), tried to stop the activity of WikiLeaks, already their customer since years. So we have experienced (even if partially neutralized in such case) the presence and strength of the service providers (even though quite different) in Internet openness and accessibility and their possible submission to governments. The shift of the role of the intermediaries suggests recurring either to the agency theory [17], or to the actor network theory [18].

5 Conclusions

This paper deals with the new, highly interesting, phenomenon of much more official data about behaviour and decisions of public leaders, available to everyone at low cost thanks to Internet. Such availability may create a sort of peer review by citizens, upsetting in this way the relationships between them and the respective administrations. However, several limitations for this change (potential or already manifested) have been mentioned in the paper. Through the study and a tentative classification of five cases a first possible research agenda has been eventually proposed.

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The Evaluation of Networks Performance in Cultural Heritage Through Intelligent Systems

Massimo Bianchi, Arturas Kaklauskas, Joshua Onome Imoniana, Rebecca Levy Orelli, and Laura Tampieri

Abstract The paper analyses and discusses the application of intelligent systems in cultural networks by proposing a framework of performance evaluation based on the network approach. This approach is the natural evolution of cultural institutions that starts from the ownership and preservation of cultural heritage, to the use of web tools and to the perspective that considers the real user's need identified not as simple information but as process to acquire a cultural awareness as the basis for cultural fruition. The research examined the search software based on the intelligent ones such as the Inquiry-Answer Extraction Networked System for Sustainable Tourism (IAST) to evaluate the performances. Thus, the basic research question is: which are the characteristics in the application of intelligent systems for cultural heritage networks which suggest a specific performance evaluation framework? On the basis of the undertaken analysis, different search tools existing in WEB could be applied to different profiles of users underlining the trade off between organizational top-down and bottom-up approaches.

Although this paper is the result of a joint collaboration, paragraph 1 is attributed to M. Bianchi, par. 2 to R.L. Orelli, par. 3 to L. Tampieri, par. 4 to J.O. Imoniana and par. 5 to A. Kaklauskas.

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1 The Intelligent Systems in the Fruition of Cultural Heritage

Owing to ICT revolution, a Cultural System could be considered today not as a complex of cultural heritage materials connected by a geographical location to be visited but as a network virtually interconnected and available for users. The time and the difficulty of its fruition could be evaluated in different ways all connected to the characteristics of tools used to search cultural elements.

Performance evaluation in network of cultural heritage systems is an issue of great importance in nowadays public governance scenarios. This is evident as we see stakeholder's engagement through monitoring procedures seek result oriented networks and not have network *per se*.

The paper analyses and discusses the case of Inquiry-Answer Extraction Networked System for Sustainable Tourism (IAST) evaluating the results performed from an approach that considers the result as a path of an evolution started from the ownership and preserving of cultural heritage to a new step of services delivering (including web tools). The performance evaluation is based on real users' needs to obtain the cultural awareness for a more consciousness fruition.

ICTs allow user the search step by step of opportunities available in the network and open the way for intelligent system applications as IAST. This process is in the hands of user and can be defined as a bottom-up and qualitative approach, mainly linked to the networking process (the possibility of create links among data) contrary to the clustering which is based on the quantity of available data.

The theoretical frame of the paper underlines the new vision of network analysis that, in the traditional approach, is focused on the structural point of view and particularly on ties and feedback time of the communications realized in the network. The new approach, instead, considers the participation of the user and its capability to create links among information elements and, step by step, to test different opportunities before to decide. The dialogue with the system provides partial answers and helps the user to take a choice.

In cultural networks, owing to the connection of the services produced by such organizations with other actors such as citizens, agencies and tourism organizations, the availability of elements and the customization of significant categories become a sine qua non condition. In this respect, the intelligent systems methodologies will play a central role in facilitating and supporting knowledge, information and data sharing.

Therefore, cultural network-centric organization becomes a sensible response to a complex human environment featured by profound and continuous changes. The diversity of available alternatives contributes to a more accurate satisfaction of complex economical, legal/regulatory, administrative, organizational, managerial, social, cultural, religion, ethical, psychological and emotional needs of all involved parties.

In the process of using IAST, the basis is the time employed to realize a successful search and to build a cultural path within a wide range of opportunities just in the logic of hyperlinks that has been analysed in previous papers [1].

2 Information Systems and Performance

Performance measurement is set around the idea that each public organization formulates its own envisaging performance by defining specific performance indicators which are used to steer and control activities with the aim to get strategic goals [2]. Hatry [3] defines performance measurement as the "measurement on a regular basis of the results (outcome) and efficiency of services or programs". Bouckaert and Halligan [4] consider performance as "not a unitary concept ... [which] must be viewed as a set of information about achievements of varying significance to different stakeholders". Achievements may be viewed as a synonym for results, which is the most typical view taken by many practitioners from the performance measurement movement.

On the other side, programmes of government do not work by themselves [5], they require 'technologies' if they are to be made operable. Technologies are devices for intervening and they include notation, computation and calculation, procedures of examination and assessment, etc. Today they can be identified with information technologies, defined by two different dimensions. The first dimension to be considered is the level of government and types of external stakeholders involved. For example, a cultural website may be developed with the input of a citizen's advisory committee. Or, as in the case of a public cultural network, different levels of government, for example local and state governments, may interact with government(s) to shape IT system deployment and in particular website deployment. This dimension can be referred to what has been presented as performance regime [6], in other words, the actors that shape the concept of performance that has to be provided by IS.

Another dimension is the types of performance for which IS is intended to accomplish. IS offers different services or information to citizens, other governments, contractors or internal managers via the IT system. Each group will of course bring their own demands of output on the system. Website or information could include items such as how the institution is structured, and other basic information. It could also include access to direct services such as obtaining tickets. Each group will make different demands via the IT system. Overall, IS implementation strategies may be focused more on: (1) efficiency gains, i.e., producing the same outputs at lower total cost, producing more outputs at the same total cost, or producing the same outputs at the same total cost in less time; (2) effectiveness gains, i.e. producing the same outputs at the same total cost in the same time, but to a higher quality standard, or producing new outputs [7].

3 The Determinants of Network Performance

The studies on the network performance and particularly on the relationships between the network structure and the performance increased in last decade among academic and business communities. The network is well recognized by

literature as the complex of actors, also named "nodes", that can be persons, groups, areas and organizations that interact by a set of ties [8].

Referring to the relationships between the structural dimensions of a network and the performance, the position placed by an actor in the network may influence the performance, the continuity of relationships with other actors, the innovativeness [9] and governance [10]. Aral, Brynjolfsson and Van Alstyne [11] stated that the structural diversity of networks is connected to performance because the wide variety of contacts realized in the network provides access to new information and resources.

Defining the structure of a network means to map the ties may be created among actors. Ties can be of different typologies but the distinction strong-weak and direct–indirect play a central role in the research. Granovetter's thesis [12] of the "strength-of-weak-ties" stated that weak ties are often more relevant in information or resources transfer as they function as bridges between otherwise disconnected social groups. This distinction is linked to the span of control principle as the number of elements may be controlled as it affects the network activities and results coordination [13].

The time is a very relevant determinant of network performance evaluation as the most of activities is constrained by deadlines and because the intelligent systems implementation could reduce the time of knowledge, information and data transfer. In particular the time of users' need satisfaction changes from using Google to intelligent systems. In the top down approach the users express to the web system all their perceived needs or purposes and, as it happens in Google, the system gives the reply within a time span that is represented by the number of results and feedback time. In this system the users immediately communicate their needs without intermediate opportunities.

With the diffusion of a mass ICT culture another situation is that the user approximately knows what he wants to demand but needs to find, step by step, the available opportunities in the network. This is the basis of intelligent system application in which we have a balance between the existing knowledge at the beginning of the research and the one that emerges step by step during the research. This last one can be defined as a bottom-up and qualitative approach, mainly linked to the networking process contrary to the clustering one based on the quantity of available data. It produces an hyperlink connection with many steps that make this path or fruition an original and unrepeatable product of personal needs and approach.

4 Performance Evaluation

In the process of using intelligent networking systems to assess the promotion of cultural heritage, something is paramount along the line for the stakeholders to believe in the horizon of the systems, one has to evaluate performances by the agency indicators.

To most diffused structural dimension of a network is the size as the number of actors that influences the coordination and information exchange. In this way increasing size can be associated to increasing problems of coordination and information transfer owing to the emerging difficulties in converge units' interests in those of the network.

This use of indicators is common in emerging economies such as Brazil, where performance evaluation is based on the compliance with the Fiscal Responsibility Act. In this case Agencies expedite on their strategies through the law of budgetary directives (planning and policies) aiming at meeting up with the government programs, such that at the final analysis, one evaluates the program outcomes and their indexes.

Under normal circumstances, the evaluation process should involve planning, implementation (execution or maintenance) and evaluation of the social and economic outcomes. Tangible and intangible – "cultural economic" goods and services, as provided by cultural institutions, may be analysed and valued in a multi-dimensional, multi-attribute and multi-value socio-economic environment [14].

As stated by Tyler and Steensma [15], rational choice lenses highlighting important factors must be used in evaluating potential technological collaborative opportunities. In some aspects the decision is related to the hybrid arrangements. In short, this consists in entirely controlling the networking process and the monitoring of the outcomes within its associates. In cultural systems evaluation is highly linked to the time needed by creating, on the basis of available elements, the personal way to access to information required for a fruitful perception.

5 Intelligent Systems and the Case Study of IAST

The most advanced electronic libraries of today employ a retrieval system that is similar to Google. The Google system is based on complex PageRank™ technology, which is being patented at this time. It ensures that the most important results always appear first.

US Patent No. 5297042 and after US 2006/0047656 European patent EP 1880320 (WO 2006121338) represented basic acknowledgements in document retrieval system that includes an inputting unit for inputting a retrieval condition including one or a plurality of keywords and a weight value for each keyword, an operating unit having first factors corresponding to relationship values and reduce the process to a limited number of steps. Search engine rankings have been adopted in most advanced intelligent libraries [16–19] and tutoring systems [20]. However, intelligent libraries and intelligent tutoring systems with search engine rankings cannot select chapters (sections, paragraphs) of specific texts, which are the most relevant to an user, cannot integrate the chapters (sections, paragraphs) of specific texts into tourist specific alternatives of teaching material and cannot select the most rational alternative. The IAST can perform the afore-mentioned functions tested in the analysis.

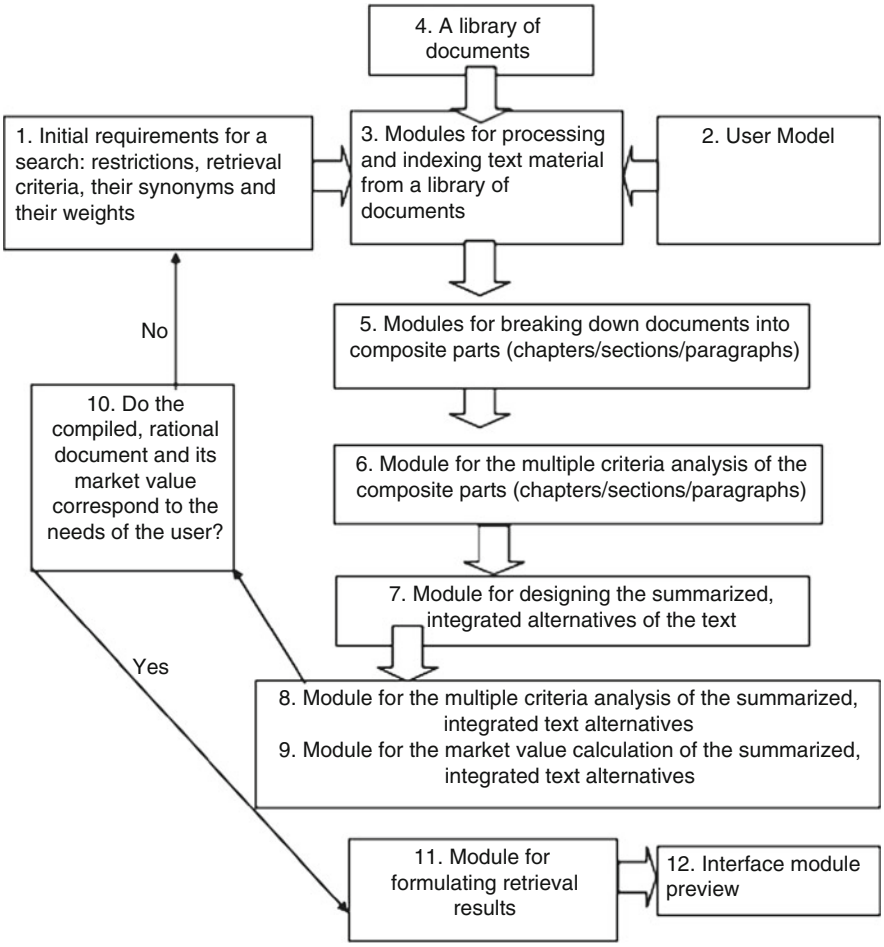

Fig. 1 Inquiry-answer extraction networked model and system for sustainable tourism

The method (Fig. 1) uses search requirements that are comprehensible to users, intuitively foreseeable and statically substantiated. It considers numerous functions, for example, the time of day or week when the user is performing the search. Usually an user's priorities for conducting a search during the evening or at leisure times differ from those for a search conducted during working hours. This method encompasses, to an equal extent, both the factors related to the text (for example, repetitions of keywords, headings) and the factors unrelated to the text (for example, an analysis of references) that do not equally influence the text under analysis.

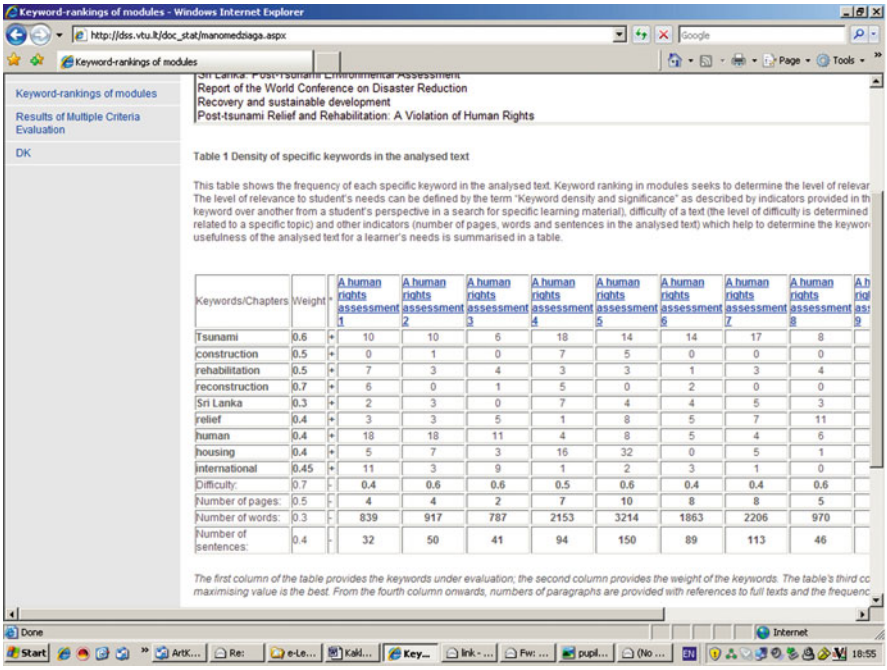

Fig. 2 Results of multiple criteria evaluation

The analysed case study is based on the situation of two tourists from Lithuania traveling to Sri Lanka. They are very interested to familiarize with the development of sustainable communities in a post tsunami period. They want to test this new system named IAST.

Different electronic information and knowledge were used during the test as follows: (1.1.) Livelihoods Restoration; (1.2.) Healthy Environment; (1.3.) Housing, Environmental Reconstruction; (1.3.1.) Coastal Zoning; (1.3.2.) Land-use planning; (1.3.3.) Reconstruction standards; (1.3.4.) Temporary Housing etc. Initially the two users open the website http://iti.vgtu.lt/alib/default.aspx and apply search keywords available in the database.

The users can look for the most appropriate information by using a search restricted by: (a) number of pages; (b) minutes of reading time; (c) combination of all possible alternatives. The degree of utility of the required information indicates the level of satisfaction of the actual user needs (Fig. 2). The more goals that are achieved and the more important they are for the user, the higher would be the degree of the information' utility. The degree of information's utility reflects the extent to which the goals pursued by the user are attained. The greater the utility degree the higher the priority of required information.

6 Conclusions

The paper discussed and tested the intelligent software capability to determine coherent parameters for the evaluation of cultural networks as it represents an issue of great importance in nowadays public governance scenarios. This required a comprehensive research into the above object that necessitated the application of multiple criteria analysis methods enabling the user to thoroughly assess its technical, legal/regulatory, administrative, organizational, managerial, social, cultural, religion, ethical, psychological and emotional aspects. Main limitation refers to the lack of achieved results generalization as the analysis focused on only one case. So future imperatives of research are addressed to examine more cases, also in different specifications of cultural heritage, to make comparison with other web tools and to find and analyse new ways of interaction through internet.

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Search Phase and the Openness Effects in MNEs

Luca Sabini, Alfredo Valentino, and Kinsuk Mani Sinha

Abstract In this work we focus on the search phase that precedes the knowledge transfer process. We argue that it is important to closely analyze this phase as, the common understanding of problem developed in this phase has a significant impact on the stages that follow. In this analysis we focus on two key factors: openness and the richness of media of communication that foster the openness within Multinational Corporation (MNC) environment. Furthermore, we also try to explore the degree of knowledge transfer due to an open environment. Openness is a change that can be induced at the MNE level by the Headquarter (HQ), the effects of this change are behavioral in nature and can be observed at the subsidiary level in the type of media of communication used.

1 Introduction

Knowledge flow within the MNC and its impediments have been the topic of scholarly investigation since the famous intellectual work of [1]. In order to transfer knowledge the source needs to know what kind of knowledge to transfer, an understanding developed in the pre-transfer phase of knowledge transfer. Pre-transfer phase of knowledge is the stage before the initiation phase of knowledge transfer. We use the 'Diffusion on the directed network' model, this simulation

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model helps us in analyzing the role of motivation and media richness in flow of knowledge.

The model adopts a process perspective because knowledge transfer is not an instantaneous process [2]. We follow the process perspective and argue that it is important to understand the process before the formal knowledge transfer begins. This analysis helps in developing a common understanding of the problem, which explains how the gap (the problem) was identified by the recipient. And, how a common understanding of the gap (a common understanding of the problem) was developed by both the source and the recipient. We explore the factors that might impede this flow of knowledge and the methods that the MNC can deploy to address them. Furthermore, we argue that a key assumption needs to be considered in order to understand the role of motivation, the environment of openness introduced by Headquarter. Openness in the context that we draw, creates an environment in which the subsidiaries are willing to share information with each other.

This discussion can be understood better by drawing an analogy with the innovation work. Rogers [3] stresses the need to investigate the pre-innovation phase while investigating the innovation diffusion process as this constrains the diffusion of the innovation. Even though knowledge transfer is a "distinct movement of knowledge within organization and not a gradual dissemination" [2], we argue that the stages prior to the knowledge transfer have a significant impact on the knowledge transfer process and affect the knowledge transfer capacity of the source.

2 Theoretical Background

2.1 Knowledge Transfer and Search Phase

In international business literature, scholars have given substantial attention to knowledge transfer process among different units [4–8]. Knowledge transfer is the process through which one unit exerts influence on other units [9].

Szulanski [2] argues that transfer of knowledge should not be modeled as an act but as a process which identifies stages or phases. This process is divided in four parts [2]: initiation, implementation, ramp-up, integration. In this study we argue that while following the process perspective we need to start analyzing the factors from the pre- transfer stage: search phase.[1] This should not be confused with the initiation stage. As, in the initiation stage a gap is identified but in the search phase a common understanding of the problem (the gap) is developed which is significantly different from gap identification.

[1] In our work we consider search phase and pre-transfer phase with the same meaning, as they both refer to the initial stage of knowledge transfer process.

The gap in knowledge based view between the source and the recipient exists because of geographical distance and stickiness. This point has been raised in RBV literature [10], in knowledge transfer literature [2] and in MNC literature [6, 7, 11, 12].

These obstacles reduce the willingness and motivation of entities to share knowledge and information within multinational corporation. These entities are intrinsically motivated to satisfy an immediate need [13], that is to solve their problem. If the obstacles to solution of entities problem are too high, the motivation goes down.

2.2 Media Richness

The capacity to resolve ambiguity, negotiate interpretations, and facilitate understanding might vary depending on the kind of media chosen [14–17].

The main assumption of *Media Richness* (**MR**) theory are:

- Try to avoid equivocality and uncertainty in organizations;
- Variety of media and these work better for certain tasks than for others.

Using four criteria, [14] present a media richness hierarchy, arranged from high to low degrees of richness, to illustrate the capacity of a given type of media to process unclear communication in organizations.

From a strategic management perspective, the media richness theory suggests that effective managers make a optimal choice if they follow these criteria. Hence, every criteria is suitable to address a specific kind of problem. Therefore, it would be preferable strategy to match a particular communication medium to a specific task or objective and to the degree of richness required by that task [18].

2.3 Openness

In the organization learning literature, openness has been defined by different authors [19–22] mainly as the partners' willingness to share knowledge in a collaborative interaction [23]. Wathne et al. [24], argue that "openness can be understood in terms of overall perceived openness of dialogue, the degree to which the partner representatives work closely together on a common task, and the degree to which the partner representatives perceive that the others withhold their knowledge" [24].

As the prior discussion indicates lack of motivation and geographical distance are two major obstacles in developing a common understanding of a problem. We argue that an environment of openness motivates the sharing of problemistic knowledge and media richness mitigates the effect of distance between two subsidiaries.

3 Model

HQ plays a key role in creating an environment of openness. This environment motivates the subsidiaries to communicate to each other. Our model focuses on the search phase which precedes the knowledge transfer process [2].

3.1 Search Phase

According to the behavioral theory of firm [25] two kinds of search are undertaken by a firm (in our case the subsidiary of a MNE): problemistic search and slack search. In our work we consider only problemistic search as, this will help us in developing a better understanding of the causal relationships.

What is the 'problemistic search process' in a MNC? How does a subsidiary look for solutions? Is it guided in this choice by the charter developed by the HQ or does the charter decide who will contact whom? Prior work has explained the charter development process in MNC [26]. This process explains the subsidiary specialization. We argue that the charter only helps in creating a general understanding of the problem. Despite the general understanding, lack of motivation might hinder knowledge transfer among subsidiaries [27].

Furthermore, few researchers highlighted that knowledge flow in a MNE can be affected by motivation in units: motivation is a property of knowledge exchange [13, 28–30].

Emerson [31], suggests that the lack of motivation can be a cause of knowledge transfer failure. But theories related to knowledge sharing frequently stress the importance of motivation, which is higher in interactive learning environment. All these environmental factors affecting subsidiary behavior can be grouped under one construct: openness.

Openness is a phenomenon that can be observed at the organizational level. Openness is a situation in the intra organizational network where positive evaluation and work coordination is present. But, positive evaluation and work coordination do not suffice. They must be supplemented by tolerance for mistake and trust as these two features are very important in a learning process. We must point out that each of these features together constitute our definition of openness. None of them have a fixed level of contribution, their individual contribution varies as per the situation.

Work coordination among the subsidiaries develops an environment of cooperation, this environment is coupled with other features. As a result, the subsidiaries understand what the other subsidiaries are working on[2] and trust each other. Hence, the motivation to share knowledge increases due to the faith in the phenomenon of

[2] This analysis should be combined with the meta knowledge to which they already have access.

reciprocity.[3] This increase in motivation reduces the level of hindrance in knowledge transfer. But we must point out that in the search phase there is no transfer of knowledge, only a common understanding of the problem is developed. Hence, the increase in motivation and the phenomenon of reciprocity helps in sharing the information details concerning the problem. This helps in defining the problem in a way that can be understood by both the source and the recipient.

Why do we need to define the problem? Due to different mental models the same problem may be understood in different ways by the subsidiaries.

The source may not be interested in understanding the problem of the recipient cause of lack of adequate motivation. This lack of understanding is a major obstacle in developing a common understanding of the problem. But an increase in the motivation of the source will encourage it to understand the problem of the recipient. We argue that this change in the motivation is induced through openness. Openness acts on motivation, which helps in developing a common understanding of the problem.

The lack of effort on the part of the recipient can be attributed to the low motivation of the source. This leads to an environment characterized by non-cooperation. As a result the recipient does not feel encouraged in explaining its problem to the source. This lack of effort on the part of the recipient in teaching its problem to the source hampers the understanding of the source.

H.1: Higher motivation to share the knowledge and problem between source and recipient higher the common understanding the problem.

MR theory helps in explaining how the flow of information with a proper media facilitates the implementation of open environment. In search phase higher is the use of media, higher is the effective understanding of problem by each entities within MNCs. According to [33], effectiveness means the proper understanding of complex problems from recipient. So we formulate the following hypothesis.

H.2: Higher degree of use of media richness more effective is the understanding of complex problems from recipient.

4 Simulation

The hypothesis that we have proposed needs access to the MNCs in order to gather data and validate it. Due to reasons of confidentiality and infeasibility it becomes difficult even if not impossible to find data of this nature. Furthermore, even if we collect data within the MNC it still might be difficult to figure out answers to questions like the causal relationship, what triggers the flow of information during the search phase, how does openness contribute to the flow of information, what kind of contribution can media richness make? Simulations allow us to answer

[3] Reciprocity is often discussed in the justice literature, especially procedural justice.

questions of this nature. In this paper we use the diffusion on the directed network simulation model. The subsidiaries are represented by the nodes, the links between the subsdiary represent the link of communication, the rate of information flow through this link is fixed with the help of diffusion rate parameter. Link chance represents openness, the higher is the level of link-chance higher is the level of openness. Openness motivates the subsidiary to share knowledge of the problem during the search phase. The diffusion rate represents the sharing of information, which is affected both by openness and media richness. In the following part we explain the results of the hypothesis.

The simulation outcome supports the first hypothesis.

The figure below, the respective histogram (in the appendix) and the table gives us the output for the first hypothesis. We start by explaining the figure then proceed to the histogram. In the figure for low motivation it can be noticed that despite of the bidirectional links the size of the nodes is diminishing accompanied with a diminishing flow through the links. Only one node continues to grow. The same phenomenon can be observed if we read the histogram. Twenty-four nodes fall in the range of zero value and only one node falls in the range of 16,8 value. This means that 24 nodes understand the problem of the neighbouring node but this understanding is almost equivalent to zero (Fig. 1).

Now let's proceed to the second situation when the level of motivations is higher. In this figure the information flowing through the bidirectional link is higher, the size of nodes is growing mutually. This phenomenon can be read in the histogram we have more nodes sharing the problem. Seven nodes understand the problem of their neighbouring and this understanding is equivalent to 0,8. The same interpretation can be made for the remaining nodes and the respective value.

This leads us to conclude that in case of higher motivation the level of understanding of a problem will be higher (Table 1).

We also found mild and not very strong support for our third hypothesis. It can be noticed that 16 nodes share knowledge at a level which is almost equivalent to zero and this is 3 nodes more than the case of higher motivation. Furthermore, we have only 2 nodes sharing the knowledge of the neighbour at a rate of 0.8 whereas

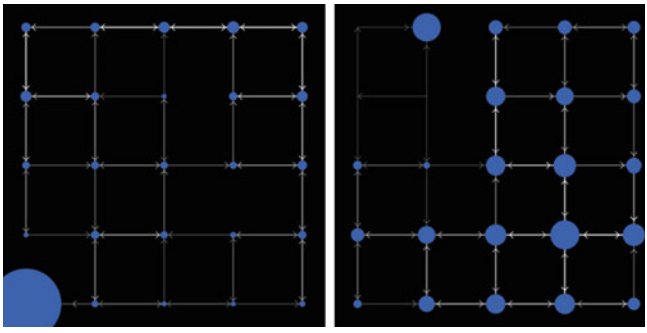

Fig. 1 This figure showing respectively low and high motivation to share knowledge

Table 1 Simulation results table

Low motivation		High motivation		Presence of media richness	
Value	N. of nodes	Value	N. of nodes	Value	N. of nodes
0	24	0	13	0	16
16,8	1	0,8	7	0,8	2
		1,6	3	1,6	3
		2,4	2	2,4	3
				3,2	1

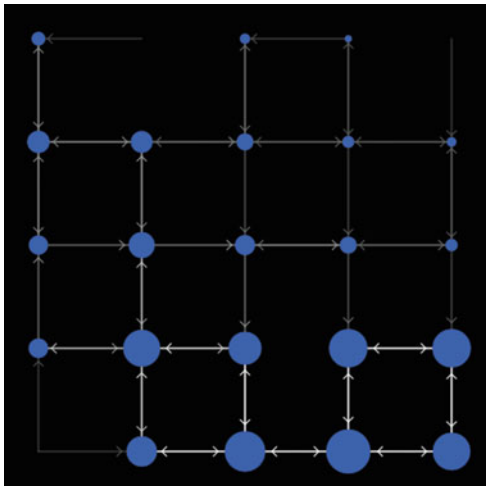

Fig. 2 This figure show respectively the use of MR in sharing knowledge

in the case of higher motivation this value was 7. We suggest that decrease in the number of nodes to benefit from the media richness is because of the need to master the techniques of the media rich tool and to understand which tool is to be used with which kind of problem. This understanding is critical for the proper use of media richness (Fig. 2).

5 Conclusions

Motivation increases the rate of problemistic knowledge flow and media richness further augments the flow. However, the simulation results emphasize that media richness by itself is not enough, the subsidiaries need to acquire or develop the capabilities needed. These capabilities help the subsidiary understand which type of media should be used for different problem and how to use that kind of media.

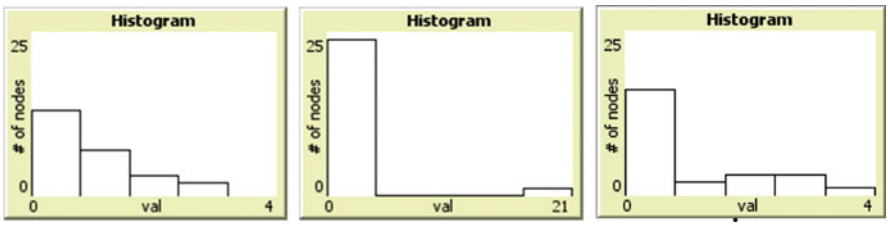

Fig. 3 This figure shows respectively the histograms for high and low motivation to share knowledge, and the histogram for the presence of media richness

Appendix

We use the [34] diffusion on a directed network model to test our hypothesis. In this model the nodes represent the subsidiary, the links represent the connection between them. The arrow on the link shows its direction, the links are either unidirectional or bidirectional. The brightness of the link shows the flow of information (we do not call it knowledge at this stage, because knowledge is contextualized information). The value that a subsidiary has is represented by the size of the node. We would like to emphasize that the value represents the amount of knowledge of the problem (we do this in order to specify the kind of knowledge we are considering). The diffusion rate is used to control for the amount of value transferred. If the node is connected (points towards them) to two nodes then it divides the value it receives in two halves and passes it to those nodes. When it is not connected to any node, it keeps the value it receives with itself. The key point here is that, if the node is does not reciprocate with the node from which it just received information then it will not transfer any information back to it. We will come back to this point later when we explain the hypothesis (Fig. 3).

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Part VIII
IS, IT and Security

Managing Information Security Through Policy Definition: Organizational Implications

Moufida Sadok and Paolo Spagnoletti

Abstract Organizations are more dependent than ever on the effective security of their information systems in order to ensure business continuity, efficiency and compliance with regulatory and governance frameworks. However, security breaches surveys reveal a poor effectiveness of security solutions and procedures implemented by the enterprises. In particular, enterprises experience difficulties in assessing and managing their security risks, applying appropriate security controls, as well as preventing security threats. In this paper we explore the nature of a security policy with a specific focus on managerial and strategic implications of the security policy implementation process. Two examples are provided in order to setup the basis of a method for the definition of security policies aligned with both operational and strategic plans of an enterprise.

1 Introduction

A security policy determines the assets that need to be protected, identifies the different vulnerabilities and threats that may affect the enterprise integrity, and includes procedures to prevent and respond to security incidents by means of access control measures, continuous monitoring and risk assessment. It can also optimize security solutions design and cost. In this paper we recognize a crucial role to the

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information security policy since it is the starting point of an effective information security framework, it gives a roadmap for the information flows building and risks analysis, and it is a major component in the alignment between business strategy, enterprise operations, and information security practices. Although the use of security policy plays a vital role in the development of organization's strategy [1] and targets the establishment of specific controls to cope with internal and external threats [2], it is rarely specified which methodologies can be used in practice to develop and manage information security policy [3, 4]. In effect, the successful formulation and implementation of security policy depends on many contextual factors such as organizational structure and culture [5, 6]. A number of IT governance frameworks and standards exist to assist organizations to manage information security, analyze risks, set-up efficient controls and ensure business continuity [7]. However, information security standards, which are concise and descriptive, often fail to provide practical guidelines to plan, apply, and maintain security processes [8–10].

The primary focus of this paper lies in the discussion of the managerial and strategic issues arising from the setup and deployment of the information security policy and that have the potential to significantly influence the information systems design, functionalities, operations, and quality. We identify and describe the issues that are commonly addressed in the security policy according to the security standard ISO 17799 [11]. In this discussion, we take into account critical features related to the enterprise business environment and its organizational resources which have a potential impact on the formulation, the maintenance and the effectiveness of an information security policy. The aim of this paper is to explore two main questions. First, why do we need effective alignment of security policy with the operational and strategic activities of the enterprise? Second, what are the available techniques for handling an effective alignment? We address these issues by focusing on the role of the security policy as a continuous process and by recommending the set up of a monitoring system and the composition of an incident response team (IRT). The monitoring is on the lookout of any security incident in order to implement necessary protection measures. The IRT is on the lookout of any major security changes in order to update the information system capabilities to respond to future security incidents. The remainder of the paper is organized into three sections. The first section provides a description of security policy components based on the review of relevant sections of ISO 17799 standard and the related literature [12]. In the same section we also provide a discussion on the managerial and strategic implication of the security policy definition. The second section discusses examples of techniques for effective alignment of the security policy with operational and strategic activities of the enterprise. We propose two examples that show the issues when a security policy must be updated as a consequence of (1) an event, linked to the daily operations of the enterprise information system, (2) a strategic decision. The final section discusses perspectives for future researches.

2 Security Policy Scope and Requirements

Previous works consider security policy among the formal countermeasures in the management of information security as opposed to the technical and informal measures [13]. Several researches have highlighted the important role of security policy as a principal component of an information security governance framework [14] and in improving the strategic and operational capabilities of an information system [15].

2.1 The Security Policy Requirements

An organization needs to *classify its information assets* in accordance to their business value and sensitivity in order to ensure an effective protection. Information assets inventories and classification help organizations to perform security risk assessment and to delimit the required protection levels. The *risk analysis* identifies the threats and vulnerabilities related to classified information assets, evaluates the likelihood of their occurrence and estimate their potential business impact. It reflects the organization's business activity, the level of protection effectiveness and provides an efficient guide to implement appropriate management actions and controls against security risks, to evaluate the internal and external levels of assets protection, to help defining and deciding the cost of acquisition, implementation and maintenance of protection solutions, and to operate protection tools and monitor enterprise information system. According to business and regulatory requirements as well as risk assessment results, *access rules and rights* to sensitive information should be exhaustively controlled and documented. A multi-level trust system against unauthorized access should be in place to regularly manage user privileges, networked services and operating system access. In addition, the efficiency of access control policy depends on a monitoring system to detect anomalies or abuse of privileges. The security policy must clearly specify *roles and responsibilities* for the security management of information across the organization. Information security personnel must be appointed to develop, implement and maintain security measures and controls. Their responsibility and authority area should be plainly stated and documented.

The security policy should outline the specific actions to minimize the damage from *security incidents*. This includes monitoring, mitigation and investigation activities that should be assigned to the IRT. Security monitoring is particularly important since network attacks are growing in number and severity and information protection is requested to cope with newly created attacks. When a security policy has been implemented, it must be periodically assessed to ensure that all system components operate safely. The IRT is in charge of identifying attacks by analyzing data collected by the detection systems to reduce the attack impact, and to make the appropriate decision for protecting sensitive information resources.

Appropriate organizational and managerial procedures should be established for gathering, analyzing and archiving digital evidences. A security policy should specify *physical* and *environmental facilities* for protecting sensitive business information against environmental threats and unauthorized access. This includes the definition of physical security areas, physical entry controls, equipment protection and maintenance. Managers and technical personnel misbehaviour, due to social engineering, human errors, abuse of privileges and trust, would bring to the networked enterprises unexpected damages. Therefore, it should be necessary to ensure that all system users understand and follow information security practices and enhance employees' security consciousness by means of *education and training*. All information users should be made aware of the procedures for reporting security incidents, and should be required to report such incidents as quickly as possible. As well, users should be informed regularly on the updates of the security policy including security requirements, legal responsibilities and business controls in order to prevent or limit potential damages. The design and use of a security policy must take into account the *regulatory, statutory and contractual requirements*. Effective controls and appropriate procedures should be implemented and monitored to ensure that information are managed in compliance with legal restrictions. For example, authentication techniques, electronic signature, traceability and storage of attack evidences must be certified and audited by legal institutions. Moreover, the security policy should address relevant legislation related to the appropriate business use of information assets to ensure the intelligibility of the production and operating mechanisms of business information. Finally, a fully documented process should support the statement of security policy objectives and scope, the implementation of operating procedures, and should describe with thorough instructions how to execute all the aforementioned components. *Security policy documents* should include in particular, authentication procedures, roles and responsibilities definition, awareness and training programs planning, monitoring actions, business recovery measures and sanctions associated with policy violations. The documentation should be complete, coherent, easy to use and accurate. Specific parts of the security policy documents should be communicated to all employees and relevant external partners.

2.2 Managerial and Strategic Implications

The above mentioned requirements suggest that a number of managerial and strategic aspects must be taken into account in the definition process of a security policy. The information sensitivity is related to several environmental variables such as security level required by the trading partners, the importance of the assets in the enterprise value chain operations, the legal rules, and the competitive environment. These constraints increase the required level of confidentiality,

integrity and availability of business information, affecting the company reputation which is considered a strategic asset. Effective protection involves the development of technical and organizational practices, ensures that these practices are appropriate and that they properly reflect the security policy guidelines. As a result, close collaboration between decision makers and technical staff is necessary during the definition phase of a security policy, with the purpose of responding to business needs in terms of sharing or restricting information, defining sensitivity levels and discussing effectiveness of protection procedures. Therefore, the *classification* scheme of *information assets* implies a set of organizational procedures for information handling and processing activities. In the *risk analysis* process, strategic, managerial and organizational factors affect the nature and extent of risk assessments. These factors include the enterprise strategic environment, the organizational structure features, the customer relationship and the value chain configuration [16]. For example, the competition intensity increases the vigilance of the enterprise against business intelligence and affects the number of control points, the sophistication of security solutions and the regularity of monitoring activities. At the organizational level, the existence of a regular control system and of formalized work practices and procedures induce more efficient risk analysis process. The variety of customers and channels used to generate value leads to different kind of threats and vulnerabilities. Finally, a high level of dependency of the value chain activities to the use of IT introduces new security design problems [17]. When *controlling the access* to the enterprise information assets, it is important to consider the organization size variable. In fact, the organization size positively affects the number and the diversity of functions and the presence of intermediate levels of responsibilities. The organization should balance between a centralized and a decentralized access policy by operating control rules which enable its business continuity. Moreover, it is important to consider the structure differentiation which also depends on the organization size, and refers to the number of specialized departments created to respond to distinct aspects of the environment. This differentiation involves the *allocation of responsibilities* and attributions within the organization and requires trust management procedures to ensure that only authorized entities can interact with the available assets. Trust management is established, based on the credentials validity, and on a real-time supervision of the user profiles. In fact, the confidence level depends on the policy for accessing the service and the history of a given user. Though, assigning a reduced trust level to the employees to keep tight control leads to a centralization of the security policy and consequently induces a rigidity of the organization. The human resources management department should play a significant role during the recruitment process when candidates must be carefully evaluated, especially if they are requested to operate daily actions susceptible to affect the required security level related to valuable information resources.

With respect to *security incidents response*, security policy should establish appropriate management procedures and channels to report quickly on security

incidents, security weaknesses and software malfunctions. The structure of the IRT, the way it works, responds and provides decision implementation after incidents have occurred is also a managerial challenge. An IRT can be characterized by its responsiveness and quality of analysis. These two factors have a significant impact on the strategic decisions on the enterprise such as the deployment and alignment of IT. One can notes that the occurrence of an IRT in the enterprise varies from one country to another and from an activity to another. For instance, in France, the 2010 CLUSIF report shows that there is no team permanently assigned to the information security activity in 43% of the companies. If there is a permanent team dedicated to security, it includes 1–2 persons for 41% of the questioned companies, 3–5 persons for 12% of the cases and it exceeds 5 persons only in 2% of the cases. Moreover, 60% of the companies have no incident response team. It appears that these values may remain low because of the following reasons: (1) a number of enterprises are not convinced of the need to have an IRT, since their activity is not IT sensible; (2) the cost management of the IRT; and (3) a few enterprises think that the incident response is not a mature technique to be integrated in their security management process. To choose security solutions, the investments in hardware and software solutions presumes a thorough cost-benefit analysis related to the structure and dynamics of the IT components as well as to the cost of the implementation, operation and maintenance phases of these solutions. In particular, activities such as *physical* and *environmental* solutions selection and acquisition planning are essentially linked to the support of business activities. As a final point, for building a *security awareness* program, it is important to measure the computer skills level of technical and managerial staff having access to company sensitive information and decide the main concern of audience who need security education according to security policy guidelines. Too often, managers experience difficulty in deciding which percentage of the IT budget will be spent on security awareness training and education because of the existence of several priority security activities. As a result, the cost-effectiveness of the awareness program should be justified as an internal business activity.

3 The Alignment of Security Policy with Operational and Strategic Enterprise Plans

The form and sources of threats to information system assets are evolving with the development of Internet use, wireless networks, and remote access technologies. In addition, the vulnerabilities cannot be determined only in the setup phase of an enterprise information system. They may occur as a consequence of the rapid changes in the business environment, of the update of management procedures, of the introduction of new assets, and if the sophistication of hackers attacks techniques. Also, changes in the strategic goals, work practices and employees errors continuously introduce new vulnerabilities. We distinguish at least three

techniques to aligning security policy components with the business requirements of the enterprise that are: (1) monitoring metrics which have been defined to manage the alignment. Among the major metrics we have considered, one can mention the following: (a) time to analyse an incident and to react to it and (b) time to update the managerial procedures after an incident has been addressed; (2) performing a risk analysis for identifying new threats and vulnerabilities, estimating their business impact and providing a dynamic set of tools to control the security level of the information system. Techniques to perform the risk analysis include the bounding of the rate of false positive and false negative the monitoring system can generate, and the estimation of the damage of uncovered attacks; and (3) defining reactive mitigation measures performed by the IRT to protect information assets and change the security policy. Reactive measures can be achieved using various techniques including cognitive construction, events correlation and attacks scenarios building.

Example 1 – Phishing attack: Phishing is a social engineering technique that exploits human vulnerability by malicious internal users through a communication network activity which appears be part of a trusted entity. Hackers use this fraudulent technique to retrieve confidential information. The hacker can be an employee who creates for example a web page for current interface service with attractive promises in order to access to sensitive files and use their contents. An efficient monitoring system can recognize the use of the stolen information when it is submitted from a server different from the computer used by the information owner or the occurrence of cessions by the information owner from two sides. Such rules of recognition should be part of an efficient security policy and can be used by the IRT to trace the attack. At least three security policy components are involved to contrast this type of threats: the awareness program, the security solutions and the security incidents response. In fact, employees need to be trained to recognize fishing attempts, and to understand and apply security policy principles. Furthermore, security policy should include anti-phishing technical measures for authenticating the website and the connection. Organizational procedures can be also requested to quickly report such incident to the IRT.

Example 2 – CRM implementation: Enterprises have increasingly recognized the importance of managing and building long-term and sustainable customer relationships. The customer relationship management (CRM) is an information system that tracks all information and interactions about customers in order to coordinate sales, improve service quality and best respond to customers' needs. A CRM system is often integrated with other information systems across all functional areas, such as a supply chain management system. Consequently, the introduction of a CRM would have significant security implications for the management of sensitive corporate information. For example, there is the problem of access control and the attribution of individual responsibilities as the CRM will make information more widely available to different types of users across the enterprise. Moreover, as with the previous example, the enterprise may need to review security solutions, particularly encryption rules, if the enterprise is intending to use online CRM capabilities on their web sites to link to retailers and customers.

4 Conclusion

In this paper we analyze the scope and the requirements of an information security policies along nine dimensions derived from a security standard. A conceptual analysis and two examples allow to put in evidence the managerial and organizational implications of the security policy implementation. Future research aiming to analyse real case studies would help in gaining better comprehension of the alignment process of the security policy with the operational and strategic activities of the enterprise and provide more techniques for handling an effective alignment.

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Prioritizing Role Engineering Objectives Using the Analytic Hierarchy Process

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Abstract *Role-based access control* (RBAC) has proven to be an effective way to reduce the complexity and costs of entitlement management in medium and large organizations. To maximize the advantages offered by RBAC, the *role engineering* discipline has been introduced. Several works show that finding the optimal candidate role-set can be seen as a *multi-criteria decision analysis*, with a trade-off among conflicting goals. However, a problem not yet addressed in the current literature is how to define the priority of each goal. With this aim, this paper describes an application of the *Analytic Hierarchy Process* (AHP) to help role engineers correctly prioritize each optimization objective.

1 Introduction

In information system security, *access control* is the process of mediating requests to data and services, and determining whether to grant or deny access requests [5]. Access control is an essential element of *Identity and Access Management* (IAM) systems, and involves technical, organizational, managerial, and behavioral considerations. Among all proposed access control models in the current literature, *role-based access control* (RBAC, [6]) is certainly the most adopted by organizations, mostly due to the simplicity of the model: A *role* is a set of permissions to perform system functions, while users acquire permissions only when they are assigned to specific roles. The most important benefit of adopting RBAC is a reduction of the administration effort due to the decreased number of relationships required to relate users to permissions [1]. RBAC offers benefits to business users as well. In fact, a role usually represents a job function or a title established for a set of users within an organization. Thus, adopting RBAC makes it

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easier to define security policies by business users who have no knowledge of IT systems.

Although adopting RBAC introduces benefits from both a technical and business perspective, many organizations are still reluctant to deploy role-based access control systems, since there are important issues to address. In particular, to maximize the advantages expected by introducing roles, the model must be customized to capture the actual needs and functions of the company. Yet, organizations often implement IAM systems without due consideration of roles. Organizations frequently do not invest enough time to define roles in sufficient detail; rather, they tend to define high-level roles that do not reflect actual job functions. For this purpose, the *role engineering* discipline [4] has been introduced. However, choosing the best way to design a proper set of roles is still an open problem [8].

Even though a general understanding exists about the goals of role engineering, there is still no consensus on what constitutes a "good" role engineering solution. To resolve this problem, research has addressed one particular aspect: Measuring the quality of designed roles. In this regard, Colantonio et al. proposed the so-called *cost-driven approach* to role engineering [1]. Enhancements to this approach are illustrated in [2, 8, 10]. The key idea is to estimate the complexity of a RBAC configuration by measuring its "size"; that is, a linear combination of individual measures of RBAC dimensions (e.g., number of roles, number of assignments). The "cost" concept may also incorporate measures of the business relevance of roles [2, 3]. In general, a cost-driven analysis evaluates a combination of several *cost elements*, each of them capturing a particular business- or IT-related aspect of RBAC. Each element naturally leads to a role engineering *objective*; examples are: Minimizing the number of roles, minimizing the number of roles possessed by each user, or maximizing the relevance of roles for the organization.

From the above observations, role engineering can be seen as a *multi-criteria decision analysis* [7], where a compromise among potentially conflicting goals should be reached. Multiple approaches exist to trade off conflicting criteria. The simplest one is the *weighted sum*: Multiple objectives are transformed into an aggregated scalar objective function by multiplying each objective by a weighted factor and summing up all contributors. Each weight is the "priority" of the corresponding objective when compared to the other objectives. However, to the best of our knowledge, there is little discussion on which weights should be used in practice in role engineering. The lack of methodology for specifying weights is the biggest shortcoming of existing cost-driven approaches [8].

To solve the problem of prioritizing role engineering objectives, this paper borrows some concepts from *decision making* techniques. In particular, we propose the *Analytic Hierarchy Process* (AHP) as a viable approach to derive priorities. Prioritizing objectives is generally recognized as the most difficult task in making a decision [13]. To help decision makers identify the most influential factors, AHP suggests to arrange factors in a *hierarchical structure* descending from an overall goal to criteria, subcriteria and alternatives in successive levels. Each level may represent a different aspect/perspective of the problem. A decision maker (i.e., role

engineer) can insert or eliminate levels and elements as necessary to clarify the task of setting priorities or to sharpen the focus on one aspect. In turn, factors of each level of the hierarchy must be *compared pairwise* in order to identify their relevance with respect to upper-level factors. The idea behind pairwise comparison is that the most effective way to concentrate judgment is to compare a pair of elements on a single property without concern for other properties or elements. People get confused when simultaneously considering more than a few facts. [12].

The remainder of this paper is organized as follows. The next section offer additional details about AHP. Then, another section describes how to apply AHP to a role engineering context. Some final remarks conclude the paper.

2 The Analytic Hierarchy Process

Methodology Description. Before detailing the distinguishing characteristics of applying *Analytic Hierarchy Process* (AHP, [11]) in role engineering, we first describe those aspects of AHP that can also be used in a generic decision problem. AHP is largely adopted in *decision making* processes, that is the cognitive processes resulting in a selection among several alternatives [7]. A typical decision making task involves many criteria and subcriteria used to *rank the alternatives of a decision*. For instance, suppose that a family wants to buy a new vehicle. Their goal might be to choose the best car. The family may consider several *criteria* for making their decision, such as cost, safety, style, etc. Assigning priorities to criteria typically involves some *measurement* to rank alternatives. Some measurements for certain criteria, such as purchase price, can be stated with absolute confidence. Others, such as resale value, are less certain since they have to be estimated. Others, such as style, are hard to state quantitatively. Another important aspect to take into consideration is *scale*. It often happens that the interpretations of numerical stimuli from a given standard scale differ depending on the circumstances. For example, intensity of sunlight has a different significance for different purposes: It may be useful for sunbathing, but too bright for reading. A more general method that does not make use of standard scales is *relative measurement*. It is particularly useful for properties for which there is no standard scale (e.g., love, political clout, straightness) or to represent subjective understanding.

The aim of AHP is to help analysts derive relative scales from absolute measurements or by using judgment. AHP has been widely used in various settings to make decisions [11–13]. It leverages pairwise comparisons and relies on the judgments of experts to derive priority scales. The comparisons are made using a scale of judgments that represents how much one element dominates another with respect to a given criterion. In particular, AHP requires the following steps [13]:

1. *Define the overall problem* and determine the kind of knowledge sought.
2. Structure a *decision hierarchy* (i.e., a tree) from the main goal of the decision, then the objectives from a broad perspective to the lowest level. For instance, if

the goal (i.e., the root of the tree) is buying a car, the first level of criteria may be "cost", "safety", "style", and "capacity". "Cost" could be further decomposed into subcriteria such as "purchase price", "fuel costs", "maintenance costs", and "resale value".

3. Construct *pairwise comparison matrices* for the elements of the same level. In the previous example, cost is first compared against safety, and then the pairs cost-style, cost-capacity, safety-style, safety-capacity, and style-capacity. Subsequently, purchase price, fuel costs, maintenance costs, and resale value are compared in pairs as well – more details follows.
4. Use comparison matrices to *weigh the priorities* of criteria in each level – how to compute priorities is explained below. For each element, multiply its priority by the priority of parent elements in the levels above to obtain its global priority. In our example, this means that the priority of the cost criterion influences the priorities of purchase price, fuel costs, maintenance costs, and resale value.

Formal Description. Now we describe how to practically apply AHP in real cases by providing the right mathematical tools. Assume that we are given n criteria to evaluate, whose weights $w_1, \ldots, w_n$, respectively, are known. Let us form the matrix A of pairwise ratios whose rows give the ratios of the weights of each criterion with respect to all others. Please consider now the following matrix equation:

$$\begin{pmatrix} \frac{w_1}{w_1} & \cdots & \frac{w_1}{w_n} \\ \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \cdots & \frac{w_n}{w_n} \end{pmatrix} \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix} = n \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix}$$

The matrix $A = (a_{ij})$, $a_{ij} = w_i/w_j$, $i,j = 1, \ldots, n$, has positive entries and satisfies the reciprocal property $a_{ji} = 1/a_{ij}$. Any matrix with this property is referred to as a *reciprocal matrix*. By multiplying the matrix A by the vector of weights $w = (w_1, \ldots, w_n)^T$, the result of this multiplication is nw. Given a matrix A, several values for w solve the equation above. To make the solution unique, we normalize w by dividing entries of w by their sum – that is $\sum_{i=1}^{n} w_i = 1$.

To make comparisons, we need a scale of numbers for elements $a_{ij} = w_i/w_j$, which indicates how much a criterion is more important than another one. Table 1 describes a scale of numbers that is typical for AHP. Once we provided a matrix A of judgments, solving the previous equation allows to identify w, namely the final list of priorities for each criterion.

The calculated priorities w are plausible only if the comparison matrices are consistent or near consistent. A matrix A is *consistent* if the following condition is satisfied: $a_{jk} = a_{ik}/a_{ij}$, $i,j,k = 1, \ldots, n$. Put another way, if the criterion X is more important than Y, and Y is more important than Z, one cannot state that Z is more important than X. It can be proven that given the largest eigenvalue λ_{max} or A, then $\lambda_{max} \geqslant n$ and $\lambda_{max} = n$ if and only if A is consistent [12]. To measure the inconsistency of A (and therefore improve the judgments), several authors suggest to

Table 1 The fundamental scale of AHP

Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor the first activity over the other
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor the first activity over the other
6	Strong plus	
7	Very strong or demonstrated importance	The first activity is favored very strongly over the other; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring the first activity over the second one is of the highest possible order of affirmation
Reciprocals of above	–	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i

compute a *consistency index* (CI) defined as $(\lambda_{max} - n)/(n - 1)$ [13]. This value is usually compared with the same index obtained as an average over a large number of reciprocal matrices of the same order whose entries are random. If the ratio (called the *consistency ratio* CR) of CI to that from random matrices is significantly small (i.e., 10% or less), we accept the estimate of w. Otherwise, we attempt to improve consistency by changing judgments in A.

3 Application of AHP to Role Engineering

This section offers a possible instance of AHP for role engineering. According to the methodology above, the first step is to define the main objective of role engineering. In our case, a plausible problem statement is the following: Given several sets of roles, each one describing the same access control state (i.e., several solution for the role engineering problem elicited through different techniques or settings) rank them in order to identify the set that best suits the given criteria.

Structuring a decision hierarchy thus represents the second step. Figure 1 depicts a hierarchy of possible characteristics that should be evaluated during the role engineering process. The total number of roles, the number of roles assigned to each user, and the number of permission assigned to each role are typical measures of structural complexity of RBAC systems [1, 2, 8, 10]. The "spreading" of role users among different organization units (OUs) of the company [2], the number of distinct job titles possessed by the users of a role, or the number of different locations where role users are based on, are possible measures of the relevance and meaning of roles. Please refer to [3] for a more general discussion of criteria for

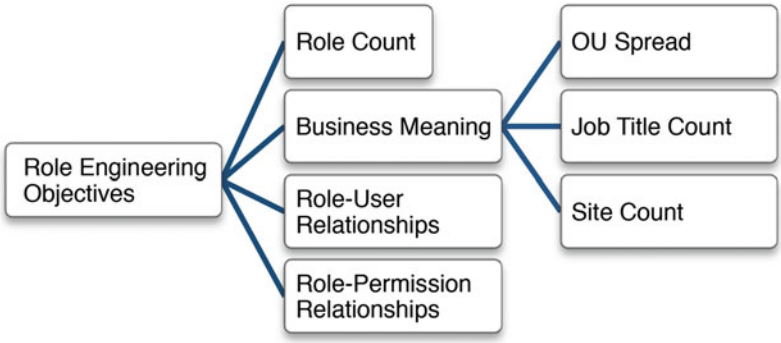

Fig. 1 Possible hierarchy of role engineering objectives

	9 (extreme)	7 (very strong)	5 (strong)	3 (moderate)	1 (equal)	1/3 (moderate)	1/5 (strong)	1/7 (very strong)	1/9 (extreme)	
Meaning			×							Role-User
Meaning		×								Role-Permission
Meaning	×									Role Count
Role-User				×						Role-Permission
Role-User				×						Role Count
Role-Permission				×						Role Count

Element	*Priority*
Meaning	0.6039
Role-User	0.2028
Role-Permission	0.1213
Role Count	0.0720

Fig. 2 Priorities for the first level of the hierarchy of Fig. 1. The consistency index CI is 0.065

	Meaning	Role-User	Role-Permission	Role Count
Meaning	1	5	7	9
Role-User	1/5	1	3	3
Role-Permission	1/7	1/3	1	3
Role Count	1/9	1/3	1/3	1

Fig. 3 Equivalent reciprocal matrix of the pairwise evaluation of Fig. 2

the evaluation of role quality. Please also note that Fig. 1 is just a possibility: Role engineers can insert or eliminate elements and levels as necessary to clarify the task of setting priorities or to sharpen the focus on one aspect.

Figure 2 describes the third and fourth steps of AHP. The matrix on the left side depicts pairwise comparison between criteria of the first level. For example, the third row states that having meaningful roles is far more important than trying to keep down the total number of roles. On the right side there are the priorities derived from that matrix. They are computed via the power method described in [9]. Figure 3 contains the same information of Fig. 2, but translated in terms of

	9 (extreme)	7 (very strong)	5 (strong)	3 (moderate)	1 (equal)	1/3 (moderate)	1/5 (strong)	1/7 (very strong)	1/9 (extreme)	
OU-Spread			×							Job Title Count
OU-Spread			×							Site Count
Job Title Count					×					Site Count

Element	*Priority*
OU-Spread	0.7142
Job Title Count	0.1429
Site Count	0.1429

Fig. 4 Priorities for the second level of the hierarchy in Fig. 1. CI equals 0.000

	9 (extreme)	7 (very strong)	5 (strong)	3 (moderate)	1 (equal)	1/3 (moderate)	1/5 (strong)	1/7 (very strong)	1/9 (extreme)			*Element*	*Priority*
zero				×						0–1		zero	0.5806
zero			×							1–2		0–1	0.2554
zero	×									2–∞		1–2	0.1141
0--1				×						1--2		2–∞	0.0499
0--1			×							2–∞			
1--2				×						2–∞			

Fig. 5 Example of weights for the OU spread. CI equals 0.028

	9 (extreme)	7 (very strong)	5 (strong)	3 (moderate)	1 (equal)	1/3 (moderate)	1/5 (strong)	1/7 (very strong)	1/9 (extreme)			*Element*	*Priority*
only one				×						few (< 10%)		only one	0.3533
only one		×								some (10–90%)		few (< 10%)	0.1238
only one				×						almost all (> 90%)		some (10–90%)	0.0458
only one					×					all		almost all (> 90%)	0.1238
few (< 10%)				×						some (10–90%)		all	0.3533
few (< 10%)					×					almost all (> 90%)			
few (< 10%)						×				all			
some (10–90%)						×				almost all (> 90%)			
some (10–90%)								×		all			
almost all (> 90%)						×				all			

Fig. 6 Example of weights for the job title count or the site count. CI equals 0.002

reciprocal matrix. Going ahead, Fig. 4 depicts priority computation for subcriteria under the upper-level criterion "Meaning". According to AHP, priorities of subcriteria must be multiplied by the priority of parent criterion. For instance, the global priority for "Job Title Count" is $0.1429 \times 0.6039 = 0.0863$.

Figures 5 and 6 clearly show that AHP can help derive relative scales from measurements by using judgment. For instance, OU Spread [2] measures the "spreading" of role users among different organizational units of the company. A spread value that equals zero means that all the users of a role are concentrated in an organizational unit (OU) branch: In that case, the role meaning is likely related to that branch. The more the spread is high, the more meaningless the role is with

respect to the OU information. Also low values for spread (i.e., less than 1) are acceptable. Therefore, Fig. 5 shows how AHP can be used to "normalize" the spread value into the range $[0, 1]$ by using judgment. Figure 6 addresses a similar problem, but for Job Title Count (or, similarly, for Site Count). What we need are roles possessed by users with the same job title (a "functional" role) or that spread across all users (an "organizational" role). AHP easily allow to model this requirement.

4 Concluding Remarks

This paper explored the application of AHP, a well-known decision making method, to derive priorities for role engineering objectives. The main idea was to help role engineers organize the criteria for the evaluation of role quality into a hierarchical structure. By reducing complex decisions to a series of simple comparisons, the identification of the best set of roles is greatly simplified. Hence, facing one of the biggest shortcomings of existing cost-driven approaches to role engineering. Thanks to AHP, it is easy for analysts to trace their thinking and to justify the steps along the way to their decision. If they have second thoughts about the final outcome, they can revisit the process and make changes if appropriate. Besides the above simplification, the method has the following additional advantages: (1) It is possible to measure the consistency of the decision maker's judgments; (2) It can integrate both quantitative and qualitative information.

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Negotiation of Weighted RTML Credentials on Mobile Devices

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Abstract In this paper we describe an implementation for mobile phones of two important services in logical reasoning, that is deduction and abduction, defined over a set of weighted credentials. The main benefit comes during the process of automated access authorization based on trust: soft constraint operations can be easily adopted to measure the level of trust required for each operation. Moreover, when the level is not sufficient, abduction can be used to compute the missing credentials and the levels that grant the access. We implement a negotiation of credentials between two mobile devices in order to grant the access to the requestor peer, with the use of deduction/abduction services.

1 Introduction and Background

Access control policies are often based on set of credentials expressing basic facts about users as well as delegation rules. A successful class of languages in this area is the Role-based Trust Management (e.g., see [10]).

In [2, 3] the authors have presented a variant of *RT* language [10] (named RT^W) that use soft constraints and semirings and is able to deal with weights on ground facts and to consequently compute a feedback result for the goal satisfaction. The proposed RT^W framework is able to represent policies: by querying such programs we can infer if the authorization, given a specific set of credentials, is allowed or not with a specific level of trust. For example, a credential can now state that the referred entity is a "student" with a probability of 80% because her/his identity of

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student is based on what an acquaintance asserts (thus, it is not as certain as declared in IDs). Therefore, also the final authorization decision can be taken according to a trust value related to the composition of all the used credentials, e.g. with a total probability greater than 90%. However, often the user simply wants to obtain a service or to access to a resource, and he does not know which credential is needed [9], or which level of trust is needed to obtain the access. Thus, often the user simply presents a very small set of credentials and expects the system to return enough information to guide him towards the missing credentials that grant him to access. When the user obtains such information, he can decide to present such credentials or, for instance, to buy the necessary credentials with "enough" trust level, in order to definitely access to the service.

Thus, two basic logical services can be used inside authorization systems. The first one is represented by deduction [9, 13]: given a policy and a set of additional facts and events, the service finds out all consequences (actions or obligations) of the policy and the facts, i.e. whether granting the request can be deduced from the policy and the current facts. Access authorization usually needs another reasoning service: abduction [9, 13]. Loosely speaking, abduction is deduction in reverse: given a policy and a request for access to (e.g.) services, it consists in finding the credentials/events that would grant access, i.e. a (possibly minimal) set of facts that added to the policy would make the request a logical consequence.

The intuition behind an interactive (client–server) access control system is the following: (1) initially a client submits a set of credentials and a service request then, (2) the server checks whether the request is granted by the access policy according to the client's set of credentials. If the check fails, (3) by using abductive reasoning the server finds a (minimal) solution set of (disclosable) missing credentials that unlocks the desired resource and (4) returns them to the client, so that (5) he can provide them in the second round. These services provided by logical reasoning are important in autonomic networks of nodes [9], where partners offer services and lightly integrate their efforts into one (hopefully coherent) network. This cross enterprise scenario poses novel security challenges with aspects of trust management systems. Access to services is offered by autonomic nodes on their own and the decision to grant or deny access must rely on attribute credentials sent by the client [9].

In this paper we briefly describe an implementation of the abduction and deduction services on mobile devices, in order to perform a negotiation of weighted credentials, when the initial offer of the requestor has not led to an authorization success. We show the architecture of our solution and the connections between the software modules; then we show an example of negotiation between two (*Android*) mobile phones and, at last we present the performance of the execution times for deduction and abduction, to show that our solution is currently feasible. The detailed background on the deduction and abduction concepts based on soft-constraints for RTML can be found in [2, 3, 5].

2 Implementation

In this section we implement the deduction and abduction services presented in [5] by using SWI-Prolog and the *Constraint Handling Rules* [7] (CHR) language.

CHR is a high-level language designed for writing user-defined constraint systems. It is essentially a committed-choice language consisting of guarded rules that rewrite constraints into simpler ones until they are solved. From an architectural point of view, our engine for deduction/abduction is composed by a parser for RTML credentials, a prolog engine based on *tuProlog*, a SemiringFactory, a CHR Engine and SWI-Prolog. The communication relationships among these modules are shown in Fig. 1.

- The RTML credentials (XML) need to be parsed before the deduction and abduction tasks. This step is executed by using the RTML Parser enhanced with weights in Fig. 1. *RTML Parser* search for the semiring type in *SimpleMember* [10] credentials and creates the corresponding runtime object;
- The *Prolog engine* is the most important part of our architecture and must be initialized with a valid and supported *semiring type*. Its most important functions are:
  - To search for valid prolog _les containing needed operators for given semiring type.
  - The translation of RTML credentials store [10] into our internal format.
  - To add credentials to prolog theory.
  - To use the *CHR engine* for abduction, if requested.
- The *CHR Engine* converts credentials in CHR deduction/abduction programs to be executed using the underling SWI-Prolog process. It manages also SWI-Prolog process lifecycle and communication;
- The SemiringFactory acts as single point of access for semirings. It is used to do initial configurations and returns a runtime representation of the given *semiring type*.
- The SWI-Prolog module is mainly a TCP server allowing bidirectional communication.

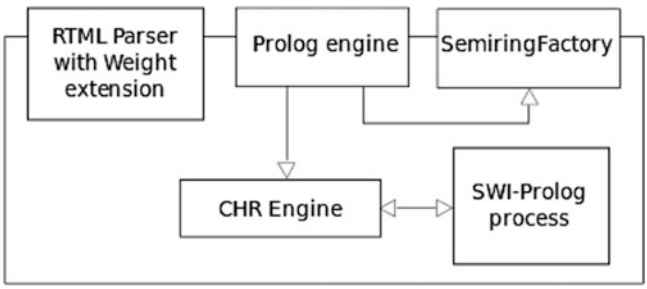

Fig. 1 Deduction/abduction service module architecture

A *semiring type* is an implementation of semiring that can be attached to our architecture and is composed by two main elements:

- *Implementation*: a Java class implementing the provided semiring interfaces;
- *Operators*: each semiring implementation needs three operators. The first two refer to semiring definition ($+$ and $\times$), the last one $\div$ is needed to abduction service and is the inverse of $+$.

A *semiring implementation* encapsulates all the information contained into a semiring definition and also the information on how semirings can be combined with each other. Our module contains the implementations for *Weighted semiring*, *Fuzzy semiring* and *Path semiring* as in defined in [1, 4] but other semirings can be simply attached by creating a Java class implementing the provided interfaces, writing prolog files containing the needed operators and adding a new semiring type name and implementation class in the semiring *config file*.

SemiringFactory loads on startup all defined semirings taking care of all needed operations.

3 An Example

We use a running example based on Policy-based Access Control to show how "soft" deduction and abduction can be used. We suppose that the soft constraint store contains all the collected information, i.e. the access policy and the credentials presented by the requestor and other parties, that is, for example, external databases. A credential, in a general definition, is an attestation of qualification, competence, or authority issued to an individual by a third party with the authority or the competence to do so. A policy describes the rules that grant the authorization. An example of policy and credentials is given in the program in Table 1: we adopt the $RT^W{}_0$ language [2, 3], a weighted extension of the well-known RT_0 language [10]. The example in Table 1 describes a fictitious Web publishing service,

EPub, which offers a discount to anyone who is both a preferred customer and a bright student. *EPub* delegates the authority over the identification of preferred customers to its parent organization, *EOrg*. In order to be evaluated as a preferred

Table 1 An example in $RT^W{}_0$, with weights associated to the credentials

Credentials
EPub.disct $\leftarrow -$ EPub.preferred $\cap$ EPub.brightStudent
EPub.preferred $\leftarrow -$ EOrg.highBudget $\cap$ EOrg.oldCustomer
EPub.brightStudent $\leftarrow -$ EPub.goodUniversity.highMarks
EPub.goodUniversity $\leftarrow -$ ABU.accredited
ABU.accredited $\leftarrow -$ $\langle$ StateU, 9 $\rangle$
StateU.highMarks $\leftarrow -$ $\langle$ Alice, 8 $\rangle$
EOrg.highBudget $\leftarrow -$ $\langle$ Alice, 6 $\rangle$
EOrg.oldCustomer $\leftarrow -$ $\langle$ Alice, 7 $\rangle$

customer, *EOrg* must issues two different types of credentials stating that the customer is not new (i.e. *EOrg.oldCustomer*) and has already spent some money in the past (i.e. *EOrg.highBudget*). *EOrg* assigns a cost value to both these two credentials to quantify its evaluation. *EPub* delegates the authority over the identification of bright students to the entities that are accredited universities. To identify such universities, *EPub* accepts accrediting credentials issued by the fictitious *Accrediting Board for Universities* (*ABU*). *ABU* evaluates a university with a fuzzy score and each university evaluates its enrolled students. A student is bright if she/he is both enrolled in a good university and has high marks. To solve the example in Table 1, we use a *Weighted* semiring $SWeighted = \langle R^+; min; +'; +\infty; 0 \rangle$, where $+'$ is the arithmetic sum and where the preference levels in R^+ represents the money cost that is needed to buy or retrieve a given credential (e.g. the cost to pay the office supplies and the clerk service): for example, StateU.highMarks $\leftarrow \langle$ Alice, 8 $\rangle$ in Table 1 certifies that Alice has obtained a good number of high marks for the exams completed at the StateU university (the credential is issued by StateU), and the cost associated with this credential is 8 euro.

The last four rules represent the weighted credentials presented to the authorization entity, while the other rules consist in the access policy.

In the example below we provide the weighted RTML representation for each credential in Table 1. *Alice* presents her credentials to *EPub* and asks to be authorized for the discount: both of them parse the credentials with the *RTML parser* (see Fig. 1) initializing each module with a *WeightedSemiring* type (i.e. we use the *Weighted* semiring [1, 4]) and loading all known credentials. Each credential without *WeightedSemiring* will be automatically ignored. *Alice* sends to *Epub* an access request using a credentials subset. Then, *EPub*'s Prolog engine try to find the minimal semiring value for the asked access request, that is *disct(EPub,Alice,Y)*, by using the known Prolog rules and the semiring operators implemented in Prolog; in this case (i.e. with the *Weighted* semiring), the arithmetic times $\times$ to compose the costs of the credentials and the *min* operator to find the best solution.

Since, w.r.t. Table 1, the credential *oldCustomer(EOrg,Alice,SemValue)* misses from the program in Table 2, the access cannot be deduced. Then, we use the *CHR*

Table 2 The generated deduction program in Prolog, obtained by parsing the credentials and adding the policy rules

Credentials
Disct(ePub,Y,T) :– preferred(ePub,Y,T0),brightStudent(ePub,Y,T1),plus(T0,T1,T)
Preferred(ePub,Y,T) :– highBudget(eOrg,Y,T0),oldCustomer(eOrg,Y,T1),plus(T0,T1,T)
Brightstudent(ePub,Z,T) :– goodUniversity(ePub,Y,T0),highMarks(Y,Z,T1),plus(T0,T1,T)
Gooduniversity(ePub,Y,T) :– accredited(aBU,Y,T)
Accredited(aBU,stateU,9)
Highmarks(stateU,alice,8)
Highbudget(eOrg,alice,6)
Highmarks(stateU,alice,8)
Trust(X, V) :– findall(T,disct(ePub,X,T), L1), min(L1,2147483647,V)
Trust(alice,V)

Engine to get all deductible clauses by using a CHR deduction program dynamically generated from the RTML credentials, as shown in Table 3. The *CHR Engine* loads the generated CHR program in Table 3, and then it checks the authorization by using known weighted credentials receiving the new deduced credential *brightStudent(ePub,alice,17)*. It also loads the generated CHR abduction program, shown in Table 4, and it asks to be authorized by using the new deduced credential. The result is *oldCustomer(eOrg,alice, 2)*, which contains the maximum value (accordingly to operators) allowed for accessing to *ePub.disct*. The communication steps between *EPub* and *Alice* depicted above are shown in Fig. 2. The most relevant parts consists in *EPub* asking to *Alice* about the missing credential (i.e. *oldCustomer*), and *Alice* (which already has a valid one) sending it back to *EPub*. Accordingly to *WeightedSemiring* operators, *Alice* can also send a credential with a lower cost than the one specified from *EPub* (i.e. *oldCustomer(eOrg,alice,1)*) because the access cost (i.e. 25 for our example) will still be satisfied. After this negotiation, the access is finally granted.

Table 3 The generated deduction program in CHR [7]

CHR program
:-use_module(library(chr))
:-chr_constraint accredited/3,oldCustomer/3,highBudget/3,goodUniversity/3,disct/3, highMarks/3,brightStudent/3,preferred/3,access/1
policyrule1 @ preferred(ePub,Y,T0),brightStudent(ePub,Y,T1),disct(ePub,Y,TA) <=> plus(T0,T1,T),(compare(>,TA,T);compare(=,TA,T)) | access(Y)
policyrule2 @ goodUniversity(ePub,Y,T0),highMarks(Y,Z,T1) <=> brightStudent(ePub,Z,T), plus(T0,T1,T)
policyrule3 @ accredited(aBU,Y,T) <=> goodUniversity(ePub,Y,T)
policyrule4 @ highBudget(eOrg,Y,T0),oldCustomer(eOrg,Y,T1) <=> preferred(ePub,Y,T), plus(T0,T1,T)

Table 4 Generated CHR abduction program

CHR program
:-chr_constraint accredited/3,oldCustomer/3,highBudget/3,goodUniversity/3, disct/3,highMarks/3,brightStudent/3,preferred/3
abductrule1 @ disct(ePub,Y,T),brightStudent(ePub,Y,T1) <=> minus(T,T1,T0), preferred(ePub, Y,T0)
abductrule2 @ disct(ePub,Y,T),preferred(ePub,Y,T0) <=> minus(T,T0,T1), brightStudent(ePub, Y,T1)
abductrule3 @ brightStudent(ePub,Z,T),highMarks(Y,Z,T1) <=> goodUniversity(ePub,Y,T0), minus(T,T1,T0)
abductrule4 @ brightStudent(ePub,Z,T),goodUniversity(ePub,Y,T0) <=> minus(T,T0,T1), highMarks(Y,Z,T1)
abductrule5 @ goodUniversity(ePub,Y,T) <=> accredited(aBU,Y,T)
abductrule6 @ preferred(ePub,Y,T),oldCustomer(eOrg,Y,T1) <=> minus(T,T1,T0), highBudget (eOrg,Y,T0)
abductrule7 @ preferred(ePub,Y,T),highBudget(eOrg,Y,T0) <=> minus(T,T0,T1), oldCustomer (eOrg,Y,T1)

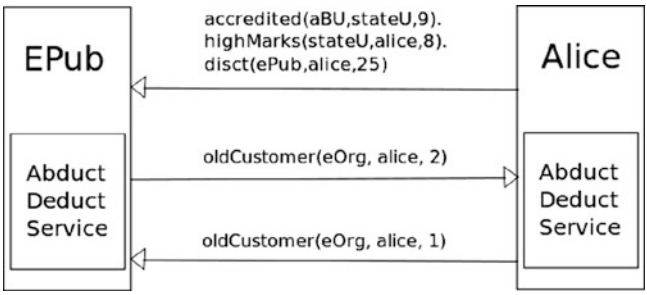

Fig. 2 A communication schema example

4 Tests

The performance evaluation has been accomplished on mobile phones featuring *Android* (version 2.2) with stock kernel and image slightly modified according to the SWI-Prolog binaries installation. The hardware specifications includes a 1 GHz ARMv7 "Snapdragon" processor and 576 MB of RAM. Our implementation contains two distinct engines. The first one is used only for the deduction service and is entirely written in Java code, while the second one is used for the abduction service and it encapsulates deduction/abduction as provided by the underling SWI-Prolog process. Figures 3 and 4 summarize our tests for the abduction/deduction service module (values are expressed in milliseconds) by considering different numbers of credentials: 5, 10 and 15.

The number of credentials introduces an overhead in the loading phase, increasing both Java only and SWI-Prolog times; it also slightly affects the deduction procedure of the Java engine. The execution time for abduction (only SWI-Prolog related) is partially independent w.r.t. the number of credentials. The motivations behind the SWI-Prolog independence between the execution time and the number of credentials can be partially found in the different kind of used rule. However, we expect an increased execution time for complex rule chains that need a complete evaluation of the credential tree (in the worst possible case). The "pure" Java engine is faster than SWI-Prolog, both for loading credentials and to perform deduction (no comparison for abduction can be done) because SWI-Prolog needs to compile both the deduction and abduction programs before using them, while the Java engine allows dynamic loading/unloading storing the deduction code as a library directly in RAM. The results obtained in our tests confirm that SWI-Prolog is a good choice also for devices with limited resources, but a "pure" Java solution, consisting of a module for ad-hoc optimized abduction, is possible and desirable.

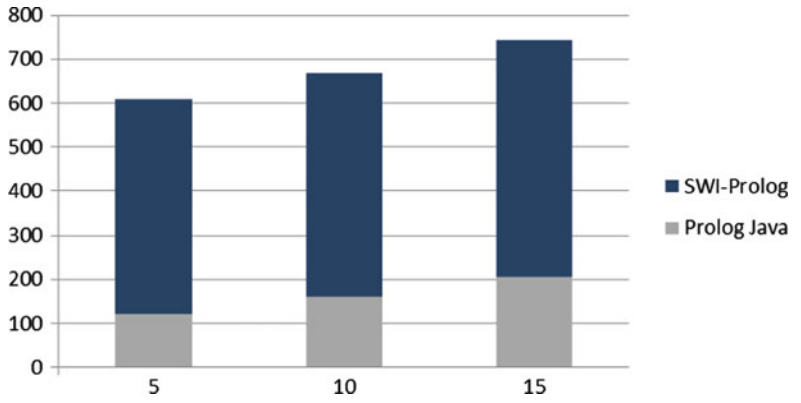

Fig. 3 Credentials loading time

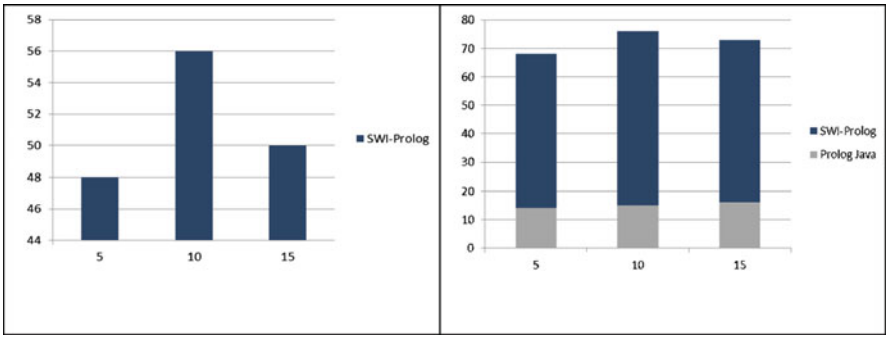

Fig. 4 Abduction/deduction times

5 Related Work

The importance of the deduction and abduction operations for policy-based management of autonomic networks has been already highlighted in [9]. Policy- based network management already requires a paradigm shift in the access control mechanism, from identity-based access control to trust management and negotiation. In [9] the authors present an algorithm whose operations are expressed with logic, and so the access authorization procedure is not directly implemented with a tool in the paper. Among the most noticeable works concerning logical reasoning and (crisp) constraints, we need to cite Maher, e.g. [11] where he investigates abduction applied to fully-defined predicates, specifically linear arithmetic constraints over the real numbers. In [12], Maher and Huang address the problem of computing and representing answers of constraint abduction problems over the Herbrand domain. This problem is of interest when performing type inference involving generalized algebraic data types. Notice that in [14] the authors present

a CHR-based tool for detecting security policy inconsistencies, where policy are represented by CHR rules. Concerning instead systems to implement abduction and deduction processes, abduction reasoning has been already realized in *HYPROLOG* [6] (available also in SWI-Prolog), which is an extension of Prolog and CHR with abduction and assumptions. The system is basically implemented by a compiler that translates the HYPROLOG syntax in a rather direct way into Prolog and CHR. Another implementation of this kind of system is represented by ACLP [8]; ACLP is a system which combines abductive reasoning and constraint solving by integrating the frameworks of *Abductive Logic Programming* and *Constraint Logic Programming* (CLP). The ACLP system is currently implemented on top of the CLP language of ECLiPSe as a meta-interpreter exploiting its underlying constraint solver for finite domains.

As far as we know, in literature there are no implementation of the deduction/abduction services with soft-constraints on mobile devices.

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Analysis of Evidences About the Relationship Between Organisational Flexibility and Information Systems Security

Maurizo Cavallari

Abstract The aim of this research is to investigate information systems security in the context of organizational issues. In doing so, we adopted a socio-organizational approach to the subject matter by investigating the interrelationship between the organization's ability to learn, exploiting and exploring knowledge, both as prior constructs of organization's flexibility, with respect to information systems security. ISS is often considered in literature as the issue putting constraints on organisational structure. The scope of present paper is to empirically explore previous conceptual findings as the reverse relationship: the possible effect on the level of security driven by the organization's flexibility. This research offers to the reader empirical evidences to demonstrate the importance of organization's flexibility as the independent variable which impacts on information system security, regarded as the dependent variable.

1 Introduction

Recent public evidences show that no organisation is safe from Information Systems threats and compromising [1]. IS security is very often characterized as a complicated blend of technological and social interactions – driven from external force such as compliance acts, as well as from internal policies – which are embedded in an organisational setting, putting rules and constraints on organisation processes. Thus we argue that it is not possible to ensure IS security if it is considered to be independent from the organisational flexibility [2]. This kind of view of IS security is reflected in the creation of security models as an integral part of overall organisational architecture, not as a distinct concern [2].

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The aforementioned is confirmed both from research which tends to focus on a narrow part of the organisational structure and processes, like role-based control over access to information, on the one hand, and from research focusing on a holistic treatment of the organisational processes, on the other [3].

This research is based on previously published work about ISS and organisational constraints, which has posed the basis for the actual empirical analysis [2]. In this paper, following the line of the first finding of the mentioned conceptual background, we address the opposite argument: is the organisation's flexibility putting constraints on the implementation of appropriate IS security measures and on the attainment of adequate levels of systems security? The study intends to analyse empirical evidences gathered in a number of organisations in Italy, whether the process of implementing information systems security is dependent from the organisation's flexibility. The aim of this research is to investigate the matter within the following point of view: what seems to be, normally, the dependent variable (i.e. the organisation) is investigated to be the independent variable, that constraints IS security (i.e. the dependent var.).

2 Literature Review

Specific academic literature directing pointing to the inverse relationship between organisational flexibility and ISS is scarce. The novelty of the present paper is to put together the established literature about organisation learning and flexibility along with the extant literature on ISS. Notable and renowned theories and authors' conceptualisations about flexibility and ISS are regarded as a starting point for further speculation. The two identified robust conceptual domains are then utilised to build up a coherent theoretical framework.

In order to explore the flexibility of an organisation, exact boundaries are to be put to the conceptual space occupied. For the scope of this paper we addressed the issues regarding organisation's flexibility with respect to the contextualist approach proposed by Pettigrew [4–7] which is relating flexibility to organisational change, and as a second logical step the theory of March [8] about exploration and exploitation learning. Other major contributions of Burgelmann [9] and Gupta [10] are taken into account in order to complete the theoretical framework.

About organisational change and flexibility. The most influential recent exponent of a contextualist approach within the change management field is undoubtedly Pettigrew [4–7]. His programmatic intent is to create *"theoretically sound and practically useful research on change"*, that explores the *"contexts, content, and processes of change together with their interconnectedness through time"* [4], p. 268. This was conceived as a direct challenge to *"ahistorical, aprocessual and acontextual"* approaches to organizational change; especially planned change

approaches, instrumental ideals of managerial agency, and the variable-centred paradigms of organizational contingency theories [6].

About exploitation and exploration learning. To achieve the definition of the "organization's flexibility" we point to the debate in literature on ambidexterity versus punctuated equilibrium. Exploitation and exploration learning do not coexist in the beginning [8], but exploitation learning is required first, for the development of basic operational capabilities. Exploration learning, if achieved at all, occurs only after prolonged exploitation learning and changes in the leadership style. This suggests the punctuated equilibrium model of organizational learning proposed by Burgelman [9].

In the framework of the present research we consider the first stage of exploitation learning with an authoritarian management style corresponds to the *"induced (variation reducing) strategy"*, as described by Burgelman [9], p. 354, whereas the second stage of exploration with a participatory management style corresponds to the *"autonomous (variation increasing) strategy"* [cit., p. 354]. Moreover, March's exploitation and exploration learning theory [8] underpin a recent organizational adaptation research proposed by Gupta [10]. Exploitation learning comprises refinement, choice, production efficiency, selection, implementation and execution; whilst exploration learning includes search, variation, risk taking, experimentation, play, flexibility, discovery and innovation [8, 10]. Empirical studies conducted by He and Wong [11] demonstrate that exploitation learning leads to the development of operational capabilities, in the first stage. In the second stage of an exploration learning organization a more participatory leadership style fosters experimentation and risk taking. The mentioned authors [11] highlight that exploration learning facilitates organization's flexibility permitting development of new processes. Other authors like Benner and Tushmann [12], start their analysis on the propositions of March and Levitt [8, 13] and then argue that while process management activities are beneficial for organizations in stable contexts, they are inconsistent with incremental innovation and change. The basic distinction between organisational learning and organisation adaptation is well discussed by Fiol and Lyles [14] as they show that change do not necessarily imply learning.

About information systems security. Common findings in research into the relationship between IS security and organisational issues, show that the implementation of efficient security measures are multi-faceted [15], and often limits action [16, 17]. Security measures are largely oriented to restrict the availability of resources in adherence with security policy, authentication, protocols, procedures, restriction and control access to resources, data, information, distributed networks and the deployment of security technologies [18], all of which are an evident trade-off with flexibility, because their primary aim is to limit operations in order to render them compliant with the level of risk defined by security policies [16].

Dhillon and Torkzadeh have pointed out that IS security must often cope with the organisational response to the restrictions brought by security measures and protocols [19]. Hagen highlights that IS security measures are often perceived by

the user as an immediate obstacle (to be possibly outmanoeuvred) whose justification is the unclear mitigation of a potential risk of an uncertain nature [20, 21].

3 Research Objectives

Previous research findings [2] show that the organisational environment can greatly influence the effectiveness of security, while there is a clear retroaction in which the implementation and the level of acceptance by the organisation of those security measures can influence the structure of the organisation and the ergonomics of the workplace [22].

In determining the objectives of present research, we started from the standpoint that Information Security is an ongoing process with the need of high dynamic changes whereas organisations have their own pace, which might not correspond to ever changing world of threats and security needs [23, 24]. A different flexibility and speed between organisational structure and security measures, is hypothesised in previous research findings [2, 25, 26]. The scenario can then be addressed as follows: the organisation with its features and processes highlighted by Taylor [27] and Spagnoletti [28] and, on the other hand, the fast changing realm of security as defined by Mishra and Dhillon [18] and Straub [3]. The aim of this paper is to investigate the relationship between the "change and learning capability", in terms of flexibility of the organisation and processes as defined by Pettigrew [29–33] and Braccini [34], and IS Security [35], the latter being the independent variable. To pursue the matter, the author of this paper addressed an empirical investigation about the previous conclusion that the organisation has a definite retroaction on ISS due to insufficient flexibility. In particular it is investigated the effect that IS Security implementation is hindered by the organisation's limited flexibility in order to respond to fast-changing IS security needs [2, 36]. The mentioned hindrance would then impede to implement ISS. The impact of existing organisation processes on IS security is sought in terms of the implementation of IS security. The basic idea is that IS security cannot be considered as a separate process from overall organisational processes and that organisational un–flexibility may hinder the process of implementation of information systems security [2].

4 Research Question

This research explores how organisational structure un–flexibility can constrain the implementation of information systems security measures. The ground of the present paper is in previous conceptual research findings aimed at understanding of the association between organisational aspects and IS security [2]. In the

previous study the research questions were answered analysing conceptual findings of extant literature. Thus the Research Question (R. Q.) will be addressed as:

Is organisation's flexibility putting constraints on information systems security?

5 Research Model and Hypothesis

Organizational aspects and IS security consist of two dimensions of organisational flexibility and level of IS security. The proposed research model is derived from a composed model derived by established literature (see Table 1).

To answer to the mentioned R.Q. above, two constructs were identified as conceptual instruments to utilise in order to pursue the empirical investigation: Organisational Flexibility and Information Systems Security. Organisational flexibility is investigated with respect to its two prior concepts of exploiting and exploring as antecedents constructs for organisation's flexibility.

5.1 Hypothesis

The hypothesis formulated and put under empirical investigation is as follows:

To measure and to evaluate the mentioned hypothesis, the following variables

the level of IS Security depends on the level of Organisation's flexibility.

where derived from the theoretical framework and from the mentioned constructs.

5.2 Variables

Organisation's flexibility	Information systems security
F1 changes in the number of levels of responsibility within last 3 years [4–7]	S1 frequency of education on ISS within last 3 years [2, 3, 26]
F2 organisational structure changes w/in last 3 years [5–7]	S2 frequency of incidents (reported or unreported) w/in last 3 years [2, 16, 23]
F3 turnover of managers w/in last 3 years [4, 30, 31]	S3 use of cryptography to protect data [2, 3, 16, 20]
F4 age of organisation structure [32]	S4 use of strong authentication [2, 25]
F5 new org. processes w/in last 3 years [31–33]	S5 controlled use of USB devices [2, 23, 25]
F6 new products w/in last 3 years [30, 33]	S6 ciphered traffic on networks [2, 23]
F7 new divisions w/in last 3 years [7, 32, 33]	S7 sandbox on browsing [2, 3, 20, 23]

Table 1 Constructs and sources

Constructs	Sources
Prior 1: exploitation	March [8]; Burgelman [9]; Gupta [10]; He and Wong [11]
Prior 2: exploration	
Organisational flexibility	Pettigrew [4–7]; Pagell and Krause [30]; Winter [31]; Beach et al. [32]; Zhang et al. [33]
Information system security	Cavallari [2]; Straub et al. [3]; Hitchings [16]; Hagen and Albrechtsen [20]; Gordon et al. [23]; Warkentin and Johnston [26]; Vaidyanathan and Mautone [35]

Table 2 Correlation

	F1	F2	F3	F4	F5	F6	F7	S1	S2	S3	S4	S5	S6	S7
F1	1													
F2	0.94	1												
F3	0.95	0.98	1											
F4	0.97	0.91	0.93	1										
F5	0.98	0.95	0.91	0.87	1									
F6	0.91	0.92	0.93	0.92	0.83	1								
F7	0.94	0.96	0.95	0.89	0.95	0.73	1							
S1	*0.91*	*0.95*	*0.89*	*0.93*	*0.78*	*0.89*	*0.80*	1						
S2	*0.93*	*0.86*	*0.93*	*0.90*	*0.85*	*0.91*	*0.84*	0.93	1					
S3	*0.91*	*0.87*	*0.89*	*0.86*	*0.91*	*0.85*	*0.94*	0.94	0.94	1				
S4	*0.90*	*0.91*	*0.93*	*0.88*	*0.90*	*0.93*	*0.95*	0.95	0.91	0.98	1			
S5	*0.95*	*0.89*	*0.92*	*0.90*	*0.93*	*0.92*	*0.91*	0.92	0.94	0.93	0.92	1		
S6	*0.92*	*0.88*	*0.90*	*0.93*	*0.87*	*0.90*	*0.92*	0.90	0.95	0.96	0.95	0.91	1	
S7	*0.89*	*0.89*	*0.87*	*0.94*	*0.84*	*0.90*	*0.90*	0.90	0.97	0.97	0.97	0.93	0.98	1

6 Data Analysis and Findings

The investigation was made by an anonymous online questionnaire with the operationalisation of constructs pointing to a five value anchored Likert scale for variables *{F1 → F7}* and *{S1, S2}*, and a bullet choice of yes/no for variables *{S3 → S7}*. Total respondents were N° 113, with 111 valid responses. With respect to Hair's study this is a statistically significant sample, i.e. *"good sample"* [37]. The intrinsic validity of the model was assured by a Chronbach's α test of more then 0.87. All analysis was conducted using "Ibm SPSS Statistics". The two tail correlation significance test showed values of 95%, so correlation significance was verified between variables. Seven over seven relationships were significant, thus comforting that these results do support nomological validity for the hypothesis of organisation's flexibility positively influencing ISS. About the testing of the sample industry distribution against the population distribution, is not significant at the *0.05* level. This suggests that the distribution of firms in the sample did not significantly differ from the distribution of firms in the population, thus indicating little or no

response bias. Correlation between significant variables was performed with the correlation index ρ and the results show values of positive correlation higher then 0.91. Variables highlighted in the inner box of Table 2 are the most significant for the correlation analysis, as variables pertaining to the same construct, naturally show a high rate. The most important correlation analysis is the one between the macro variables obtained grouping organisation flexibility variables, i.e. *{F1, . . ., F7}*, and the information systems security ones, i.e. *{S1, . . ., S7}*, that shows a value higher then 0.92.

We can conclude that there is a definite statistically significant, support of the tested hypothesis.

7 Limitations and Scope for Further Research

Future research could focus more on the relationship between the organisation's flexibility and the other constructs about ISS. The purpose of the relationship analyses in this study is mainly to demonstrate the nomological validity of the factors, thus the hypothesis. More rigorous studies could be completed to substantiate antecedent and consequent relationships among all the variables, i.e. whether the organisation's size plays the role of mediator between the independent variable and the dependent one. More sophisticated theoretical arguments and statistical tools would then be required to further examine these relationships in depth.

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Part IX
Blending Design and Behavioral Research in Information Systems

Building Theories from IT Project Design: The HOPES Case

Paolo Spagnoletti, Andrea Resca, Valentina Russo, Francesco Taglino, and Laura Tarantino

Abstract Design science is increasingly attracting the interest of scholars in the field of Information Systems. Starting from a design problem, a researcher selects the kernel theories from which to derive prescriptions for the meta-requirements, the product features (meta-design), the design process (design method) and some testable design product and process hypotheses. The theoretical contribution of this research stream is related to both the new artifact and the practical guidelines for developing it. In this paper we argue that design science as a research strategy can also have an impact on the available knowledge on the social phenomenon to which the design problem refers. In fact, especially when multi-disciplinary teams participate to the design of an IT system, kernel theories can benefit from the different perspectives of actors involved. The design process of a multimedia platform providing innovative social e-services to European elderly persons and their social entourage represents the case study for supporting our hypothesis.

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1 Introduction

With respect to Gregor's framework [8], theories in Information Systems can be divided in five classes: theories for analyzing, theories for explaining, theories for predicting, theories for explaining and predicting, and theories for design and action. An example of design theory paper is the Markus et al. contribution [11] who proposed a theory for systems that support emergent knowledge processes. Different models and methods have been proposed in the literature for conducting design research [7, 9, 15, 20–22]. These theories focus on "how to do something", by giving explicit prescriptions on how to design and develop an artifact, whether it is a technological product or a managerial intervention.

The debate on design science has been at the foreground among Information Systems (IS) scholars in different contexts spanning from local conferences (i.e. [2]) to top journals [1]. For instance, in a recent commentary in response to the 'Memorandum on Design Oriented Information Systems Research' written by more than 100 professors from the German-language IS, the Editors in Chief of four IS top journals stress the fact that EJIS (Vol. 17, No. 5), JAIS (Vol. 8 No. 2), ISR (20, No. 3), and MISQ (Vol. 32, No. 4) have all solicited articles and published special issues on design science research [1].

The debate on IS design science research led to the identification of a number of schools that differ in terms of the need of the kernel theory and its nature and on the generality problem [4]. In our work we agree with Baskerville et al. [1] in assuming that design science contributions "*may include the discovery of novel theory related to IS phenomena through design science procedures or the significant extension of existing theory through its exercise in a design-and-build research cycle*".

The objective of this paper is to contribute to this debate, by showing how the discovery of novel theories can be related to IT artifact design. A particular attention is given to the potential enrichment of theories from multi-disciplinary contributions through design science research. Our main assumption is that through this approach is it possible to investigate the link between IT design choices and the socio-technical phenomenon emerging from the interaction between the IT artifact and the organizational settings.

The empirical part of this work is based on the analysis of the development process of a networking platform (HOPES[1]) that supports social interaction of elderly people with relatives and caregivers. This platform is under development in the context of a European project.

The paper is structured as follows. We firstly describe the design research method adopted in this work. Then we introduce some general aspects of the

[1] This article has been drafted in the context of the HOPES project "Help and social interaction for elderly On a multimedia Platform with E-Social best practices" funded by the EU Commission under the AAL Programme. We thank all the project partners for their contribution. Project website: http://www.hopes-project.org

HOPES case and we discuss about possible design research contributions drawn on this case. Finally we close the paper with implications for research and practice.

2 The Design Research Method

The problem of giving explicit prescriptions on how to design and develop a class of IT systems belongs to what has been named as "IS design theory" by Walls et al. in their seminal work [21] inspired by Simon's [16] and Dubin's [3] contributions. In this article and in the following review and assessment in 2004 [22], Walls et al. distinguish two aspects of a design theory: the design product and the design process. The design product is defined through meta-requirements, meta-design (features), kernel theories and a set of testable design product hypothesis. Differently, the design process components are the design method, kernel theories and a set of testable design process hypothesis. In both aspects, kernel theories are usually taken from the natural or social sciences.

This model has been extended by Gregor and Jones [7] who have proposed a new "anatomical skeleton" for IS design theories, based on eight components encompassing four issues identified in the Walls et al. conceptualization. For instance, the distinction between kernel theories for design processes and kernel theories for design products made by Walls et al. [22] has been criticized. For the purposes of the present work, we derive a model for formulating a design theory that lies on both the above mentioned frameworks. The model is based on five components whose relationships are depicted in Fig. 1.

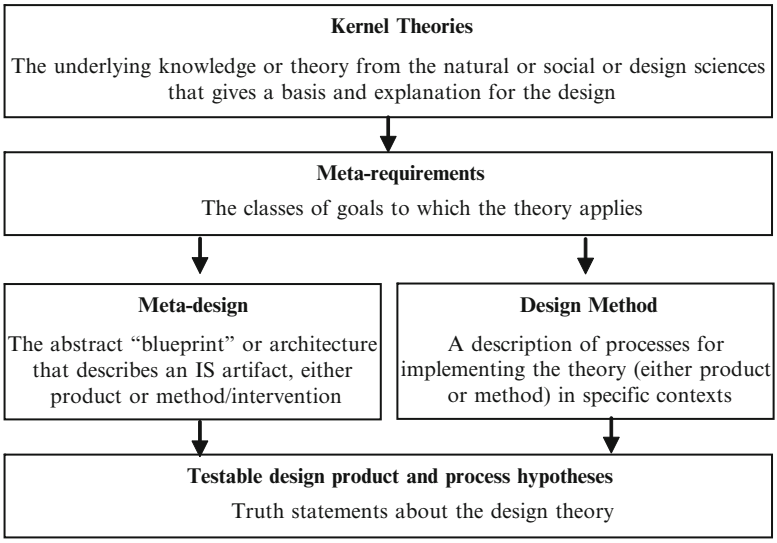

Fig. 1 Relationships among IS design theory components (Adapted from [22])

As a first step towards the definition of design theory, we need to clearly identify the purpose and scope of the theory. This will help us in motivating the choice of kernel theories and to further derive prescriptions for the meta-requirements, the product features (meta-design) and the design process (design method) as well as the definition of testable design product and process hypotheses.

3 Design Theory and the "HOPES" Case

HOPES is an intelligent multimedia platform providing innovative social e-services for European elderly persons and their social entourage (as carers/supporters and IT tutors when needed). The platform is under development in the context of a European project started in September 2010, with the first prototype delivered in June 2011. The ultimate goal of the project is to enhance socialization, quality of life and autonomy of elderly persons by preventing isolation and loneliness, and generating positive social experiences and behaviour. In few words, the project proposes to foster social interactions through the development of an accessible, easy-to-use and innovative IT platform that provides a forum of well aging, an exchange of "social best practices" and socialization services in a European network.

The general requirements at the basis of the project proposal demand for the integration of a range of IT-based solutions for: (1) managing existing e-information by exhaustive search of available information (Web and databases crawling) and intelligent structuring (i.e. Text Mining) in the HOPES repository; (2) transforming selected information into personalized (ad-hoc) solutions; (3) providing validated solutions as "e-Social Best Practices" (e-SBP). All these services must be provided through a Web 2.0 approach by supporting the social interaction of end users. These characteristics make the HOPES platform an interesting case for analyzing the potential contribution of adopting a design theory approach to the development of complex IT systems. In particular, among the many possible perspectives that can be adopted to look at the HOPES case, we have identified four design problems. These are the design of IT systems for supporting communities, the design of interaction environments suitable for elderly people and their care networks, the design of intelligent solutions for e-care, the design/definition of evaluation criteria to assess the improvement of the quality of life.

For each of the above mentioned design problems, in the following subsections we briefly illustrate the potential theoretical contribution deriving from the adoption of a design theory approach on the HOPES project. We do this by instantiating the five components of the IS design theory with examples related to the HOPES project. Table 1 summarize the results of this analysis.

IT supporting communities. A design theory for IT systems supporting communities can contribute to the available body of knowledge on online communities which mainly focuses on theories for explaining and sometimes predicting online community dynamics. In fact only a small number of

contributions in this area are concentrated on the characteristics of such systems and on how to develop and maintain them [14, 19]. A possible kernel theory in this domain can be related to previous theories explaining the behaviour of community members by comparing the characteristics of online communities in opposition to offline ones [13, 18].

Interaction environments for elderly people and care networks. For an elderly oriented IT platform to be successful, special focus has to be put on the interaction environment, which encompasses devices, techniques and paradigms used to communicate with and through the system. Strategies to motivate elderly in using HOPES services must be accompanied by a careful attention on limitations deriving from physical (visual, auditory, motor) and cognitive impairments, and from scarce e-literacy [5]. A design theory based on the idea of "cognitive prosthesis" as a compensatory strategy for such limitations may benefit HCI design methodologies as a whole when extending the function of prosthesis from "compensatory" to "augmenting", and considering IT products as "amplifying" human capabilities while seamlessly integrating within the ambient (coherently with anthropological views of technical object as natural extensions of the human body).

Intelligent solutions for e-care. Knowledge management at large is a challenging discipline [12], in which contents search and information retrieval [17] occupy a relevant place. In particular, semantic search uses richly structured knowledge resources (e.g., taxonomies, ontologies) to tag (or annotate) any kind of digital resource (e.g., documents), and to enable users to specify queries in a detailed and not ambiguous way. Finally, reasoning facilities allow for a contextualized, with respect to the given query, search results. It is our thinking that a design theory on intelligent solutions for e-care, which is here focused on a smarter and personalized provision of contents (i.e., e- Social Best Practices) to elderly people, could contribute to the existing methods and tools for semantic search. Weaknesses of the applicability of such methods also concern their usability. In fact, most of the work on this field has been conducted towards: ontology representation languages, semantic annotation techniques, and reasoning methods. Then we think that usability and an easy to use approach should be improved. For this reason, a context like HOPES, where the actual actors are aging people with usually low-tech skills, could give important feedback on queries specification methods, acquisition and presentation of results, navigability of results.

Quality of life improvement evaluation. A design theory for IT systems supporting the evaluation/measurement of Quality of Life (QoL) rely on preference-based self assessed methods, through the multidimensional assessment. Possible contributions to kernel theory in this domain is well represented by some scales (i.e. indexes), which measures, in terms of cost-effectiveness, the impact that the introduction of an IT artifact may have on the Quality of Life of (elderly) people. In this framework have become widely used several generic preference-weighted health state classification systems, which combine a health status measure with a societal value or utility for each health state: the most commonly used systems include the Health Utilities Index (HUI) [6] and the Euro QoL EQ-5D [10]. The Health Utilities Index is a recently developed system for measuring the

Table 1 HOPES design summary

	IT systems for supporting communities	Interaction environments for supporting elderly people and carers	Intelligent solutions for e-care	QoL improvement evaluation
Kernel theory	Explaining the behaviour of community members by comparing the characteristics of online communities in opposition to offline ones	Conceiving the interaction environment as a set of cooperative "cognitive prosthesis" that leverage and extend human intellectual capacities	To allow a smarter and personalized provision of contents (i.e., e-Social Best Practices) to elderly people, by using semantics- based reasoning over knowledge resources	Indexes and scales to evaluate the impact, in terms of cost-effectiveness, of the IT artefact on the lifestyle
Meta-requirements	Ubiquitous access, sociability and interoperability, personalized contents, security and privacy	Adaptation to user's impairments, ubiquitous computing, ambient intelligence, community awareness,	Contents accessibility; Knowledge provision and sharing; Contents personalization; Interoperability	Providing information and solution in an intuitive, quickly and easy (according to the IADLs requirements) way
Meta-design	Multilinguism, personalized interfaces, features for information exchange, dynamic adaptation of contents to user profiles, policies and modules for managing authorizations, authentication module and rules for authentication	Multimodal interaction, direct input languages, sensorial languages, support for experience sharing, peripheral display	Ontology acquisition; Semantic annotation; Semantic search and retrieval; Intelligent but simple presentation of contents. Dynamic adaptation of contents to user profiles; Easy to use contents navigability	Easy-to-use (interactive navigation methods), lively (to be attractive), creative, connected (with the real needs of the elderly), integrative, participatory and inclusive

Design methods	"personas" definition through focus groups, iterative development, contribution of domain experts, risk management methods, Analysis of privacy regulation	User centered design methodology, "personas" definition through users inquiries, low/high fidelity prototypes, visual design, gestalt theory, user-based assessment	Semantic (social) tagging; User profiling; Semantic similarity reasoning; Semantic matchmaking; Simple "wizards" for query definition; Semantic clustering and classification	QoL enhancement detection through focus groups and questionnaries index-based
Testable propositions	Accessibility, users' classification and users' needs coverage, actual use, content relevance, application of explicit rules, security/usability trade-off, privacy perception	Accessibility, usability, ergonomics, cost of information access, gestures' intuitiveness, memory workload, affordance, consistency	Effective precision and recall of queries results; Effective usability of the solution with respect to skills and capabilities of elderly people; Usability as the first requisite	Scales and evaluation indexes aimed at pursue the best cost-effectiveness QoL enhancement, platform accessibility and usability user perception

overall health status and health-related quality of life (HRQL) of individuals, clinical groups, and general populations, based on eight attributes (vision, hearing, speech, mobility, dexterity, cognition, emotion, and pain/discomfort). The Euro QoL-5D scale, developed, validated and endorsed by the European Union, it is a standardized instrument for being used as a measure of health outcomes, applicable to a wide range of health conditions and treatments. It provides a simple descriptive profile and a single index value for health status by exploring five domains (mobility self-care, usual activity, pain/discomfort and anxiety/depression). Both these indexes can contribute in the design process of an IT platform providing an immediate response on the real effectiveness improvement of the QoL by investigating the impact, according to the users opinion, that the IT artifact has on their own lifestyle (habits, mobility, independency, socialization, etc.). A second, possible, contribution to kernel theory may come from secondary outcomes that take into account the disabilities of which the population may suffer. By exploring the domains, named basic and instrumental, according to those activities in which is required or not the interaction with tools, one may use the Katz ADLs, as well as the Barthel Index, to investigate the functional independence in basic activities of daily life, and the Lawton and Brody IADLs to inquire the functional independence in activities of daily life which requires the interaction with instruments. Both ADLs and IADLs can contribute to the design process of IT platform by providing prescriptions about the abilities of interaction of the (elderly) people with an IT artifact, and by including these suggestions in the following developing process of the IT platform itself.

4 Conclusion

In this paper we maintain the importance of design research on IS by stressing the fact that many different theoretical contributions can emerge from the design of a single IT artefact. Through the example of a multi-disciplinary EU project we have identified four design problems confirming the innovative and transformative role of information technology (IT) artifacts. Interdependency of such design problems can be singled out by the analysis in Table 1, where some entries appear in more the one column (e.g., “personas”, or “accessibility”), hence highlighting “bridges” between design problems.

We have discussed how the mutual exchange of knowledge among researchers who take part to a design project, enables the possibility to contribute with significant extensions and profitable reciprocal contaminations to existing theories. Further research in this area can contribute both to the development of new theories in each specific area and to a more holistic view on design science theorizing through the adoption of different design research methods and models.

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Towards a Reconstruction of Theoretical Foundations of Enterprise Architecture Management

Simon Weiss, Stephan Aier, and Robert Winter

Abstract Enterprise architecting has grown to a well-established discipline. Based on the design science research paradigm, a multitude of models and methods have been developed and real-world practices have been assessed. However, as the development of EAM has been rather practice-driven, a theoretical foundation for EAM seems to be lacking. Based on a set *S1* of well-known EAM properties and EAM means-ends relationships, this paper addresses this gap by identifying an initial set *S2* of information systems theories that can serve as theoretical grounding for EAM. As a first iteration of Hevner's (Hevner AR (2007) A Three Cycle View of Design Science Research. Scandinavian Journal of Information Systems 19 (2):87–92) Rigor Cycle, we identified 12 theories that can be related to EAM and have the potential to serve as a theoretical grounding for more profound EAM design theories.

1 Introduction

Enterprise architecture (EA) describes the fundamental structures of an organization (company, government agency etc.) and supports its transformation by explicating the components as well as their interdependencies of the "business to IT stack". Enterprise architecture management (EAM) is concerned with the establishment and continuous development of EA. As such, the notion of EAM goes beyond EA modeling and includes the management tasks of planning and controlling enterprise transformation from an architectural perspective [2].

In recent years, EAM has been established in a growing number of organizations as means to ensure transparency, agility and consistency, compliance and efficiency [3]. The overall development of EAM has been primarily practice-driven, though.

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From a scientific perspective, a number of models and methods have been developed using a design science research (DSR) approach. A number of authors provide overviews of respective EAM approaches that have evolved based on varying understandings, origins, representations and targets of EA [4, 5]. From a practice perspective, it is frequently assessed (e.g. by Gartner, Forrester) how EAM is conducted in companies, i.e. what practitioners understand under EAM; what the objectives of EA programs are; and which aspects is currently being worked on.

An aspect EAM research is lacking, though, is its theoretical foundation. To the best of the authors' knowledge, there exists no comprehensive overview of theories that can contribute to EAM so far. However, a theoretical foundation would be beneficial to rigor design science research [6, 7], i.e. the enhancement of the knowledgebase of applicable EAM design knowledge. The goal of this paper therefore is to provide an overview of information systems (IS) theories that can serve as a basis for EAM research and eventually help to construct better design theories in this area.

The remainder of the paper is structured as follows: In section two we outline the conceptual foundations of our research. In section three we link identified IS theories to EAM properties and EAM means-ends relationships. The article closes with a short summary and outlook.

2 Conceptual Foundations

The rationale for this paper is based on Hevner's [1] rigor cycle. "The Rigor Cycle connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that informs the research project" [1]. In this respect, we intend to relate known (kernel) theories (cause-effect relationships) to observable and apparently effective EAM practices (means-ends relationships), aligned to Goldkuhl's [8] conception of grounding of design theory [also 6, 7]. As mentioned earlier, we can observe both prescriptive statements (design theories e.g. in the form of EAM models and methods) as well as instantiated action in EAM practice. In this paper, we approach the issue of theoretical grounding. Accordingly, (kernel) theories can provide validated cause-effect relationships that theoretically ground means-ends relationships within the domain of EAM. Being a first iteration of the rigor cycle, this paper intends to:

- Establish an initial set *S1* of well-known EAM properties and EAM means-ends relationships, and
- Search for candidates in IS theory that can serve as theoretical grounding set *S2* of cause-effect relationships.

3 Linking IS Kernel Theories to EAM

As a first source of potential kernel theories of EAM, we focused on the list of IS theories from York University.[1] The list is comprised of 84 theories that are used in IS research (effective June 2011). Even though on varying levels of detail, each summary comprises information about main construct(s)/factor(s), originating author(s), seminal articles, originating area, etc.

In a reverse-search, we looked at every single theory and identified the ones that can be related to one or more elements of *S1*. We could observe that IS theories can be related to either the mechanisms of the core components of EAM (type 1), or to the impact of EAM in its organizational context (type 2). Type 1 theories relate to how the sub-functions of EAM (e.g. EA planning, development, communication, controlling, governance) should be managed, whereas type 2 theories can be related to the way the EAM function interfaces with its environment and why EAM seems to be well-suited for dealing with certain managerial issues in a potentially organization-overarching context. Table 1 provides an overview of the relations between the elements of sets S1 and S2, and respective types. Below, the essence of each theory and its links to EAM are described briefly.

Theory 1 – General Systems Theory (GST): Today, a lot of variations of this general theory exist, while the common thought being that any entity (e.g. an organization) consists of parts and relations between these parts, which connect them into a whole. Rather than regarding an entity's or organization's parts separately, systems theory focuses on the arrangement of and relations between the parts [9].

Table 1 S1-S2 allocation matrix incl. theory types (T1 or T2)

		Set *S1*				
		Transparency by modeling	Coordination by planning	Consistency by principles	Effectiveness by consulting	Compliance by reviews
Set *S2*	T1 (GST)	T1				
	T2 (Agency)		T2			
	T3 (DOI)	T2			T2	
	T4 (Dyn. Cap.)		T2		T2	
	T5 (OIPT)	T2		T2	T2	
	T6 (Admin. Beh.)	T1				
	T7 (Contingency)	T1	T1	T1		
	T8 (Inst. Theory)				T1/T2	T1/T2
	T9 (ANT)	T1	T2		T2	
	T10 (Cogn. Load)	T1				
	T11 (SSM)			T2	T2	
	T12 (SNT)	T2	T2			

[1] Available at http://istheory.byu.edu

This thought is also inherent in EAM, which regards enterprises as systems with numerous parts such as strategies, products, processes, organizational units, (IT) systems, etc., which are all related to each other in a certain way, but can be structured into (logical) subsystems, e.g. different layers of abstraction, for the purposes of complexity-reduction, decoupling and containment [10, 11]. One can therefore state that, on a very basic level, systems theory supports EAM with its approach to focus on understanding the relations between an organization's components, in particular between business and IT [12].

Theory 2 – Agency Theory: Agency theory, or principal-agent problem, deals with the difficulties that arise when a principal hires an agent in the light of incomplete and asymmetric information and self-interests of both parties [13].

In our setting, this problem may for instance occur (and as a matter of fact, we regularly experience this with our industry partners), when a project manager is reluctant to spent $10 M more, even if it would save another unit $20 M and the directive of the top manager was to maximize benefit for the whole organization. Only an overarching program management or EA approach is able to detect, verify, and resolve such issues. Agency theory is therefore in favor of EAM as an overarching planning tool facilitating a mitigation of principal-agent problems.

Theory 3 – Diffusion of Innovations Theory (DOI): Diffusion of innovations theory (also known as innovation diffusion theory (IDT)) is widely used in IS. The theory aims at explaining how, why, and at what rate innovations, in particular new technologies, are adopted by societies or organizations. While many different variations of DOI are in existence, the three most important antecedents to the adoption of innovations and IS implementation success have been identified to be technical compatibility, technical complexity (ease of use) and relative advantage (perceived need) [14].

The link to EAM is that EAM particularly helps coping with the former two aspects. As EA intends for instance to provide transparency across architectural layers and to unveil links of IT to upper layers, it makes the possible impact of innovations transparent. EAM can therefore be regarded a suitable means-ends relationship for implementation success or technology adoption.

Theory 4 – Dynamic Capabilities: Teece et al. [15] define dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments." Dynamic capabilities theory states that sustainable competitive advantage depends upon such capabilities of resource development and renewal.

As EAM clearly deals with methods for tackling the tasks mentioned in the definition, it represents in itself a dynamic capability. Thus, it provides a means for the end of competitive advantage.

Theory 5 – Organizational Information Processing Theory (OIPT): Similar to other theories, OIPT argues that organizations require quality information for coping with uncertainty, improving decision making, and realizing change. According to OIPT a fit of information processing needs and information processing capability determines the information processing performance. One of the two common strategies to cope with these challenges is to "implement structural mechanisms

and information processing capability to enhance the information flow and thereby reduce uncertainty." [cf. 16, 17].

EAM can provide means to this end by especially satisfying information needs and processing capabilities by grasping relations between organizational elements.

Theory 6 – Theory of Administrative Behavior: The theory of administrative behavior holds two key concepts, namely the concept of bounded rationality and the concept of satisficing. Both concepts call for a method that capture information and complex relations in an aggregated and processable way in order to overcome the "limits in formulating and solving complex problems and in processing (receiving, storing, retrieving, transmitting) information." [18]

To our mind, a broad (business to IT) and flat (focusing on aggregated components and relations) EAM approach is suitable for this task as opposed to approaches that focus on certain tasks in depth (e.g. business process management or IT support) [cf. 2, 3].

Theory 7 – Contingency Theory: Contingency theory is a class of behavioral theory that claims that there is no (single) best way to organize or lead a corporation and make decisions. Rather, the optimal approach depends upon various internal and external contingency factors [cf. e.g. 19].

We can observe many of the ideas of contingency theory to be valid for EAM as well [2, 20]. First, a one-size-fits-all EAM approach is not reasonable. Second, EAM should fit to its wider organizational (and inter-organizational) context. After all, every organization is different and has differing EAM requirements accordingly. Third, the various EAM tasks themselves should fit, i.e. the subsystems of the EAM function (like EA planning, modeling, etc.) should be aligned.

Theory 8 – Institutional Theory: Institutional theory elaborates on how elements like (social or organizational) structures, rules, norms and routines are created, diffused, adopted and adapted over space and time, including potential disuse and conflict [21]. Applied to EAM, we can analogously observe that EA needs adaptation and adoption processes, and cannot be introduced in a glimpse [22]. The introduction of a (more or less powerful) EA board for instance, is regularly subject to discussions and conflicts - not to mention an enforcement of architectural transformations or universal principles.

Theory 9 – Actor Network Theory (ANT): ANT claims that an actor-network resembles a heterogeneous network, which comprises not only people, but also objects and organizations, which are all together regarded as being equally important and inseparable. A significant break-down of the order of the (social) network may result when removing any actor (e.g. the president, telephones) [23].

This theory can be related to EAM from two major perspectives. From an inside-out perspective, ANT supports EAM as holistic approach to respect not only application system or processes, but resources and capabilities across all layers from strategy to infrastructure. From an outside-in, i.e. stakeholder-oriented perspective, one can infer that many (internal and external) stakeholders are important for an organization and should be catered for through respective viewpoints of the EA [24]. Disrespecting the interests of a governmental body for instance, may have tremendous consequences.

Theory 10 – Cognitive Load Theory: The theory states that the performance of learning or problem-solving is determined by cognitive load, which in turn depends upon a task-based dimension (mental load) and a learner-based dimension (mental effort). Mental load is determined by the elements of intrinsic cognitive load, extraneous load and germane load. The ease with which information may be processed in the limited working memory can particularly be affected by altering the characteristics of extraneous load and germane load [25].

EAM too intends to reduce the difficulty of tasks like business/IT alignment by providing means and methods (e.g. EA modeling) to reduce extraneous load (irrelevant details) and to increase germane load (by putting architectural artifacts into known schemas/models). A similar argumentation applies to cognitive fit theory [26], which is closely related to cognitive load theory and is consequently not explicitly treated here.

Theory 11 – Soft Systems Methodology (SSM): SSM distinguishes hard and soft problems that have each its unique characteristics. As opposed to hard problems, soft problems, which are also referred to as ill-defined or wicked problems, contain social and political or generally new elements that complicate problem definition and resolution [27].

Based on SSM, EA transformation projects can clearly be regarded as soft problems due to a multitude of interdependencies that also contain social and political elements. Checkland's iterative SSM approach to address soft problems is also very close to EA development processes as they occur in EA frameworks (e.g. TOGAF). SSM may therefore contribute on how to design EAM processes.

Theory 12 – Social Network Theory (SNT): In contrast to other sociological studies, SNT does not primarily assess actors' attributes, but their relationships and ties [28]. With respect to EA, a network perspective using research from social network analysis can provide a useful abstraction for understanding architecture, which can be viewed "as a network of software components linked by their interdependencies" [29]. Another research question related to SNT could be which role(s) and links certain persons responsible for EA should have in the (social) network of an organization.

4 Discussion and Summary

Motivated by a lack of theoretical foundations for EAM design science research, this paper depicted an initial set *S2* comprised of 12 theories that can be related to the discipline of EA, used as substantiation for doing EAM, and in particular guide further research and eventually practices in the field. The discussed theories were identified based on a set *S1* of observed and apparently effective EAM means-ends relationships. While a more in-depth discussion of each theory is out of scope of this paper, the argumentation gives examples of how the mentioned theories can be related to EAM. The important contribution of the paper at hand is an initiation to

discuss and rethink EAM approaches based on commonly accepted and relevant kernel theories, and to adapt or refine these theories if appropriate.

With respect to the limitations of this work, it should be noted that both sets *S1* and *S2* were developed as a first iteration of Hevner's DSR Rigor Cycle and are thus not complete. It is planned to refine and extend both sets in further iterations and to develop more profound relationships between respective elements. To this end, two issues are of particular interest: Firstly, some theories will certainly offer a better grounding and/or explanatory power for EAM than others and should therefore be prioritized for further in-depth elaboration. These theories have to be identified. Secondly, it has to be argued and assessed whether the kernel theories are applicable/adaptable the way they are, or whether mid-range theories should be constructed in order to bridge the gap between kernel theories and design theories, as proposed by Kuechler and Vaishnavi [30].

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Focus Groups, Meaning Making and Data Quality

Patrizia Bertini

Abstract Data quality represents a major strategic asset for organisations and privacy is one of the main influencing factors impacting on organisations 'practices related to customers' data collection. Other elements which affects this relationship are individuals handling data within the organisation and their different needs, however there is limited research focussing on these aspects. This work presents early findings of an empirical qualitative research using focus groups within a social constructivist approach to delve into managers' perception of data quality and to understand the impact of privacy on organisational practices. Focus groups have been widely adopted in academic research as an exploratory method to collect people's opinion. This study shows how some features, like involving pre-existing groups, the adoption of questionnaires and the workshops' setting can positively influence focus groups' outcome, encouraging participants' co-operative interaction, helping them to clarify concepts and raising awareness about privacy and data quality.

1 A Social Constructivist Perspective

The present research is part of the EnCoRe project, a 45 months research project studying how to improve the ease with which individuals can grant and revoke their consent to the use, storage and sharing of their personal data by others. This paper is part of PhD research looking at data quality and privacy related practices from a social constructivist perspective. The aim is to reveal how notions associated with data quality and privacy are constructed within organisations and how different needs and understanding of these concepts can affect organisational practices.

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In a social constructionist view, "all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context" ([7]: 42). In the social constructivist paradigm, reality is divided in two realms: social or institutional facts and natural or brute facts. Brute facts are "phenomena having a being independent of our own volition" ([5]: 1): they exist independently of any human institution.

Institutional facts require human institutions to exist, they depend on the presence of other human beings since they "are typically objective facts, but [. . .] they are only facts by human agreement or acceptance" ([25]: 11). Facts are constructed by a collective intentionality that imposes special status on a phenomenon since the phenomenon can not perform its functions based solely on its physical characteristics [24]: institutional facts therefore can exist only because of collective attitudes and recognition. Intentionality is pivotal as it enhances collective agreement which leads to meaning making processes and to the construction of institutional facts. A constructivist approach focuses on what is done with words in terms of what is said because "constructivists are especially interested (. . .) in actively constructing and co-creating knowledge by working together with actors involved" ([6]: 75).

This research uses focus groups to elicit interactions and meaning making processes to reveal the organisational dynamics and unfold privacy and data quality related definitions: data collected result from a process where individuals are agents and co-producers of their reality [6]. Meaning making requires participants to share their opinion in a co-operative interactive process to come up with a new understanding [1, 14, 18]. The new shared definitions result from conflicts which arises from participants' cognitive diversity and by the context [2]: since co-workers often assume concepts without discussing them with their colleagues, this can lead to misunderstanding which can be unfolded by the focus groups.

This paper analyses data collected in four workshops to reveal how social constructivist behaviours can be enhanced by focus groups and how focus groups can be effective in unfolding data quality related meanings.

2 Understanding Focus Groups

Focus groups are social events consisting of group discussions organised to explore some specific topics and to collect participants' opinions in a permissive and non threatening environment [1, 10, 16]. They reveal not only what participants think, but also the reasons behind attitudes and how meanings are constructed [20, 30]. During their interaction, participants stimulates' each others and have a certain degree of freedom over the topic, so that each contribution triggers more spontaneous interplays [11]. Moreover, participants' control over the process facilitates the disclosure of issues which are more salient for the group [10, 21, 22, 28]. The researcher becomes more like an observer who keeps participants focussed on

the topic [10, 22] reducing the distance between the researcher and the social context. The less authoritative role of the researcher and participants' level of freedom results in an unstructured environment which generates 'unruly' data, as participants produce less coherently sequenced accounts of individual and collective experience [28].

Although focus groups have become a common method in academic research, sometimes they are inappropriately referred as 'group interviews': Ho [12] describes "focus group as a group interview without the alternate question-answer sequence found in typical interview sessions" but Gibbs [10] clarifies that "group interviewing involves interviewing a number of people at the same time, the emphasis being on questions and responses between the researcher and participants". On the other hand, focus groups are not used to generate multiple accounts of individual perspectives, but they explicitly rely on the group interaction to produce and collect interaction-based data [11, 16, 28, 30]. Since focus groups' unit of analysis is the group and its dynamics, unlike group interviews, participants' interaction is an integral part of the whole research process. Focus group relies on group interaction and considers interactions as data, while group interviews rely on participants' interactions with the researcher to elicit data.

2.1 Adopting Focus Groups: The Method and the Organisations

Despite many concerns [19, 20, 22], the research involved pre-existing groups of co-workers and workshops were held at organisations' offices: this resulted in a natural-like setting which revealed fragments of interactions close to the spontaneous occurring ones [16, 17, 21, 28]. Hollander [13] warns that one of the risks of such groups is the impact of what is being said on future relationships; to collect individuals' view and to reduce this pressure, the data collection included a preliminary questionnaire and a follow up email. The use of a questionnaire is also meant to activate participants' thinking and to provide inputs for the discussion [17]. The researcher asked non-selective questions and adopted a non-directive approach to create a casual setting and facilitate the discussion. By limiting her interventions and putting herself as a learner, participants were fooled into acting as co-researchers. The methodology was pre-tested with four colleagues who participated in a role playing game-like activity in a 2 h' simulation.

The recruitment of the organisation has been conducted using LinkedIn, the business social network with more than five millions subscribers from the UK.[1] LinkedIn members can get in touch and discuss business related topics by joining or creating one of the available groups. To recruit the organisations, the researcher signed up to the data quality related groups and started a discussion in June 2010

[1] Data from LinkedIn official website, http://press.linkedin.com/about/ [accessed on May 5th 2011].

which has resulted in 107 contributions.[2] This way the researcher had access to the profiles of relevant professionals and could contact them. Once the selected professional accepted, s/he was asked to involve two or more colleagues working in data quality and privacy area of their organisation. From October to December 2010 the researcher ran four focus groups with four UK based organisation from different business areas, involving 15 professionals with an average of 16 years of experience.[3] Focus groups took place at the organisations' offices engaging three to five participants each. Workshops were audio-recorded and transcribed.

The following table shows some data about the groups' composition; 'utterances' are communicative units consisting of a speech "clearly delimited by the change of speaking subjects" [3].

2.2 *Focus Groups and the Construction of Accuracy*

Since data represent a strategic competitive advantage with a direct impact both on customer satisfaction and organisations' revenues, organisations tend to collect as much data as possible, even without a clear strategy [9] with inevitable consequences for data protection practices. The relationship between data quality, data collection and data protection needs to be clear within organisations, so that customers' privacy is protected and the quality of data is appropriate and accurate. Data management practices are regulated by laws: both the Directive 95/46/EC and the UK Data Protection Act underline this relation between data processing and privacy and organisations are also well aware of it:

> P2: *So the dimensions of data quality are, are integrally linked to the privacy aspect, because [. . .] there's almost like a causal relationship between the two in the sense that the minute you begin to degrade data quality you're beginning to impact, in one way or another, on the person's privacy. . .* [Q1]

As the DPA has been enacted to conform to the European Directive, which requires member states to regulate personal data processing, its influence on the DPA is evident: both documents describe data protection principles which requires personal information to be processed fairly and lawfully and for limited purposes. The quantity of data collected should be adequate and relevant; data should be accurate and up to date and kept for no longer than necessary. Data should be processed in line with the rights of individuals, be secure and not transferred to other countries without adequate protection. Most of these principles are part of data quality dimensions, where 'dimensions' are parameters and attributes meant to represent an aspect pertaining to data quality [27].

[2] The discussion is available here: http://tinyurl.com/linkedin-dataquality [created on 20th May 2011].

[3] Participants' professional experience ranged between 7 and 25 years.

The questionnaire presented a list of 12 dimensions related to these principles; participants were asked to rate 3 dimensions: 12 out of 15 partakers selected Accuracy and 11 ranked it as the most important. As the workshop began, participants were asked to sort the dimensions again and explain their choices. Once they answered, the researcher challenged the group asking them to agree on two dimensions; the question was not meant to look for a consensus, which in many cases was impossible to reach (i.e. Q10, Q11), but to stimulate the constructivist process. The analysis of groups' interaction to define Accuracy, provides an example of how focus groups can engage participants in a collaborative social constructivist activity.

All focus groups agreed that data do not have to be 100% accurate, though the processes and arguments which lead to this statement were different in each workshop.

Some groups indicated that Accuracy depends on external factors, like requirements:

G1: *Yeah that might be an interesting discussion to have, coz in my mind the data doesn't have to be 100% perfect as long as it meets the customer requirements* . . . [Q2]
T2: *Accuracy does not mean that it has to be 100% accurate. It's [how] the requirement is stated*. . . [Q3]

But most of participants underlined the importance of understanding the degree of Accuracy of their data and defining the level of confidence:

G2: *[. . .] you need to understand how accurate your data is really. So accuracy doesn't mean it has to be 100% but it does mean to me you need to understand the accuracy you're looking at.*[Q4]
P2: *[. . .] Many measures of data quality, particularly for statistical decisions don't require 100% accuracy [. . .] I guess the best example of that is, you know, the psychological polls that you see at the elections or whatever, where they come with their, you know, + or – 3%* . . .
P5: *[. . .] I would agree with you pretty much 100% apart from the fact that [. . .], it all has to be 100% accurate to a level of confidence and [. . .] it's that level of confidence that needs to be defined*. . . [Q5]

The previous quote (Q5) shows how, through a critical yet constructive behaviour, participants build the concept of 'confidence': partakers explored their different positions in order to build their shared knowledge by questioning and testing their viewpoint in the so called 'exploratory talk' [18]. The following quote is another example of exploratory talk: here participants discuss data quality dimensions critically, revealing their views and challenging their positions:

F1: [. . .] *And consistency is an important one from my point of view, it's purely because if you don't have the consistency then the understandability goes out the window. . .[. . .]*
F2: *Do you mean consistency of accuracy? Or propagation?*
F1: *Consistency of the fact that I've. . . [. . .]. So I have a consistency through the database of, you know, the same thing. It's closer I suppose in a way to conforming to a standard, but it is consistent*. . .
F3: *It's about being reliable, isn't it?*
F1: *Yes. And therefore understandable*. . . [Q6]

The next quote shows a 'cumulative talk' [18] where participants build on each other's contributions in a supportive and uncritical way, so that the concept of 'confidence' emerges as constructed on the previous utterance:

F1: *[. . .] So it doesn't have to be 100% correct, depending on the application.*
F2: *[. . .] I would add to that it doesn't have to be 100% [accurate], but you need to know where it isn't.*.[Q7]

Sometimes, in their attempt to construct the meaning of Accuracy, participants engaged in a struggle for definitions. The following quote is a cumulative talk showing participants' collective thinking leading a partaker to change their mind:

F2: *My third one was concise representation. Because it's. . . to me it translates to consistency and accuracy.*
F3: *And I've got timeliness as my. . . I had consistency, now I've got timeliness, coz it's about being accurate and up to date.* [Q8]

Accuracy and fit for purpose were mentioned as strongly related in all workshops as explained in the following quote, where the speaker explains this relationship by examples to strengthen his position:

F2: *. . .you know, [data] doesn't need to be 100%, if we got a feeling for how much market share they've got, they're approximately 8–9%, well that's fine [. . .] but if we're looking at accuracy of the customer data on the data warehouse and we're concerned to see the levels of sales etc., we want to know the exact level of sale [. . .]. So it's fit for purpose.* [Q9]

3 Discussion

Participants adopted diverse strategies to discuss and construct meanings, based on their personal experiences and background and on their knowledge of shared history. Difficulties in reaching a consensus arise from partakers' diverse needs and approaches as the groups themselves recognized:

T2: I *think what we say is we struggle to agree on a second [dimension]. There's obviously pools in different people's areas here like [he] is our data quality champion internally, so conformance to a schema so that the data remains accurate is obviously very close to his heart. . .* [Q10]
P3: *Yeah, and I think going back to your question, you say, you know, can we pick and can we agree on three, I think the simple answer to that is no. . . [. . .] so I think, because of the different approaches we have, maybe these three could agree and I'll just sit on the side on this one....* [Q11]

Diversity in participants' attitudes can create misunderstandings and confusion which the focus group helped to bring to light:

G3: Y*eah that was interesting coz you thought that and I was thinking completeness in terms of what fields there were that they were filled, I suppose. I was thinking of attributes [. . .]. . .*
G1: *Yeah it's true. I come from a geographical background so I was thinking geographical completeness and you were thinking attribute completeness. . .* [Q12]

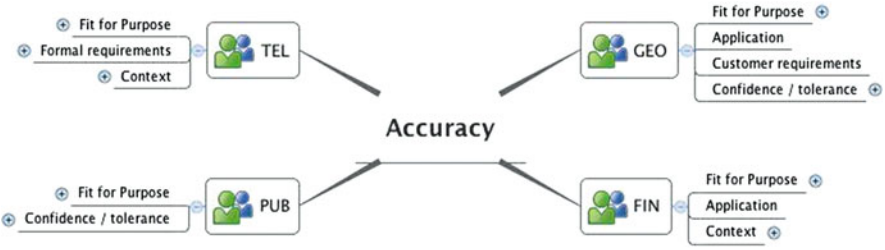

Fig. 1 The figure shows which topics were considered in the discussion related to accuracy

The previous quotation demonstrates the general tendency to assume that others involved in the same context also share assumptions about values and purposes, not considering that words have a variable meaning [18]. Therefore, although participants have been working together, they never felt the need to clarify the terms because they didn't know the term needed a clarification [29]. This kind of misunderstandings can have a major impact on organisational practice where the same data set is used by several people from different departments with distinct purposes.

This reflects also the lack of a commonly agreed meaning of dimensions in the data quality field where Accuracy is defined in various ways, including the degree of data reflecting real world objects [4, 9], as a quality related to the processes of data collection [15], or in terms of data free of errors [26]. The process revealed also the connections between Accuracy and Consistency (Q6, Q8); Olson [23] suggests that Consistency is part of Accuracy as Accuracy "refers to whether the data values stored for an object are the correct values. To be correct, a data value must be the right value and must be represented in a consistent and unambiguous form." (:29). A second emerging pattern relates Accuracy to the purpose of data collection and the context of use as explained in Q9 [8, 23]. Discussions around Accuracy associated it to 6 main areas: the impact of applications (Q7), customer (Q2) and technical (Q3) requirements, the importance of the purpose (Q9), the influence of context (Q9), confidence in data and errors' tolerance (Q4, Q5). Each organisation focussed on specific issues to construct their meanings and even if the final outcome is the same, each group put in place different strategies and arguments to get to their conclusions as shown in Fig. 1:

4 Conclusions

If the constructivist researcher is expected "to show concretely how the actors' interaction can enhance thinking and the knowledge creation thinking" ([6]: 84), the examples prove the potential of focus groups in eliciting interaction and bringing out differences. Building a shared knowledge required participants to engage in a co-operative and creative endeavour [18]; through collaborative

behaviours and cumulative and exploratory talks, participants revealed their views and by building new meanings collectively they brought to light their differences and faced conflicts which contributed to the quality of the output [2]. As resulting from this analysis, focus groups proved to stimulate social constructivist behaviours and some features turned out to be particularly effective:

- Participants' control over the process: leaving partakers some freedom and autonomy resulted in spontaneous and natural-like interactions. Participants were free to contribute, while the researcher avoided making selective questions or forcing answers. Nevertheless, as shown in Table 1, participants' interaction was balanced and everyone engaged in the process. Moreover, partakers' control allowed them to raise topics spontaneously and this helped them to discover misunderstandings i.e. Q12.

Table 1 The following table shows some data about the focus groups

Type of organisation	FG length	Transcript size (words)	Number of utterances	Researcher generated utterances	Participants' generated utterances
Geographic data [GEO]	1 h28′	14,464	295	22.70%	G1. Group data manager: 30.1% G2. Data analyst manager: 25% G3. Data procurement manager: 22%
Telecommunication [TEL]	1 h37′	16,549	357	19.60%	T1.Regional head of security: 10.6% T2. CISO: 23.8% T3. Principal manager ICT security: 21% T4. Global privacy manager: 24.9%
Finance [FIN]	1 h33′	13,886	484	18.80%	F1. Enterprise data manager: 37.3% F2. Head of customer and market insight: 29.9% F3. Customer segment manager: 13.8%
Educational public agency [PUB]	1 h58′	18,650	334	18.50%	P1. Head of records and rights: 16.4% P2. Senior data project manager: 28.4% P3. Council solicitor: 20.3% P4. Interim head of data manager: 11.3% P5. Head of information authority[a]: 4.7%

[a]Participant was on the phone and was disconnected several times

- The context: running the focus group in the organisations' office created a natural-like setting where participants felt at ease. Reproducing a daily-like situation reduced pressure and elicited casual interactions. Such a spontaneity is also due to the groups' composition: participants were reassured by the familiar environment and felt comfortable to disclose stories and discuss even sensitive cases. The context was an incentive for confidential talks which would hardly emerge in a cross-organisational context, where participants would feel the pressures of the presence of competitors.
- The questionnaire: it induced participants to think about the topic beforehand. This helped the constructivist process as partakers reflected on the questions and made their own opinions individually. Moreover, questionnaires provide evidences of participants' pre-workshop opinions which can be compared with views emerged during the focus group to reveal the impact of the constructivist process, i.e. Q8.

These elements increased focus group efficacy by promoting participants' interaction and commitment and generated highly constructivist behaviours.

Participants' differences in approaches and needs (Q10, Q11) and the internal confusion (Q12) affected the process positively: from the study emerges that the more different participants views, the more they engaged in the meaning making process [2]. Furthermore, the workshops also increased participants' awareness and understanding of data quality concepts: by bringing together co-workers from different departments, they could have a better picture of their needs and expectations.

The role and importance of Accuracy as emerged in the preliminary research will require further analysis and a new round of focus groups is underway to improve understanding of Accuracy and allow for generalisations of results.

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Part X
Professional Skills, Certification of Curricula, On-Line Education and Communities

How Teams Can Achieve Success Using New Technologies in Order to Help Knowledge Sharing and Organizational Learning in Communities of Practice: A Case Study in Public Sector

Luigi de Bernardis, Riccardo Maiolini, and Raffaella Naggi

Abstract The aim of this paper is to explain how new technologies can contribute to overcome problems in developing of knowledge sharing in self-regulated team within a socio-technical approach. Especially knowledge sharing among Community of Practice's members can be helped adopting some simple web-based solution. This knowledge sharing, that in the past was possible only "off-line", allows to teams the spanning of temporal and special boundaries. After a review of socio-technical assumptions, we draw a model where the adoption of simple web-based technology have a mediation effect on both individual and team performances. The propositions based on this model have been tested in a recent case study. Findings confirm that adopting web-based solutions, the knowledge sharing among Communities of Practice member across the company and about solution to variances have a stronger effect on team performance.

1 Introduction

Today, one of the most interesting challenges in the organizational field of research is to try to understand how knowledge sharing can be better developed inside teams and other form on human organization, as for example the communities of practices. Considering cultural and technical barriers is always complicated to build inside organizations an efficient model that permits the sharing of information. The adoption of "on-line" systems permits the reduction of barriers and the possibility to adapt IT based solutions, as cultural models that can be useful also for the organization of human models. The socio-technical approach is useful in this paper

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because it stresses the quality of technical performance and people's work life, looking at the relationship between social and technical factors that create the conditions to gain a good level of organizational performance [1].

2 Theoretical Background and Research Question

One of the fundamental assumptions of the socio-technical model that distinguish it from the classical organizational studies derives considering teams and groups as a primary unit of analysis and not individuals. Another important aspect that highlights the relevance of the socio-technical approach is that the socio-technical design is concerned with advocacy of the direct participation of end-users (in some cases also in the design of information systems), because the high level of cohesion within the teams. The collective nature of groups, or teams, is an important element that must be considered when testing or developing researches based on the socio-technical approach. Because of this reason, the paper is based on the analysis of what we call Community of Practices (CoP).

3 Socio-technical Design Criteria

Within the socio-technical approach [2], the organization of microstructures is based on: shared target on a complete phase of a process assigned to a team; empowerment of team about tasks, resources, timing, evaluations; members control "variances" from planned, team shares solutions; multi-skills competences; free access to resources and information for team members [3]. According to Marchiori [4], the advantages of socio-technical approach are an improvement of productivity due to self-regulation, a higher efficiency due to reduced cost of control and an improvement of workers' satisfaction. Socio-technical theory pays particular attention to internal supervision and leadership at the group level and refers to it autonomously, because considering a high level of cohesion and self regulation inside groups [1].

The most cited implementation of this model took place at Volvo in Kandar (in 1974) e Uddevalla (in 1989) [5]. From the analysis of precedent works it evidences that the socio-technical design is based on the development of micro-structures with a high level of competences; the challenge is to combine the competences in an efficient way among different working groups [6]. The knowledge sharing among group members is a distinctive characteristic of socio-technical model also in the studies published by the first group of researcher of Tavistock Institute [7]. For instance in a case-study on an Indian factory Rice [8] describes teams composed by five people (two senior, two junior and a maintenance worker): the knowledge sharing among seniors and juniors is a clear design criteria.

4 Knowledge Sharing

Knowledge sharing is not only the result of a good communication or the effect of information distribution [9]. In a rigorous sense, knowledge cannot be shared, it is not like a commodity that can be passed around freely [10]. Knowledge sharing is more the result of a double sense learning process where minimums of two parts try to understand each other, acquiring and distributing knowledge. The knowledge sharing process is organized in two parts: the externalization and the internal reconstruction of information [10]. Not all the information that is externalized is important and the consequence is that the internalization varies considering the effective needs of the other subjects. The effectiveness of knowledge sharing rises from the consciousness that people want to share their information and learn from other components of the groups. For this reason, participants must contribute to the discussion inspiring and getting inspired by the externalization of different positions. In other words, the effectiveness of knowledge sharing is possible when there is an exchange of information among groups that have a learning scope and that are conscious of this scope. The Communities of Practices give an example of this kind of groups.

5 Communities of Practice (CoP)

According to Wenger [11], Communities of Practice (CoP) are social groups that help organizational learning and knowledge creation and sharing. They are based on a common initiative, an engagement to reciprocity and shared knowledge and routines. CoP can exist in an organization in the same business, among different Business Units, out of institutional boundaries, through multiple organizations. Communities of Practice born in a spontaneous way but some organizational conditions are needed.

Identity is one of the eight followings key conditions proposed by Wenger [12]. Goals (each CoP must have a shared vision of its reason of being), shared place (a real or virtual place where knowledge is created through a face-to-face interaction that technology can only make easier), group identity (definition of Who we are), personal identity (reputation among members diffused through personal profiles), shared culture (common values and defined roles), roles and behaviors (clear definition of expected behavior for each role), feedback (CoPs' life depends from participation), technology (CoPs are social building, technology helps them to better use time and spaces).

Wenger's view of CoP is strictly linked with learning that represent the moment of building of a collective identity. Wenger's learning theory is based on the followings key points: (1) a social theory of learning has to integrate the components of knowledge creation process: meaning, practice, community, identity; learning is based on the interaction between participation and reification;

(2) concentration on meaning, not only on information (3) need of continuous interaction between experience and competencies; (4) learning contributes to build our individual and collective identity.

A high stress is on participation and reification that support CoPs where participation is the social experience of belonging to the community and reification is the way to institutionalize knowledge among CoP members. Learning is therefore a social process [13]. Using CoPs for the identity regulation means "cultivate" them and let them grow. Although CoPs are essentially informal they need to be supported. Wenger and Snyder use the "cultivation" metaphor saying, "Like gardens, they respond to attention that respects their nature. You can't tug on a cornstalk to make it grow faster or taller, and you shouldn't yank a marigold out of the ground to see if it has roots. You can, however, till the soil, pull out weeds, add water during dry spells, and ensure that your plants have the proper nutrients" [14].

The knowledge sharing among team members is easier if people decide to belong to a Community of Practice and if technology makes this choice more useful. Starting from these reasons, we suggest the following research question: **How teams can achieve success using new technologies in order to help knowledge sharing in Communities of Practice**?

6 The Model and the Propositions

The socio-technical model that links team performance and people satisfaction to some organizational condition created designing the organizational micro-structure can be represented underlining the mediation effects of web-based systems adoption (Fig. 1).

In this paper, we focused on mediation the effects of web-based solutions adoption on team performances especially on the relationship with the "variance control and solution sharing".

These effects are described in the following propositions:

Proposition 1: *Adopting web-based solutions, the knowledge sharing about solution to variances has a stronger effect on team performance*.

Proposition 2: *Adopting web-based solutions, the knowledge sharing among Communities of Practice members across the company has a stronger effect on team performance*.

7 Research Context and Methodology

In order to provide empirical evidence of concrete feasibility, we describe the case of a Chamber of Commerce (Chamber of Commerce) of a local area in the south of Italy. This kind of Institution exists in each Italian sub-regional area ("*Provincia*")

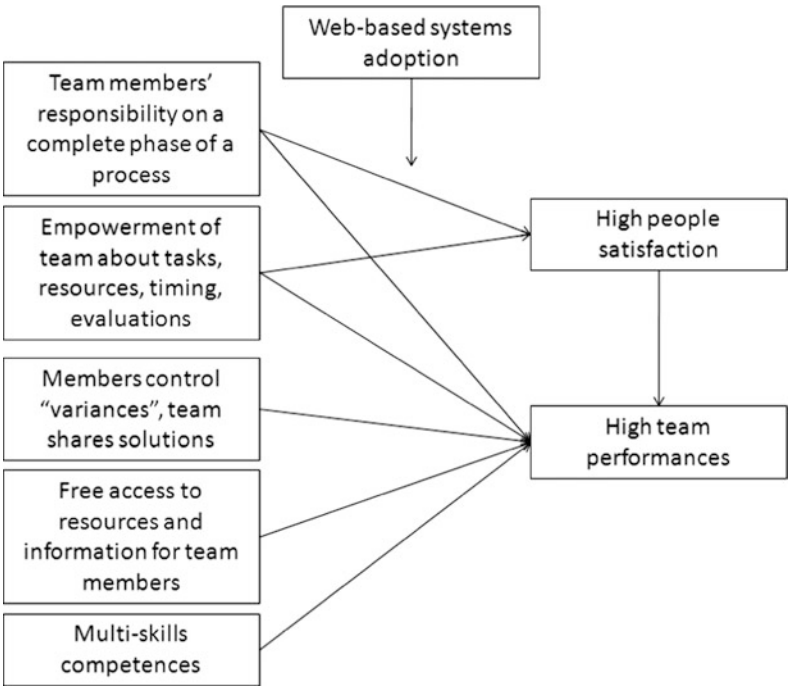

Fig. 1 The model

and it has two missions: to assure legal publicity of information and to promote local marketing. All companies must pay each year a fee based on sales. The Executive Board (called "*Giunta*") is composed by managers and shareholders elected within Owners' and Consumers' Associations. The *Registro delle Imprese* Office has the mission to assure legal publicity of information about Companies (legal office, administrators, equity owners, ...). The right book-keeping of *Registro Imprese* assures information about owners and other legal characteristic of companies involved in a business affair. *Registro Imprese* works on files that concerns two kinds of operations: Annual operations (balance sheet) and "Spot" operations (first registration, modifications, ...). There are two users categories: companies who send files and professionals who send files for companies (notary, accountant, services agencies). Actually, the case history of this paper concerns the most relevant Italian e-government project. Since 2003 companies are obliged to elaborate files using a software – FEDRA – delivered by a company (Infocamere, owned by Chambers of Commerce) and to send them (with electronic attaches) using TELEMACO software. Users have to sign files by a digital code delivered to them. Today, Chamber of Commerce manages electronic files for 100% of the company and for 70–80% of individual enterprise.

The organizational redesign has been based on socio-technical criteria [15] and it grouped small departments into four teams (two teams of five people for

collective legal entities, one of eight people for individual legal entities and one of ten people for individual craftsman).

In describing this case study, we use both interviews to 28 employees and secondary data (performance information system, internal reports).

8 Findings

In this section, we describe findings from this case study that seems to confirm that:

- Teams have been designed in order to "cultivate" a Community of Practice among members;
- Team performance and individual satisfaction increased dramatically;
- Knowledge sharing among CoP's members has been helped in both temporal and spatial dimension.

8.1 Team Members and Their Community of Practice

According to Wenger, eight organizational conditions are required in order to facilitate CoP. In the following table, we analyze how in this case study those conditions are verified [12] (Table 1).

The "cultivation" of this CoP helped knowledge sharing and organizational learning among team members.

Before the redesign, the process was separated into four phases and each of them was realized by different organizational roles. The four phases were: File acceptance, File analyze, Payment and Authorization. Performances depended on individual skills of workers that were different for each role.

After the redesign, the whole process is responsibility of an operator that receives the file by mail, analyzes, authorizes and delivers it. So, these changes in process structure required redefining workers skills. People able to work on File acceptance need to learn how to complete files' analysis. People able to complete files' analysis must learn how to select files among all sent items. The boss of Department is no longer required to authorize files but its role is transformed into a "facilitator".

8.2 Team Performance and People Satisfaction

Team performance's level depends on the percent of files without variances (unexpected events) and on standard time required to solve them. This organizational redesign reduced both percent of files without variances and on standard time

Table 1 Organizational conditions

Organizational condition required	Organizational condition verified
Goals (each CoP must have a shared vision of its reason of being)	The benefits of belonging to teams have been underlined to members and the performance targets were continuously monitored
Shared place (a real or virtual place where knowledge is created through a face-to-face interaction that technology can only make easier)	Each Friday team discuss about variances and solutions. Those solutions were posted on a simple web-mail system
Group identity (definition of Who we are)	Each group was clearly defined and people gradually build an institutional sense
Personal identity (reputation among members diffused through personal profiles)	A moderate completion arose among people in order to contribute to team success. For instance, someone decided to work early in the morning in order to choose the easier files
Shared culture (common values and defined roles)	The new role of operator was clear to people
Roles and behaviors (clear definition of expected behavior for each role)	The new role of boss as a facilitator was difficult to be understood. The boss doesn't authorize files but he doesn't still support operators
Feedback (CoPs' life depends from participation)	The weekly meeting was an opportunity to propose solutions and clarify problems
Technology (CoPs are social building, technology helps them to better use time and spaces)	Technology help to reduce the percent of files with variances (unexpected events) and the standard time required to solve them

Table 2 Agreement on organizational choices

Statement	Percentage of agreement (%)
We need a repository for our knowledge	100
We want to be informed about our performance	100
We need a common interpretation of procedures	99
I prefer to manage a complete process	82
It is better if customer know who manages his issue but all team member should have access to every files	82
My boss should care about my professional development	73

required to solve them. Anyway, it was possible using simple web-based technology. Findings show higher performances: the reduction of backlog of files to be completed in 2 months is about 13% (from 1,805 to 1,570).

According to the socio-technical approach, performance at team level depends also on people satisfaction. As shown above, the organizational redesign assigns a complete phase of a process to an organizational role. This choice can improve the individual satisfaction because people make sense of their own responsibility. We verified people satisfaction using a questionnaire that provides a high level of agreement about organizational choices (see Table 2).

8.3 Relationships Between Knowledge Sharing and New Technology Adoption

Proposition 1 *states that, adopting web-based solutions, the knowledge sharing about solution to variances has a stronger effect on team performance.*

The average time required to solve variances (unexpected events) represents the indicator used to measure team performance. It has been reduced, in this case-study, introducing a simple web-based repository that uses the web-mail application. Before the redesign, when the operator got a variance tried to remember how he solved that problem in the past, or asked to a colleague or asked to his boss how to do that. The new design created a mail address "team A" that received all variance notice from operators. Each operator can now give his advices and the boss posts the "shared and right" solution using that address. In this way, the percent of files without variances (unexpected events) has been reduced because that repository is an "*open operational guide*" where operators can find solutions for variances.

Proposition 2 *states that, adopting web-based solutions, the knowledge sharing among Communities of Practice members across the company has a stronger effect on team performance. In order to facilitate the searching activity in solutions database, organizational designers defined free access to information and a common syntax. All team members can access to e-mail posted by members of every team. This redundancy creates an organizational climate open to cooperation but it required a support in selecting information. Therefore, a common syntax has been defined by the team, using the subject to indicate the problem. In this way, the operator that has to solve a variance can find the shared solution searching among the sent mail (if he is seeking the shared solution) or among received mail with that subject (if he is interested in peer advices).*

As we described above, the adoption of this simple web-based solution, help teams in improving dramatically their performance. So, the knowledge sharing among Communities of Practice member across the company and about solution to variances has now a stronger effect on team performance, as argued in proposition 1 and 2.

9 Discussion and Conclusions

This case-study provides evidence of how new technology adoption can amplify the effects of knowledge sharing on team performance. We argue that new technologies help to overcame some problems that limited in the past the effectiveness of socio-technical approach.

Nevertheless, we underline some limitation of these findings. First of all, both the sharing of target on complete phases and the empowerment of team member cannot be helped by technologies. Knowledge sharing is not spontaneous and uninhibited [5] and, stressing too much people to share, is not always a good way

to develop sharing behaviors [16]. The naturalness cannot be combined with complex organizational models whit a strong tradition in terms of hierarchy and classical organizational approaches: the adoption of technological solution, in the direction to amplify knowledge sharing, can be a menace to power and legitimacy among groups that seems the openness as a strong way to modify their attitudes. In addition, the development of a Community of Practice is a social process that cannot be forced but that need favorable organization conditions to success.

Future study should analyze the mediation effects of web-based technologies adoption on others antecedents of team performance within the socio-technical approach to organizational innovation.

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Analysis of Serious Games Implementation for Project Management Courses

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Abstract Previous researches in pedagogy and project management have already underlined the positive contribution of serious games on project management courses. However, the empirical outcome of their studies has not been translated yet into functional and technical specifications for "serious games" designers. Our study aims at obtaining a set of technical and functional design guidelines for serious game scenario editors to be used in large classes of project management students. We have conceived a framework to assess the influence of different serious games components over student's perceived acquired competency. Such frameworks will allow us to develop a software module for reflective learning, which is meant to extend theory of serious games design.

1 Introduction

Information system (IS) project management courses are known to be challenging to conceive, since most of the skills required for project managers cannot be achieved *ex cathedra*. Problems in IS are characterized by incomplete, contradictory and changing requirements, and solutions are often difficult to recognize because of complex interdependencies. This leads to an educational dilemma in teaching such problems because a rich background of knowledge and intuition are needed for effective problem-solving. Hence complexity is added rather than reduced with increased understanding of the problem [2].

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As a consequence of the large number of failed projects a strong challenge to traditional methods of project management based on universal best practices (such as the Project Management Institute) emerges in the academic world and among practitioners [8, 14]. Traditional approaches are part of a very instrumental and functionalist vision of promoting project management principles that do not reflect the reality of the projects, which is ambiguous, fragmented, complex, socio-technical built, and with a strong political character. Therefore, project management is a discipline that requires knowledge and reflective practice that allows players to lead the project team in an emergent way. This kind of frameworks requires a high degree of interaction between teacher and students. But face-to-face exchanges are hard to manage when the number of students is greater than 40 [16].

Game-based learning (also known as serious games) uses simulation to allow students to actively acquire competences required to solve problems. Hence game-based learning scenarios might be the solution to introduce large classes to IS project management since they are known to have an effect on student's self-efficacy as well as acquisition and retention of declarative and procedural knowledge [15]. Yet little interest has been given so far on how to design a scenario editor to support an IS project management course by means of game-based learning. In software engineering courses, game-based simulations are far less used than other types of educational approaches (e.g. industrial partnership or team learning) and they lack to incorporate model-based instruction and reflective learning [10]. We expect a similar trend in IS project management courses. Therefore our research question is:

How to design a game-based learning scenario editor to support an information system project management course for more than forty students?

By adopting a design science methodology this study aims at obtaining a framework to design game-based learning scenario editors to enhances project management competences for students attending the course. Such framework is induced by testing different software components to assess their influences of students' acquired competency. Therefore the creation of a model to assess the software components described in this paper is the initial step of such study. We start here by assessing the gaps in the existing literature and by deriving a conceptual model in the next section. The third section illustrates the methodology we adopt to test our conceptual model and to assess the pedagogical effect of different software tools. The results of a first assessment performed in one of these teaching courses are presented in the fourth section as example. The paper ends by discussing the results obtained and by highlighting the next steps of our study.

2 Literature Review

This section briefly assesses the state of the art in game-based learning for project management course. We are looking for concrete evidences regarding the link between game-based learning and performance of the IS project management course. Hence we use the guidelines of Okoli and Schabram [11] for a protocol to

assess the existing literature. For sake of simplicity we decide to limit our Google Scholar search to articles published in the period 2005–2010. Using the selected keywords ("project management"; "information systems"; "game-based learning") we obtain 59 results, among which 21 are cited by at least another paper and accessible to us. Since we are interested in articles that have assessed the performance of the serious game analysed, we skim our set of articles to only a few. For those papers we perform forward and backward analysis, i.e. we assess the papers that cite/are cited by them. At the end we obtain two streams of research: ex-ante evaluation and ex-post evaluation. Since we wish to connect these two stream of research we derive three concepts: the *student's perceived acquired competency* (1), which is the set of measured capabilities that the student acquires in class; the *perception of the serious game design* (2), which we consider here as the set of features that the game-based learning software possesses to empower the teacher; the *student's engagement* (3), i.e. the student's will to take part actively to the game-based learning experience.

The first stream of research focuses on the ex ante evaluation of the effect that serious game design has on student's perceived acquired competency. This group of papers claims that while traditional methods are based on an instructivist methodology, game-based learning provides a constructivist learning environment where learners can practice the formulation of requirements specification through requirements elicitation and learning by doing [6]. In addition to that game-based learning provides a challenging and complex real-world environment within which to apply their theoretical knowledge to overcome difficulties in dealing with ambiguity and vagueness, while developing self-confidence and increased motivation [4].

The second stream of research focuses on the ex post evaluation of the effect that student's engagement having played the serious game has on the student's perceived acquired competency. Researchers collect student's suggestions for game changes [3, 13] and perceived competences needed [5, 9, 13, 17].

To link these two streams of research we suggest considering the student's engagement as a mediator between serious game design and student's perceived acquired competency. At the end we derive the following set of hypotheses: **(H1) the perception of the serious game design influence the student's perceived acquired competency; (H2) the student's engagement influences the student's perceived acquired competency; (H3) the perception of the serious game design influences the student's engagement**.

In the next section we illustrate how we intend to design an experiment to test our hypotheses.

3 Methodology

In this section we briefly describe the methodology we use to perform our experiment. Design science seeks for outcomes that can be relevant for practitioners and that have been obtained in a rigorous way. The purpose in this kind of study is

usefulness rather than truth. Although design science has been used since many decades, it has been officially accepted in information system since the Management Information System Quarterly article of Hevner et al. [7]. In our study and in this paper we adopt the methodology suggested by Peffers et al. [12], which proposes a process composed of six steps. Following the first step we clearly identify our problem, using the literature review, as summarized by our research question.

The second step of the methodology identifies the objectives of the solution. In this sense, in the previous section we have identified two gaps in the literature: the first one concerns the link among *ex ante* and *ex post* evaluation criteria, whereas the second one regards the use of reflective learning by means of serious games. Thus our study should start by conceiving a framework to assess the correlation among ex ante and ex post evaluation criteria. Then we will move towards the development of an additional module for reflective learning over the student's achieved skills and towards the assessment of its added value.

Design and development: In the third step of the methodology the design and development of the new component occurs. Yet in the first part of our study described here, the development is minimal since we have decided to reuse an existing serious game. The selected platform to test our assessment framework is a game-based learning scenario editor called Albasim. The main reason underlying the choice of such platform is its large set of existing features and the direct link that the authors have with the development team of the software. This is going to be very useful during the second part of the study, when we will be developing an additional component. Figure 1 illustrates the dashboard used by the game players by means of a web browser. On the top right corner there are the key performance indicators. On the top left corner of the screen the four stages of the game are illustrated: the players start by the project initiation (1), then they move on by planning the project (2) and executing it (3) before closing it (4). The central part of the screen is multifunctional, whereas the right side of the central screen allows the player to manage resources and task, and to read e-mails send by the central system. For what concerns the reflective learning, the system does not have a dedicated feature, leaving to the teachers the task to arrange students' presentations to share lessons learned, as explained in the following section.

The pedagogical scenario implemented: The fourth step of the methodology of Peffers et al. [12] requires a demonstration of the artefact. In our case the game requires two 4-h sessions, for a total of eight class hours over 2 weeks. Before the first session the students receive the software manual and the business case. At the beginning of the first session students get familiar with the idea of serious game and to the functionalities of the software (e.g. the dashboard). Then the students are asked to gather in group and to collect and process information own by the different fictive players in the game, in order to deliver a project proposal to be validated with the client (i.e. the professor). During the rest of the week the students are supposed to work in group to complete the assignment and send the improved project proposal to the professor, who choses two proposals among them. At the beginning of the second game session the chosen groups are asked to

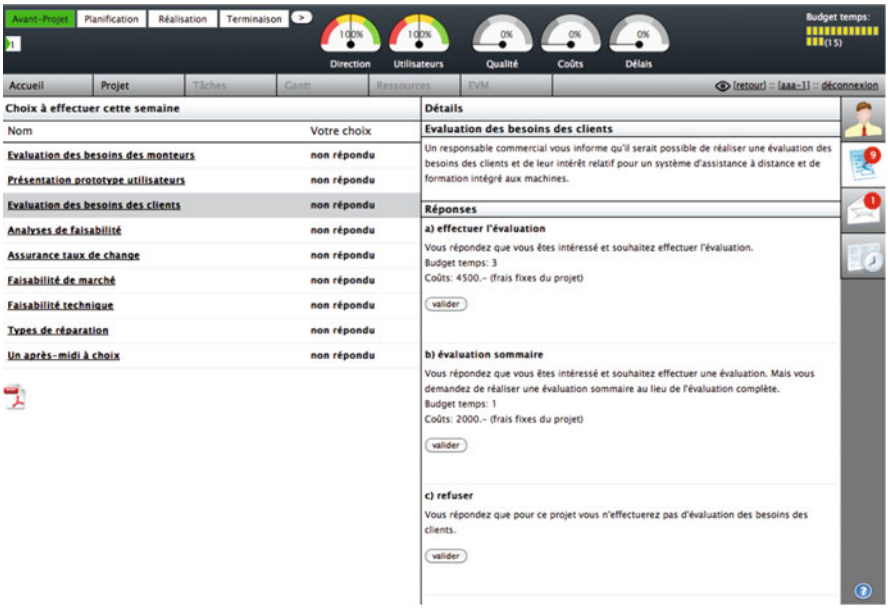

Fig. 1 Dashboard of Albasim (Source: www.albasim.com)

do a short presentation of their project proposal to the rest of the class. Once two student groups have presented the teachers gives them a constructive feedback and add some remarks about the overall performance of the other groups (best and worst practices). After the presentations the teacher recalls to the class key theoretical concepts regarding project planning. Then the students are asked to work in group to make and to justify their planning decisions, while taking into account a set of constraints (time, cost, quality, resources availability and risks). In the rest of the week student groups are ask to finalize the WorkBreakdown Structure, Program Evaluation and Review Technique and Gantt diagrams, together with cost estimations.

Evaluation: the fifth step of the methodology concerns the evaluation of the artifact. To operationalize our constructs we reuse existing items from the two streams of literature whenever possible and we obtain a set of five-point Likert scale items, which are meant to be collected by questionnaire to be handed once the students have completed the assignments of the second game session. For the student's perceived acquired competency we derive four items inspired by Zapata [17] and Mawdesley et al. [9]. For the serious game design we implement seven items inspired by Hainey and Connolly [6] and de Freitas et al. [4]. For the student's engagement we use seven items inspired by Gresse von Wangenheim et al. [5] and Dantas et al. [3]. A set of open questions has been collected as well, but their answers will be not presented here for sake of brevity.

4 Current Results

We have tested the serious game with a sample of bachelor students enrolled in a project management course with a special focus on information systems. We have collected students' perception by means of an electronic survey. We have obtained 74 answers out of the total of 104 students. Although limited in size, we consider this sample as representative for our study and a good starting point to perform statistical analysis using Stata 11. We started by performing the Cronbach's alpha test over each set of items to measure how well each set of items was representing the concepts. A Cronbach's alpha value of 1.00 would be optimal, whereas a value below 0.70 should be rejected. In our case we obtained the following results: acquired competency = 0.79; design = 0.80; engagement = 0.77.

While testing the causality effect we have performed seemingly unrelated regressions among the three constructs obtained by performing the average of each set of items (i.e. tau-equivalent factor loadings). In other words we have asked Stata 11 to tests all the regressions at once.

Figure 2 represents the results that we obtained and it shows that serious game design has also a direct effect over student's acquired competencies, which is statistically significant ($p < 0.01$). It also appears that the student's engagement has an effect over the student's perceived acquired competency that is statistically significant ($p < 0.05$). Finally the serious game design has an effect over the student's engagement that is statistically significant ($p < 0.01$). **Thus all hypotheses are confirmed**.

The direct and indirect effect of serious game design explains almost 50% of student's perceived acquired competency variance among students ($R^2 = 0.47$). This is to say that none of the two effects should be neglected. In addition to that the student's engagement variability among students is largely explained by serious game design ($R^2 = 0.56$), which leads us to believe this model has a good explanatory power. We have also controlled for the effect of sex and nationality and the results were not statistically relevant.

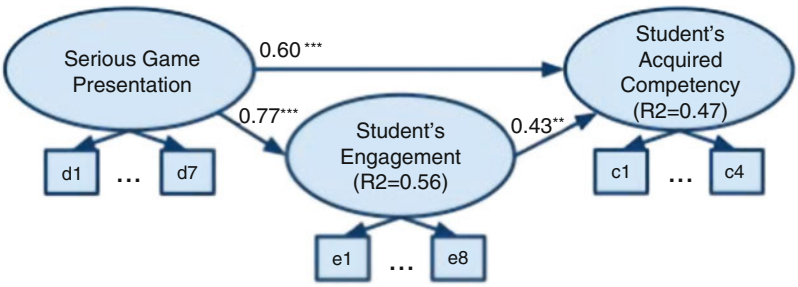

Fig. 2 Results of the preliminary test

5 Conclusions and Further Works

We start this section by recalling our research question: How to design a game-based learning scenario editor to support an information system project management course for more than 40 students? In this paper we present our framework to link ex ante and ex post evaluation criteria to assess a game-based learning editor. Now that the framework is in place we can develop the reflective learning module and we can assess its added value by using such module on a subset of the overall students' sample, treating the rest of the class as control group. The results we obtained so far lead us to believe that serious game design has a direct and indirect effect over student's perceived acquired competency, which is mediated by student's engagement. The module we wish to develop has a graphical interface that allows the scenario designer to represent the scenario as a graph. The module is expected to be able to mine the log of student groups' actions and to represent them under the shape of graphs, in order to benchmark the different groups' experience.

In the next iteration we intend to have students groups playing different versions of the same game, whereas the student's acquired competency will be tested with a set of questions in the final exam of the course. These improvements should increase the reliability of our results against endogeneity due to common method variance [1].

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New Frontiers of Managerial Training: The LiVES Project

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Abstract The evolution of the Internet allowed the Web to become, among the different media, the most global, interactive and dynamic medium to share information. Therefore, in the last decades, e-Learning has been widely used not only in the academic community, but also in the business sector. Within this context, thanks to their own competences, people can develop specific characteristics which may provide a competitive advantage for their organizations. The development and use of new technologies for the creation of three-dimensional (3D) Virtual Worlds set new challenges and enlarge the very idea of 'learning environment'. This paper aims at investigating the characteristics of training activities directed at the managerial class, in such a way as to increase their efficacy; it also analyses how the use of specific innovative technologies may be an effective solution.

1 Introduction

The evolution of the Internet allowed the Web to become, among the different media, the most global, interactive and dynamic medium to share information. Therefore, in the last decades, e-Learning has been widely used not only in the academic community, but also in the corporate environment [1, 2]. E-Learning allows to distribute course-related contents through any means of communication [3], directly via the Internet or, more specifically, via an intranet, as well as via satellite transmission, interactive TV or audio/video media (tape, CD-Rom) [4]. Moreover, in literature, e-Learning is often called in different ways, such as: Web-Based Learning (WBL), Internet-Based Training (IBT), Advanced Distributed

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Learning (ADL), Web-Based Instruction (WBI), Online Learning (OL) and Open/Flexible Learning (OFL) [5].

E-Learning introduces a new learning method, which is different from the traditional paradigm of the "Bucket Theory". According to this theory, the mind of the learner is a "passive container", inside which the lecturer deposits part of his knowledge, as its sole owner [6]. Indeed, e-Learning is able to change teaching, by changing communication into a team work, an activity based on peer interaction and cooperation. The lecturer is no longer the key actor, and a new community is developed, which includes lecturers, tutors and learners, acting as a "Knowledge Building Community" [7–10].

Within the business/administration sector, thanks to their own competences, people can develop specific characteristics which may provide a competitive advantage for their organizations. Updating competences and transferring them to other members of the same organization might be the starting point [11]. Corporate managers can guarantee business success only by developing and fostering core competences [12], i.e., those characteristics which enhance performance, taking it to a higher level [13].

The real source of competitive advantage lies in the ability of the management to consolidate technologies and productive capacity into competences that allow each business to quickly adapt to the changing market opportunities [14]. Indeed, the competence is a specific characteristic of an individual; it is connected to an effective or superior performance within a specific task. It can be measured on the basis of pre-established criteria [13]. Therefore, training can refer to a deep and global activity which produces an intellectual, physical and moral change within the individual. Training can be an effective tool in the pursuit and develop of such competences [15]. Some authors think that e-Learning is a suitable answer to corporate needs, and to managers needs in particular, in order to manage competence update and transfer [16].

This paper aims at investigating which characteristics managerial training shall have, in order to increase its efficacy; it also analyses how the use of specific innovative technologies may be an effective solution. These are the staring points for the definition of "meta-requirements", in compliance with the Design Research model of Walls et al. [17]. The next paragraph provides a taxonomy of e-Learning models, as well as a description of the changes produced in this field by technological innovation. According to Walls et al., these contents will contribute to the definition of the so called "Kernel Theories".

Moreover, a research project will be described: the LiVES (Learning in Virtual Extended Space) project, which aims at creating a technologically innovative environment, based on 3D virtual reality, in which providing training courses for the managerial class. This project will be taken as a case to use in the design research process.

2 E-Learning and Its Models

Generally speaking, learning is made up of models and strategies [18] which include the characteristics of how the learner builds the meaning of the concepts put forward [19]. With reference to e-Learning, the three main model, with their different learning characteristics and methods, are described below [20]:

- OPEN or FLEXIBLE LEARNING: This approach describes distance learning; emphasis moves from the curriculum to the learner's needs, by creating an immediate and available learning environment (here and now) [21]. It is a "student-centered" model, focusing on learning rather than teaching.
- DISTRIBUTED LEARNING: This approach is based on the possibility to supply training at any time, everywhere and in different places, combining also different technologies [22]. Within this contest, learners can complete courses and study programs at home or at the workplace, by communicating with lecturers and with colleagues via e-mail, forum, videoconference and other IT-based forms of communication.
- LEARNING COMMUNITIES: A learning community is a group of people supporting other people in their learning activities, by working together on projects, learning from each other, through a collective social-cultural experience, where participation leads to learn new concepts [23, 24]. Learning communities provide the opportunity to make experiences on interdisciplinary topics, by promoting connections among students, between students and lecturers and among the different subjects [25]. Learning communities are informal learning environments, where emphasis shifts from teaching to learning.

The term "learning community" includes any social network which unites people in order to share knowledge; for this reason, it is better to talk about "Communities Of Practice" Or "Knowledge Building Communities" [20], here described:

- COMMUNITIES OF PRACTICE: Groups of people who are informally united by sharing experiences and passion for a common task [26]. Such communities are common in the business/administration sector, where knowledge is seen as an intellectual capital [27].
- KNOWLEDGE BUILDING COMMUNITIES: Learning communities where communication is perceived as a transformation (meaning a new learning experience) through knowledge sharing and building. Participants share a common goal to build and share knowledge through activities, projects and discussions, where the lecturer/tutor is an active participant [28].

The following picture describes the above mentioned three models, highlighting the different characteristics and their correlation [29] (Fig. 1).

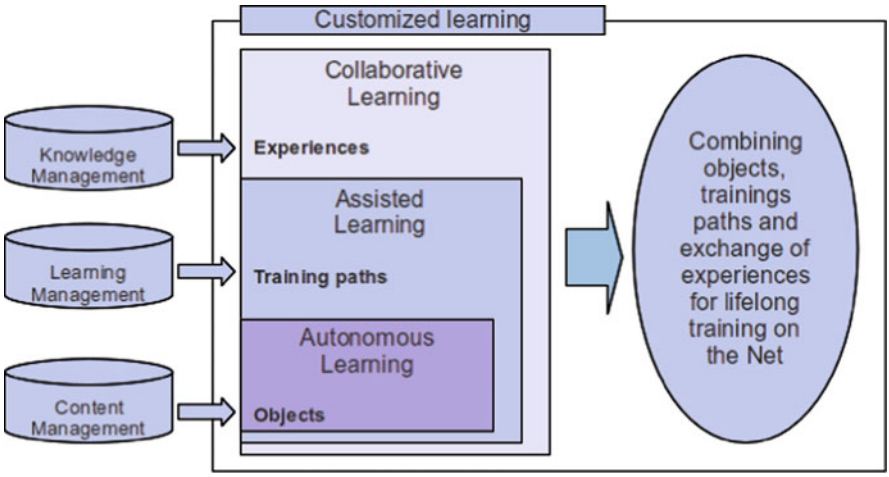

Fig. 1 E-learning models (Based on Salis et al. [29])

3 Collaborative Learning in the 3D Virtual World

In the last years, technological innovation contributed to the creation of new methods of interaction, affecting not only education, but also setting new challenges and enlarging the very idea of "learning environment" [30]. In particular, the development and use of technologies that allow the creation of 3D virtual words is extremely important. These can be defined as a set of nodes (PC desktops) connected in a network, where users move and interact in a 3D environment [30]. Within the 3D environment, users are represented by an avatar, thanks to which they can interact with other avatars (users) and with the environment. The most popular 3D platform are: Active Worlds, OnLive! Traveler, Adobe Atmosphere, OpenSim, and the perhaps better known SecondLife. Each of them has three different functions: an interactive 3D environment, the use of avatars for representing users and an interactive chat-room to allow users to communicate among each other.

Even if 3D virtual words are still in evolution, they provide communication opportunities supported by text-based/chat-based applications, such as Multiple User Domains (MUD) Object Oriented (MUD Object Oriented, MOO). Usually, these latter support constructive learning, and allow the development of Knowledge Building Communities [31] by promoting interactive learning, cooperation and commitment opportunities in space and time, both within and among classes [32].

According to Monahan [33], 3D virtual worlds show the shift from "text-based online learning environment" to "immersive platforms". Unlike MOOs, they provide 3D visual representations of space and allow learners to interact with information from their own angle, supporting learning activities based on constructivism

[34–36]. Indeed, Winn [37] thinks that, during a traditional course, information is often provided like a "third person symbolic experience". On the contrary, the most effective way to learn is through a direct experience. According to Winn [37], 3D virtual reality can contribute to fill the gap between experiential learning and the symbolic representation of information.

4 Innovative Methods of Managerial Training: LiVES Project

On the basis of the above sections, the following three remarks can be obtained:

1. Updating and transferring managerial competences can lead to a competitive advantage for the organization;
2. E-learning seems to be the method that best meets training needs of managers and of those working in the business and administration sector;
3. The experience within 3D virtual words allows a more effective learning since it is based on direct experience.

On the basis of these assumptions, the requirements of the LiVES research project were defined. LiVES (Learning in Virtual Extended Spaces) studies the potential and the implementation methods of 3D platforms within lifelong vocational training. This project aims at defining, creating, integrating and experimenting an innovative platform based on an interactive virtual class, where professionals and/or students can discuss, share experiences, and train. In particular, the system that will be created shall meet the following requirements:

- Allowing students and professionals to actively take part to training activities in a more natural, effective and pleasant way;
- Stimulate social interaction through an interactive information/communication flow among users in real time, even when users are in different places;
- Improving the approach to problem-solving through innovative tests which are able to make learning experiences similar to real practice, as much as possible;
- Supporting, protecting, respecting and stimulating the specific potential of every person, such as originality and creativity in the professional practice through three-dimensional graphics and interactive objects;
- Enlarging access to lifelong training also to professionals with less mobility (e.g., disabled people).

On the basis of the above requirements, the main activities involved in platform creation and integration will be the following:

- Selecting a suitable 3D platform for the training activities of the project. The selection criteria will be the following, but not limited to: availability, diffusion, usability, use in documented training activities, easy management.
- Creating virtual environments within the selected platform, where training activities shall take place. Specific areas for students and tutors will be created,

as well as common areas for free discussions. This virtual environments shall be a reference for similar future training activities.
- Creation of software tools useful for training activities. Activities shall be supported by avatars and especially provided software tools.

The platform will be experimented during training activities for managers working in the IT sector, in order to minimize problems connected to the interaction with innovative technologies. In this way, the platform will be provided with a special environment where specific training problems may be analyzed and a participating approach will be guaranteed, aiming at the platform development.

5 Conclusions and Future Research Steps

Following one of the models available in the design research, this paper analyzes the problem of managerial training and how innovative forms of e-Learning may support an effective training activity. On the basis of the literature review (Kernel Theories), the meta-requirements for a suitable learning environment for managerial training were defined. This led to the proposal of a research project which includes, among its goals, the creation of a 3D platform to support training within this sector.

The limitation of this paper is that the LiVES project is still underway, therefore, no empirical study was carried out on the problems that might emerge in the phases after requirement identification. However, this provides us the opportunity to further develop this research, on the basis of the evolution of the project phases.

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Organizational Aspects and Governance of a Learning Environment Aimed at a Common Curricula for European Senior Civil Servants

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Abstract The purpose of this work is to investigate the benefits of the introduction of a specific online environment in the training process of European civil servants. It includes the final results and the organisational impact of a training course combining 24 h of e-learning courses and 30 h (1 week) of intensive in-class courses. For each module, the e-learning part provided general training contents to enhance participants background required for in-class sessions. Through the designed learning activities and the analysed project results we want to demonstrate the effectiveness of the overall system (tasks, contents and organizational aspects) and promote e-learning adoption in the European Public Administration field. With a view to stimulating co-operation and the exchange of experts' experience and best practices in Europe, the goal is to identify and test an innovative model of trans-national collaborative learning environment supported by European schools, Public Administration Institutes and e-learning experts.

1 Introduction

This work tries to investigate the benefits of the introduction of e-learning and specific methodologies in a training process for European civil servants. It describes the final results and the organisational impact of a course combining 1 month of e-learning courses and 1 week of in-class courses. For each didactic module, the

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e-learning phase provided general training contents to enforce participants background necessary for in-class sessions. If we think about life-long training for civil servants, one of the most important points is to find a learning method which would work well for this kind of user [1]. Learning is not a matter of simply adding one piece of knowledge to another. If we design learning activities on a graph with time on one axis and achievement on the other, we will see that learning doesn't take place as a simple curve [2]. It is required to fully improve the ability and quality of civil servants and make them uncorrupted, self-disciplined and professional, related to governmental regulations state at civil servants, provincial and ministerial, department and bureau and county and section levels. To obtain these skills, often they should participate to training activities as schools of administration, executive academies or other training organizations approved by the human resource offices at the department and bureau level or above. An analysis of the main drivers to introduce a real change in the Public Administration (PA) context was undertaken. We looked at political, economic, social, legal, and environmental contexts of Public Administration to develop and implement an accurate training strategy [5, 6]. The following factors were identified to better develop the training activities and the right contents:

Political factors:

- Commitment to create a modern European public administration to support social and economic development;
- New relationships established between national civil servants in EU context;
- Reform and institution building of which training and development is an important sub-component;
- Absence of a civil servant wide human resource strategy and policy as a framework for training and development.

Economic factors:

- Resource constraints owing to latest EU macro-economic situation;
- An expected cut of national and European funds.

Social factors:

- Motivation of people for self-development;
- Opportunities for many civil servants to meet international best practices;
- Implementing a real change management;
- Lack of embedded management culture in Public Administrations;
- Transferability of several PA approaches to the other situations;
- Knowledge and individual experiences exchange between civil servants;
- Low status and acceptability of the current training opportunities.

Legal and environmental factors:

- Traditions of a law based approach to PA;
- Primacy of the regulation to determine PA competence;
- Lack of dedicated training infrastructure.

For the project previously has been implemented a pilot to demonstrate the effectiveness of the overall system and to promote the e-learning adoption in the EU Public Administration field [3]. After 1 year, the project was concluded and the results analysed. With a view to stimulating co-operation and the exchange of best practices in Europe, its purpose is to build and test an innovative model of trans-national collaborative learning, thanks to the active involvement of European schools.

2 Project Goals and Objectives

The project ESCS is an initiative financed by the Italian government and aims at developing shared knowledge, key skills and competences among middle rank civil servants of EU Public Administrations in order to increase and improve collaboration and civil servants' mobility within the EU Member States. It is an initiative implemented within the framework of the Agreement entitled "The promotion of coordinated initiatives to implement the Lisbon 2,000 objectives for training senior civil servants from the Italian State and other European Union countries" [4] and it followed the positive experience of the Patent Project funded by the Leonardo da Vinci programme of the European Commission and aimed at shaping a European shared framework for the training of senior civil servants in order to promote mobility and mutual understanding. The goal of the project is to develop shared knowledge, key skills and competences among middle rank civil servants of National Public Administrations in order to increase and improve collaboration and civil servants mobility within the European Union countries. The partners are some of the most important European schools and institutions such as:

- Bundesakademie für öffentliche Verwaltung im Bundesministerium des Innern – BAköV (Germany);
- Ecole Nationale d'Administration – ENA (France);
- Kormányzati Személyügyi Szolgáltató és Közigazgatási Képzési Központ – KSZK (Government Centre for Public Administration and Human Resource Services) (Hungary);
- Krajowa Szkola Administracji Publicznej – KSAP (Poland);
- National School of Government (UK).
- National School of Public Administration – EKDDA (Greece);
- Scuola Superiore della Pubblica Amministrazione – SSPA (Italy);
- Université Paris 1 Panthéon-Sorbonne (France);

On the basis of the "scientific curriculum of the European senior civil servant", developed by a scientific committee of experts, a training programme for civil servants of EU member countries was implemented and tested in a class composed of 45 participants from different partner countries. The class was composed of senior middle-rank civil servants from European national public administrations

wishing to sign up for mobility initiatives within European Union countries. The training programme has been defined to reach the following learning outcomes:

- Sharing knowledge, skills and competences to cooperate with EU colleagues;
- Analysing each country specific knowledge;
- Each module was taught by the partner school which has developed it.

Training was delivered in English by lecturers and experts from different European backgrounds. A final certificate recognised by all the partner Schools was released to the participants. SSPA adopted a basic e-learning platform and a blended learning method. Both e-learning and traditional classroom have their respective advantages and disadvantages. The civil servant training covers both basic theoretical contents and case studies, and is suitable for a blended learning.

3 Training Methodology Adopted

The choice to adopt a blended approach, based on in-class training and e-learning, gave extremely positive and efficient results and was highly rated by participants, who were invited to assess the quality of the training through *ex ante*, *in itinere* and *ex post* evaluation forms. The results of these evaluations provided a very useful basis to improve and implement other ESCS courses in the future. After making a careful and through research, the author determined the processes of this specific experience for civil servants, as shown in the Fig. 1.

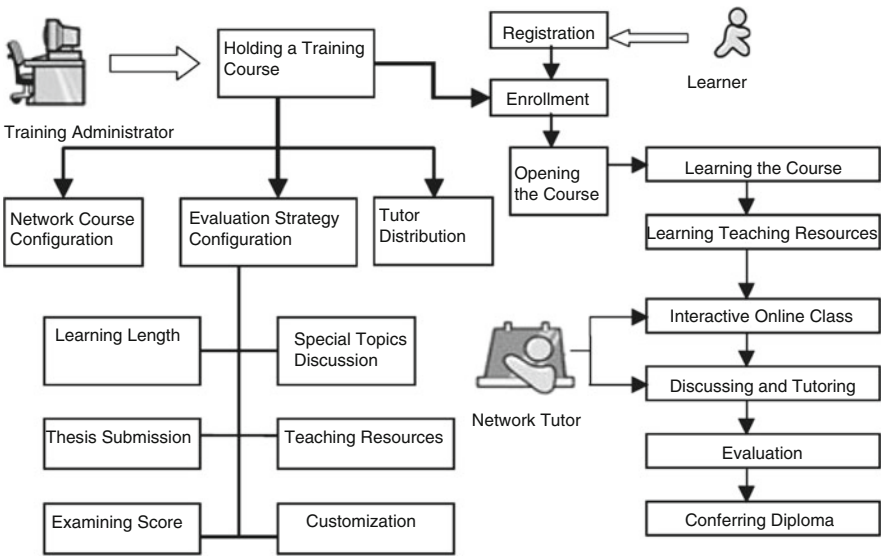

Fig. 1 Process chart of the platform for EU civil servants

According to the previous processes, the system consists briefly of four subsystems: courses, teaching administration, tutoring and system management. To fulfil these objectives, we tried to design and implement a training model of teaching, transferable and repeatable in different European contexts, in order to enable PA civil servants to acquire the shared knowledge and the necessary country-specific background to start working in a Public Administration in another EU member State. A final certificate, recognised by the project partners through a memorandum of understanding, and bearing their respective logo, was delivered at the end of the course by the Italian Minister for Reform and Innovation in Public Administration. The e-learning part was delivered through a platform and accessible through the SSPA website (http://www.sspa.it/?p=2583). The open source platform adopted for this purpose was based on the Learning Management System named "Moodle" as showed in Fig. 2.

With only a few modifications, this platform can become even more functional and adapted to the participants' needs. The e-learning contents included mainly text material. Before the beginning of the course, the tutor sent to each participant an e-mail containing the access ID and password as well as all the necessary instructions for accessing the platform. Users accounts were created by the platform administrator for participants, lecturers, staff and tutors. The language chosen for communications between participants, lecturers and tutors was English. The tutor followed the progresses made by each participant in the e-learning course and maintained direct and regular contacts with them by e-mail. A pre-assessment quiz, an intermediate questionnaire and a final test were prepared in order to assess participants knowledge before, during and after the e-learning. The tests were performed on-line by participants and a forum for each module was created to enable them to interact with the tutor and the teaching staff on specific contents. The

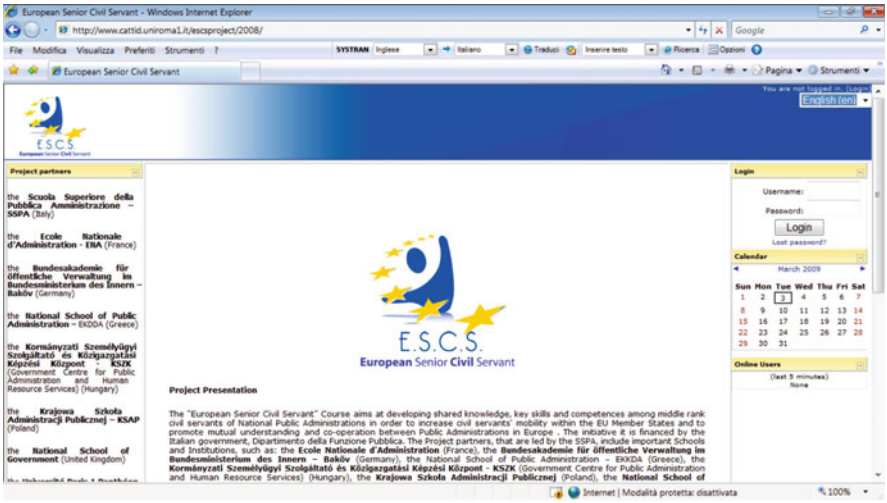

Fig. 2 The e-learning platform for civil servants

platform included also three additional forum: a forum café, a technical forum and a news forum where additional useful information can be published. From the evaluation questionnaires, it emerged that the e-learning contents, were rated as efficient, exhaustive, relevant and tuned with the in-class contents. Following the blended learning approach, the in-class part of the course provided a more in-depth insight of the topics tackled in the e-learning part. A third level included country specific parts. For these sessions, participants were divided into three groups in different classrooms. In-class training was organised into 6-h teaching days. Participants were asked to fill-in evaluation questionnaires at the end of each day and at the end of the course in order to receive an exhaustive feedback on the overall course organisation and the knowledge acquired.

4 Project Improvements

As shown by the overall active participation during the implementation of the course, the selection procedure proved to be valid. Possible improvements in this respect may include for instance a more complete information on the course and selection procedures (indicating clearly the selection criteria) through the SSPA website. Moreover, we want to examine the possibility to adopt the same procedure used by SSPA. It was possible to identify [7] some suggestions for improving the learning methods such as:

- The e-learning contents could be completed with other material based on different media (links to relevant websites presenting statistics or economic data of interest, slides or data to be examined during the in-class sessions, videos presenting in-depth analysis or practical cases) available in streaming or download mode. The resources needed in this respect are quite reasonable for very good results in terms of quality, processing and connection times;
- An easier way to contact the tutor for a more immediate interaction (in the current version, the tutor can be contacted only by e-mail);
- Extension of the e-learning course length to 2 months. Many participants claimed in their evaluation questionnaires they need more time to follow thoroughly and carefully the e-learning modules;
- Introduction of more immediate communication tools in order to establish a direct line between tutor, participants, staff and lecturers (chat, wiki, etc.) and obtain a major involvement (full immersion);
- Introduction of a scheduling function or “to do list” in order to provide information related to training activities or deepening;
- Improvement of the monitoring and reporting features (progress report) in order to provide participants with a detailed list of topics/lessons and the scores obtained in tests and exercises;
- Elimination of the automatic transfer of messages from the technical forum to the whole list of platform users (spam effect).

- Daily in-class training could be re-organised in order to leave more time in the afternoon for study and social activities;
- Splitting the group of participants into not country-specific sub-groups left a sense of incompleteness to some participants, who expressed the need to have a final plenary session for the general review of topics.

Participants appreciated the practical approach adopted as well as the use of case studies, exercises, role playing and team working activities. We tried to reach a correct mix of objectives, information systems and organizational aspects to find the most suitable methodology for these courses.

5 Course Structure and Learning Evaluation

The main modules adopted for the online and in-class training activities are:

European Integration and EU institutions: The historical origins of the EU; EU policy areas and EU enlargement; EU legal framework; EU decision making procedures; EU effective networking and lobbying.

EU Legal Framework and Country-specific: Political institution and legal framework; Public administration and coordination; Political role and legislative process; Coordination with EU laws; Public administration: legal power and civil service legal status; Policy making decision and implementation; Civil servant role in the process of implementation; Explanation of professional skills for government.

Managerial tools and behaviour: Change management; Motivating and coaching people; Cross-cultural and diversity management.

Ethics: Introduction to ethical reasoning; Typical cases of ethical conflict in PA.

Statistics: How to read a statistical document; How to perform statistical comparisons; How to perform statistical analyses.

Economics – general training: Principles of EU economic policy; European monetary integration; Current issues of economic policy in the EU; Competition policies in the EU and its member States; The Lisbon process; Countries economic outlook; Key institutions; Institutions and regulatory framework; Policy issues.

The evaluation was made after the e-learning modules, during and after the in-class modules. Participants were asked to indicate how far they agree or disagree with the following statements:

- If they learned new ideas or skills (or both) by attending the blended course;
- If they learned something that they can definitely use in their job;
- If they learned something new from talking to other colleagues;
- If they learned things which can help they in the long term.

Participants were asked also to rate the training course modules in their features:

- Relevance of the topic covered;
- In-depth analysis of the topic;
- Effectiveness of the presentations;
- Efficiency and relevance of teaching tools;
- Balance between theory and practice;
- Involvement in the didactical activity;
- Training materials/hand-outs used;
- Interaction with other course participants.

After the pre-assessment phase, the learning results has been very enthusiastic and the rate of the attendants was very high:

- Pre-assessment quiz average: 50.14%;
- On-line learning modules attendance: 78.45%;
- Final test average: 87.26%;
- Forum usage average: 49.13%
- Participants interaction: 34.56%

The main aspects emerging from daily evaluation forms were the positive rating of the topics and the added value of the modules [8]. The final questionnaire aimed at evaluating the overall satisfaction, the attainment of the course objectives and of personal training goals. As a whole, participants gave a general positive feedback. Other questions more strictly related to the course organisation and the services provided (course administration, venue, catering and accommodation), were also included. These aspects were rated positively by participants.

6 Conclusions

It is generally accepted that, in order to compete in today's complex and rapidly changing world, civil servants will need continuous access to learning resources throughout their entire working lives. Increased competition and financial limitations make a pressure for flexible learning to become an essential ingredient of educational policy [9]. The purpose of the project is to develop shared knowledge, update know-how and improve skills and competences among middle rank civil servants of EU Public Administrations in order to increase collaboration and mobility within the European Union countries. Flexible learning methods, usually, give more attention to the learning process, the ability to learn, the need to learn rather than the acquisition of knowledge itself. Therefore, they need active learners to solve problems, analyse information, and take decisions. So it is possible to conclude that one of the solutions is to provide to civil servants blended learning courses and self-teaching packages to acquire more competencies and exchange previous experiences through communities of practice.

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Part XI
IS Design, IS Development, Metrics and Compliance

Alignment of Service Science and Service Oriented Computing: A Unified Interpretative Approach to Service Design and Planning

Marco Comerio, Simone Grega, Matteo Palmonari, and Gianluigi Viscusi

Abstract At the state of art, service ecosystems are seldom considered under a holistic perspective, whereas silos oriented perspectives prevail (the organizational level, the ICT level, and so on). Due to this separation of concerns, it is difficult to provide comprehensive solutions to plan service oriented initiatives combining models and solution developed at different levels. A significant problem in this scenario comes from the multi-faceted relationship between real services, which impact on the information system as a whole, and Service Oriented Computing (SOC), which is a paradigm to support ICT-based service automation and management. In this paper, we discuss an interpretative approach aiming at bridging the gap between services and SOC. The approach is based on a conceptual model called eGora*. The discussion is supported by a real life scenario based on previous on the field experimentations.

1 Introduction

The Service Oriented Computing (SOC) paradigm supports the realization of service-based ICT infrastructures. However, SOC covers only one perspective among the many considered in initiatives aimed at designing and planning services in service ecosystems. Other perspectives are e.g. the management perspective (e.g., business processes), the economic perspective (e.g., service value) and the legal perspective (e.g., Service Levels Agreements and compliance with industry and country rules). At the state of art, service ecosystems are seldom considered under a holistic perspective, whereas silos oriented perspectives on the different

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subsystems prevail. Furthermore, moving between sub-systems asks for filling conceptual and ontological gaps e.g. between the technological system of Web services (WSs) and the organizational system. Efforts towards a holistic perspective have been carried out in the area of Service Science [1, 2]; nevertheless these efforts are still grounded in disciplinary boundaries which inherit the above discussed separation of concerns. In this paper, we discuss a model-based interpretative approach to the design and planning of service oriented initiatives. In particular, the model-based approach proposes to map high-level goals to tasks addressed in SOC, by using a conceptual model, called eGora*; the model supports the identification of the information entities to be considered, the evaluation and reuse of available models and techniques developed in SOC together with extensions needed in a comprehensive service planning context. The approach aims to support business and system analysts in the definition of the main components required by a service oriented initiative by choosing the right level of intervention together with the appropriate state of art models, methods, and tool. The discussion of the approach and related conceptual model is supported by a real life scenario based on previous on the field experimentations. The paper is structured as follows. First, a reference scenario for service design is proposed, followed by the discussion of the eGora* conceptual model. The model is then applied to the scenario in order to support decisions about the choice of the most appropriate SOC model, technique. Discussion of the results and future work conclude the paper.

2 Service Design in Service Ecosystems: A Reference Scenario

In this section we outline a reference scenario in order to illustrate our model-based approach to service design in service ecosystems. Let us consider a private service provider who aims to realize a process that supports citizens and General Practitioners (GPs) to consult/report medical examinations with an electronic medical record and to receive/send this report. The process is composed by the following services: (1) *medical record consultation service*: the citizen's case history is available online and reports the clinical results of the medical examinations, also accessible by the authorized GPs according to privacy clauses; (2) *medical record digitalization service*: the medical records referred to a patient are collected and digitalized in order to preserve and make available the clinical results; (3) *medical record delivery service*: medical records are home delivered to the citizen that requests the service. The goal of the service provider is to reuse existing services already offered by other specialized service providers. The selected services are then composed and adapted in order to provide a group of services satisfying functional and quality requirements. Several heterogeneities are introduced by these services and must be taken into account in the design and planning of a service-oriented initiative. For instance, the medical record consultation service can be provided as an e-service that allows on-line consultation of a citizen's case history only if the citizen agrees the handling of his personal details.

Moreover, the citizen that subscribes this service is exempt from the collection of his medical documents. In general, these aspects refer to the normative terms of the service. The medical records digitalization service can be designed as a service composed by: (1) a service that allows the collection of medical documents, the storage of the original documentation and its digitalization; (2) an e-service that allows the GP to sync automatically data referred to the traceability of the medical documents (e.g., identification number, patient name, date, etc.) and to access directly to the digitalized documentation; (3) a Web service that allows the GP to monitor and trace the actual state of the process. Another significant aspect related to the medical records digitalization service is the possibility to offer an ISO/IEC 27001:2005 certification that is intended to bring information security under explicit management control. This certification is perceived by the client as an added-value of the service. Finally, the medical records delivery service can be designed as using different channels. For example, the service can post medical documents using the first-class mail or certified mail within one working day or three working days respectively. Vice versa, the service can use a certified e-mail as delivery channel sending digitalized medical documents within one working day. The selection among channels depends on the user's preferences and needs.

3 A Comprehensive View of Service Ecosystems

The *eGora** conceptual model is based on models and approaches developed both in the Service Science and SOC literature so far. The model has been defined according to the following directives: (1) the introduction of a concept namely *Service Science Component* to group all the entities tightly related in a service ecosystem (i.e., process, service and Web service); (2) the characterization of Service Science Component through classifications that cover the several facets shared by all its subconcepts (e.g., *abstract* or *concrete*, *internal* or *external*, *composite* or *atomic*); (3) the introduction of concepts that cover architectural (e.g., *Web service*), management (e.g., *process*), economic (e.g., *value*) and legal (e.g., *contract*) perspectives. Figure 1 shows the eGora* conceptual model that is built around the following first-level concepts:

- *Service*: the commitment to carry out, under certain circumstances, a series of activities of more or less intangible nature, which have place in an exchange between a provider and a client. A service has the inherent goal of producing value and it can be realized through a Web service [7, 8].
- *Web service*: a self-contained, self-describing, modular applications that can be published, located, and invoked across the Web [9].
- *Process*: a set of activities whose execution leads to the production, distribution, exchange and consumption of a service and that can be implemented by a Web service [10].
- *Actor*: a human/organizational subject involved in service provision and consumption.

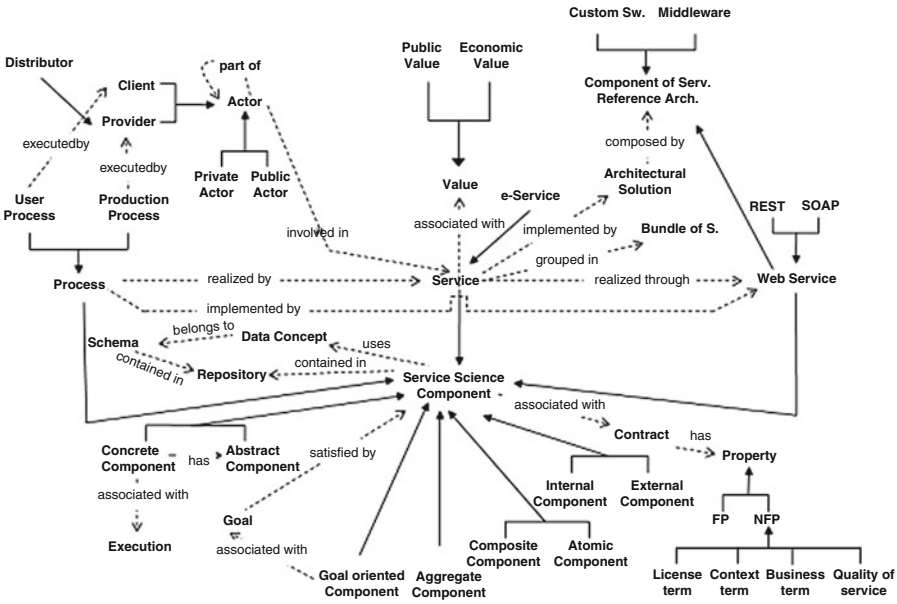

Fig. 1 eGora* conceptual model. *Solid lines* represent Is-A hierarchies, *dashed lines* represent functional relations

- *Value*: for a user it represents the degree of achievement of the outcome expected when the service has been requested and the contract has been signed, plus the increment of outcome the user has perceived and gained during the access to the service; for a provider the value corresponds to the revenues achieved plus the experience and other intangibles achieved by the provider in the execution of the service [11]. eGora* further distinguishes between (1) *public value* where the achievements for public sector providers are not strictly related to economic revenues, but to the satisfaction of constituencies (citizens and businesses) needs and well being; (2), *economic value* consists in a financial outcome and profit for business providers.
- *Goal*: a need/objective of a client that can be satisfied (all or in part) by executing a process/service/Web service.
- *Contract*: an agreement between actors or an agreement proposed by an actor which describes process/service/Web service in terms of functional and non-functional properties, i.e., Quality of Service (QoS), Business, Context and License terms [12].
- *Bundle of service*: any group of services provided instead (or together to) atomic services [3, 5].
- *Architectural Solution*: a layered software architecture whose internal organization is oriented to the efficient production and execution of a multitude of services [11].

The concepts of the eGora* model that have been addressed by standardization attempts include *Web service*, *Process*, *Contract* and *Architectural Solution*. As for

As to *Web service*, SOC modeling languages range from WSDL and WADL, to light-weight models for the semantic annotation of WSDL descriptions such as SA-WSDL, and to rich ontologies for semantic Web services such as OWL-S and WSMO. As to key research topics in SOC includes tasks such as WS-Discovery [9, 13], WS-Composition [14], WS-Choreography [15], WS-Negotiation [16], and WS-Monitoring [17]. As to *Process*, proposed languages for process modeling span from languages more oriented to design such as BPMN (Business Process Modeling Notation), to languages more oriented to process execution such as BPEL (Business Process Execution Language); business process modeling is related to SOC-related tasks, and to design-related tasks, such as Business Process Management [10], Operational planning (e.g. see [11]) and Strategic Planning (e.g. see [18] for the eGovernment domain). Nevertheless, while the connections between services and processes concern fine-grained process descriptions to model Web Service execution, the relationships between business models at the planning level, and services or WSs have been less investigated, with significant exceptions such as [6, 8, 19]. As for *Contract*, several modeling languages have been developed within SOC, such as WS-Policy and WSLA (Web Service Level Agreement); nevertheless, they cover only QoS specifications of WSs (i.e., technical characteristics addressing a subset of the non-functional properties that can be included into a service contract). Contextual (e.g., service coverage), business (e.g., service price) and legal (e.g., limitation of liability) terms are not considered. Proposals of modeling languages able to cover all the contract terms are discussed in [12, 20, 21]. Other concepts of the eGora* such as *Service*, *Value*, *Actor* and *Bundle of Services* have been considered by a number of papers that explicitly or implicitly emphasize the need to consider services in a holistic perspective [3, 4, 5]. As to these issues, the eGora* model extends and subsumes at a more abstract level the ontology presented in [8]. Whereas the interpretation of services as *commitments* adopted in the eGora* model was first introduced in [7]. The idea of a knowledge repository storing information about services even when they are not WSs, already introduced in [8], is also adopted e.g. in [22]. Considering planning-related tasks, [23] introduces an approach to identify and specify requirements on information-based business services and their associated derived WSs. Finally, as to *architectural solution* (e.g. the Oasis' SOA-Reference Model), eGora* introduces (1) a distinction between services and software services; (2) a set of concept related to business perspective in service ecosystems addressing service value and bundle of service; (3) the concept of goal to make the users' needs explicit.

4 Model-Based Support for Service Design

This section discusses the question whether – and to what extent – the models, techniques and technologies developed in SOC can be reused in a comprehensive service planning context. The discussion is carried out focusing on the high-level

goals introduced in the reference scenario. The planning of an initiative to support citizens and GP to consult/report/receive/send medical examinations starts from the identification of the high-level goal regarding the reuse of existing services. This goal consists in identifying medical record consultation, medical record digitalization, medical record delivery services that satisfy functional and non-functional requirements.

As an example, the requirements for the medical record delivery service consist in sending/receiving medical examinations through a multichannel service (e.g., first-class mail, certified mail or e-mail) characterized by different QoS (e.g., delivery in one working day) and legal terms (e.g., the e-mail must be certified). Among the tasks addressed by the SOC and BPM communities (see Fig. 2), a first task relevant to the above mentioned goal is Web service discovery and selection (i.e., the identification of the best among a set of WSs according to the compliance with a set of functional and QoS requirements specified by a client). This task is focused on WSs and requires knowledge related with the Web services and their specializations, contracts, goals and actors (see areas delimited by solid lines in Fig. 2). Contracts are the specifications of functional properties (FP) and QoS terms of the service. Goal defines the functional and QoS requirements of a client that must be satisfied by the service. Actors represent the parties (i.e., client and provider) involved in Web service usage and provisioning. Boxes with solid borders in Fig. 2 identify the entry-points of the Web service discovery and selection that are the concepts in the eGora* model from which the task can be activated: (1) the actor (e.g., the service designer) asking for a service with specified

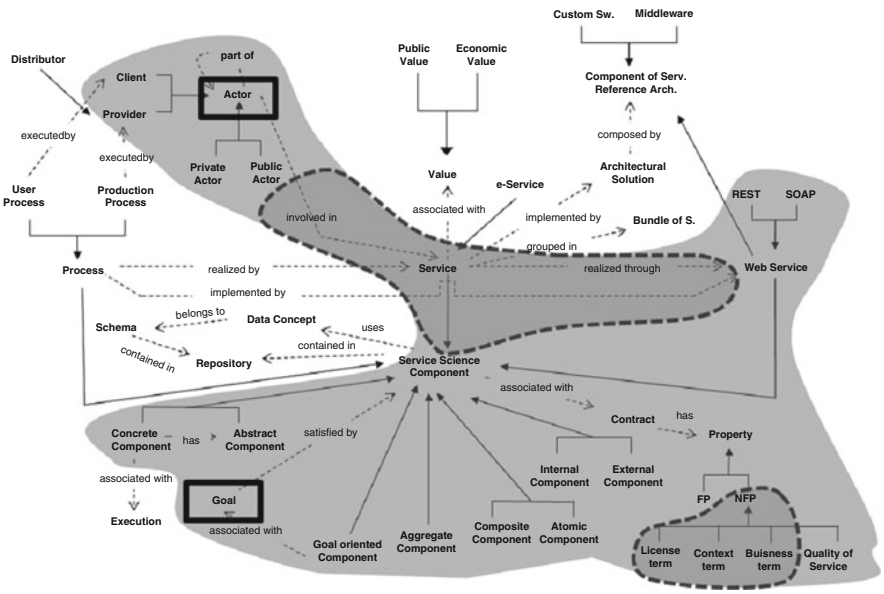

Fig. 2 Concepts and entry points for service discovery and selection

FP and QoS or (2) a predefined goal on which the discovery and selection must be performed. As mentioned in previous sections, the Web service discovery and selection task can be realized applying models, techniques and technologies developed in SOC. As an example, the model in [9] can be applied to identify existing medical record delivery services that satisfy QoS (e.g., delivery in one working day) requirements. However, since a conceptual gap between a real service (i.e., the medical record delivery service) and an ICT-based service realized through a Web service exists, it is not possible to adopt the model in [9] to fully reach an high-level goal to reuse existing services. As an example, the model in [9] cannot be used to represent and evaluate the context (e.g., multi-channel delivery) and legal terms (e.g., the e-mail must be certified). Papers in the literature [8] addressing also real services adopt repositories of service information, often based on semantic technologies. Remarkably, if it can be assumed that WSs descriptions are made available by service providers, repositories of service information need to be built. Thus, the knowledge that need to be considered must be extended to (1) real services and their multi-faceted properties and (2) business, context and license terms of service contracts. Figure 2 shows the knowledge (i.e., new concepts are in areas delimited by dashed lines) considered for service discovery and selection.

5 Conclusion and Future Work

In this paper we have discussed a model-based approach aiming to support business and system analysts in choosing appropriate models, techniques and technology for service oriented initiatives. To these ends we point out the need for a holistic perspective behind the approach, aiming to fill the actual gap between the mainly technological perspectives on Web services and services considered as configurations of elements which belongs to economics, organization and law. In this paper, we have mainly analyzed this service ecosystem at the level of the technological subsystem, by showing the yet available wide spectrum of solutions and choices residing behind functional and ontological silos in SOC. In future work we will extend the approach to the other sub-systems through the application to new scenarios and case studies.

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Profiting from IT-Based Capabilities in SMEs: Firm-Level Evidence from Italy

Paolo Neirotti and Elisabetta Raguseo

Abstract Drawing on the resource-based-view and contingent studies, this paper examines the diffusion patterns of the capabilities that Small and Medium Enterprises (SMEs) develop from Information Technology (IT) use and how the industry environment affects their impact on profitability. Data are gathered through a sample survey conducted among firms in Italy in 2009. Results show that in more dynamic industries firms enjoy lower returns on profitability from their IT-based capabilities. By contrast, industry munificence has positive moderating effects on the returns firms experience from enriching their capabilities base through IT. Managerial implications of these results are discussed.

1 Introduction

In the last few years the rise of a new technological paradigm for Information Technology (IT) sparked interest in studying how diffusion and the strategic value of these technologies are evolving. Despite Information Systems (IS) are an enabler of more internal transparency and better coordination practices in the stage of business growth of small firms [4], Small and Medium Enterprises (SMEs) have long been found to under exploit the potential value of IT. Specifically, SMEs' managers and external consultants usually lack appropriate expertise and absorptive capacities on applying IT effectively to innovate internal routines and business processes. Moreover, the lower human capital respect to large firms may impede SMEs to undertake the complementary investments in the organizational capital that are fundamental for the IT payoff to manifest [4]. These flaws are particular evident in Italy, where in the last few years SMEs have exhibited limited innovation capacity and one of the slowest productivity growth in Europe [3].

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The shortage of human capital and managerial skills in many SMEs implies that in these firms the diffusion of the capabilities that are based on use of IT (henceforth IT-based capabilities) may lag behind the adoption of IT resources, in particular in industries with less favourable conditions to IT adoption. In this regard, despite the evolving nature of IT has inspired a great deal of empirical research on the business value of IT, IS research has analyzed the economic returns that SMEs can get from IT adoption processes without looking at the capabilities that they actually develop by investing in IT.

This study represents a first attempt to bridge this gap by investigating two research questions: (1) Which are the diffusion patterns of IT-based capabilities in SMEs? (2) Do industry environmental conditions moderate the relationship between IT-based capabilities and profitability? To investigate these questions, this study formulates three hypotheses – tested on a sample of 238 Italian SMEs – grounded on contingent models and the resource-based view.

2 Theoretical Background and Hypotheses

Following a common approach in Information Systems literature, in this study we draw on a definition of IT-based capabilities as "complex bundles of IT-related resources, skills and knowledge, exercised through business processes, which enable firms to coordinate activities and make use of the IT assets to provide desired results" [2]. The development or the enrichment of firms' capabilities through innovative use of IT reflect the outcome of IT assimilation processes, through which firms become able to incorporate and routinize IT resources into their business processes to enhance performance. Accordingly, firms may develop two types of IT-based capabilities: (1) "externally-oriented" or (2) "internally-oriented" capabilities [2]. The former allows firms to respond in a timely way to changes in markets and shifts of customers and suppliers. The latter originates in the use of IS for improving their internal efficiency and the managerial control on operations. This definition of capabilities reflects a focus on the outcome of IT adoption processes, rather on its antecedents [7]. Indeed, a part of past studies [5, 6, in particular] interprets capabilities related to IT as the preconditions for its successful assimilation. These studies therefore refer to coordination mechanisms between business functions and the IT staff, governance systems for IT decisions, technical skills and absorptive capacities in the IT domain. Given this focus, they fail to assess whether IT is actually a General Purpose Technology that generate economic growth in the majority of industries.

Following the discussion above, our focus on IT-based capabilities may allow to investigate the competitive value of IT more in-depth. In this perspective, the resource based view [1] and the contingent theory provide appropriate arguments to understand how IT may impact a firm's profitability.

According to the contingent position, the profitability returns of firms capabilities are contingent on what the environment requires as critical success

factors. Dynamism and munificence are the most important environmental factors influencing how firms create resources and the competitive value of the capabilities that they develop from their use. For example, capabilities affecting a firm's external orientation towards its customers and suppliers may be more valuable in more dynamic industries, as environments where new threats can appear suddenly and opportunities may be short-lived require superior market responsiveness. By the same token, in munificent industries – due to higher demand growth and greater market opportunities – firms exhibiting greater product development capabilities, superior market knowledge and entrepreneurial capacities are more likely to improve their performance. Conversely, "internally-oriented" capabilities might be more critical for performance in more mature and stable industries, being such environments less forgiving on operational inefficiency.

H1. The higher the environmental dynamism and munificence, the higher is the impact of externally-oriented IT-based capabilities on a firm's profitability.

H2. The lower the environmental dynamism and munificence, the higher the impact of internally-oriented capabilities on the firm's profitability.

Contingent theory does not however take into account that some of the capabilities that firms develop from IT investments might have minor returns on profitability, due to fact that the related technologies are widely diffused on the open market and their implementation do not offer particular obstacles. Thus, as the resource-based-view (RBV) suggests, the returns from IT investments are more likely to be lower in industries exhibiting high competition, high market turbulence and rapid responses from competitors in introducing new technologies. Where these conditions occur, firms may not fully appropriate returns from their IT-based capabilities, as the productivity growth enabled by IT-based innovation is transferred to greater consumer surplus and not to higher firms' profitability [4]. Furthermore, in industries with high dynamism and competition, barriers to imitate IT resources may be weak because these industries have historically attracted a great number of vendors offering industry-specific IT solutions. This fact may have favoured a greater number of firms to adopt IT assets in the earlier stage of their diffusion curve, thus at a higher cost (and at a lower "appropriability rate") respect to firms in other industries. Thus, we expect what follows.

H3. The higher the dynamism within an industry, the lower is the impact of IT-based capabilities on profitability, in particular for the capabilities that are more diffused.

Figure 1 shows the conceptual model followed for the hypotheses validation and highlights that IT-based capabilities may mediate the relationship between firm's preconditions and performance. The empirical validation of this position requires to take into adequate account the endogeneity that may affect the linkage between capabilities and performance. Indeed, unobserved firm-specific factors due to superior management capabilities or some other idiosyncratic factors may co-determine both the development of IT-based capabilities and superior profitability. If firms that develop IT-based capabilities are in general better managed, Ordinary Least Square regression model may overstate the impact of IT investments on profitability. Thus, we use treatment regressions models based on a two steps

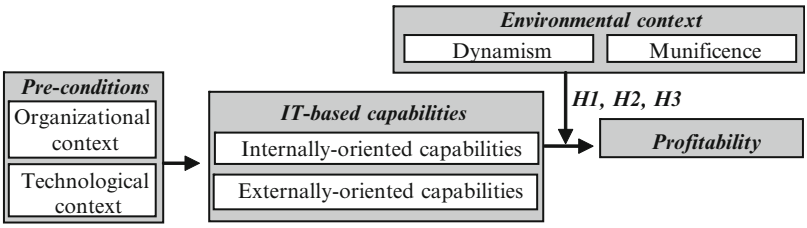

Fig. 1 Conceptual model

approach because they allow to deal with correlation among firm-specific unobserved factors and IT-based capabilities. Specifically, these models estimate two regressions simultaneously: the first is a probit regression predicting the probability of a "treatment", i.e. the condition where firms have developed a given IT-based capability. The second is a linear regression for profitability as a function of the treatment variable, controlling for observable cofounders. Thus, the probit equation allows to model each capability as depending on certain preconditions.

3 Research Methodology

3.1 Sample and Data Collection

The data used for this study are the output of a survey carried out between February and April 2010 in the Piedmont region (Italy), which is conducted every year since 2002 on a population of 5,600 SMEs. The survey was carried out on four industry groups: (1) manufacturing, (2) trade; (3) business services; (4) transportation and logistics. About 2,000 companies in the population were randomly selected and were contacted by phone to identify key respondents within the managerial cadre. Then an online questionnaire was delivered, which was built after case studies conduction. A representative sample of 360 firms provided usable responses. The limited availability of data on financial performance from the AIDA database (Bureau Van Dijk) reduced the sample to 238 firms (Table 1).

3.2 Measures

Capabilities. Using a five-point Likert scale with responses ranging from "strongly disagree" (−2) to "strongly agree" (+2), respondents had to evaluate IT impact on a series of items related to the firm's internal and the external orientation. We asked respondents to base their assessment on the impacts observed over the previous 4 years (between 2006 and 2009). Principal Component Analysis (PCA) was

Table 1 Sample composition (number and percentage of firms)

Industry	Small	Medium	Total
Manufacturing industries	71 (29.83%)	51 (21.43%)	122 (51.26%)
Wholesale and retail trade	48 (20.17%)	10 (4.20%)	58 (24.37%)
Transportation and logistics	8 (3.36%)	6 (2.52%)	14 (5.88%)
Business services	27 (11.34%)	17 (7.14%)	44 (18.49%)
Total	154 (64.71%)	84 (35.29%)	238 (100.00%)

applied to these items. The analyses separated four types of capabilities (results are not reported to conserve space). The first factor refers to internally-oriented IT capabilities as it reflects improvements in internal efficiency that were derived from IT use. The second factor refers to the impact of IT in new product/service development processes. As such, it represents an externally-oriented IT capability, as well as the third factor, which refers to the improvement of market capabilities through improvements in knowledge of customers' behaviour and service-levels in sales and after-sales activities ("improved market capabilities"). The fourth factor reflects the use of IT to increase the firm's revenues volume, by allowing the entry in new segment markets or an increased penetration in the current market segments. To operationalize these measures we dichotomized them (1 for high and 0 for low-value sets), based on the median value.

Environmental conditions. Dynamism and munificence were assessed using national accounting data from Istat. For each industry segment (defined at a 3-digit level of NACE codes), the industry-level total sales for 5 years were regressed on the year variable. Dynamism was operationalized as the variability in annual industry sales and was measured as the standard error of the regression slope coefficient of annual industry sales divided by the industry mean for the 5 year period. Munificence was measured as the growth rate in annual industry sales for 5 years, measured as the regression slope coefficient divided by the average industry sales. For each industry characteristic, we ranked the values by year and split the industries into two sets (high and low), based on the median value for the measure.

Profitability growth. The profitability impacts were operationalized by measuring changes in profitability differentials between 2006 and 2009. Specifically, for each year and each firm we considered the differences in ROA, ROS and the EBITDA/Revenue ratio respect to the median value in a peer group composed by all the Italian firms in the same industry segment (defined at a 3-digit level of NACE codes). This procedure allowed to assess whether in the period under analysis a firm has achieved a competitive edge (or disadvantage) or has bridged (or increased) a former competitive delay. This measure of profitability also controls indirectly for economic cycles (and thus the shift to a recession phase in 2008) and other macroeconomic factors such as industry concentration.

Preconditions. The preconditions related to the state of IS adoption was measured by considering whether the firm had adopted three types of enterprise systems: (1) ERP packages; (2) CRM systems; (3) product data management (PDM) or product lifecycle management (PLM) systems. Concerning the organizational

preconditions, we took into exam firm size (number of employees in logarithmic form) and the horizontal coordination routines in the IT planning process ("IT-business horizontal integration" mechanisms). Specifically respondents were required to evaluate on a Likert scale the degree of involvement for the top management team in the following tasks: (1) definition of the business requirements for the new IS; (2) decision-making process for business strategy choices; (3) change management endeavours induced by IT adoption projects; (4) management accounting system.

4 Findings

Table 2 reports descriptive statistics and highlights that internally-oriented capabilities are the most diffused outcome of IT investments, consistently with high adoption rates for ERP systems (about 38% of the sample). By contrast, diffusion of the other capabilities and the related technologies (CRM, PDM) was rare.

Table 3 reports a synthesis of the results of treatment regression models by showing the treatment effects and their interaction with the dummies measuring dynamism and munificence. In the main equation we also included control variables and the performance level in the year 2005. To conserve space, we have not included these effects in Table 3. Furthermore, for every model, we adopted a "from general to particular" backward stepwise method to tackle the possible biases arising from omitting relevant variables or from including irrelevant ones.

The analysis highlighted that IT-based capability positively affected profitability differentials. Furthermore, dynamism negatively moderates the relationship

Table 2 Descriptive statistics

	Variables	Name	Mean	Median	St. dev.
Technological context	ERP	*ERP*	0.38	0.00	0.49
	CRM	*CRM*	0.14	0.00	0.35
	PDM	*PDM*	0.03	0.00	0.16
Organizational context	IT-business horizontal integration	*IT_B_INT*	0.74	0.00	0.94
	Size	*SIZE*	1.55	1.51	0.37
IT-based capabilities (internally-oriented)	Internal efficiency growth	*IIE*	0.19	0.33	0.82
IT-based capabilities (externally-oriented)	Improved new product development capabilities	*NPD_CAP*	−0.25	0.00	0.81
	Improved market capabilities	*MKT_CAP*	0.05	0.00	0.88
	Business growth	*BG*	−0.47	0.00	0.95
Environmental context	Munificence	*MUN*	0.64	1.00	0.04
	Dynamism	*DYN*	0.38	0.00	0.48
Profitability	Δ ROA	*ΔROA*	0.42	0.19	5.84
	Δ EBITDA/Revenue	*ΔEB/REV*	1.22	0.43	7.26
	Δ ROS	*ΔROS*	0.41	0.19	5.73

Table 3 Effects on profitability differentials (second step of the treatment regression model)

Model	*Dep. var.*	Type of treatment effect (CAP)		*DYN*	*MUN*	*DYN x CAP*	*MUN x CAP*	*MUN x DYN*	*MUN x DYN x CAP*
1	*ΔROA*		7.74***	1.22	…	−2.16[a]	…	…	…
2	*ΔEB/Rev*	*IIE*	8.82***	…	…	…	…	…	…
3	*ΔROS*		7.98***	…	…	…	…	…	…
4	*ΔROA*	*NPD_CAP*	8.29***	1.28[a]	−1.83*	−3.58**	2.42[a]	…	…
5	*ΔEB/REV*		7.26***	…	−0.04	…	2.68[a]	…	…
6	*ΔROS*		6.95***	1.35[a]	…	−2.06[a]	…	…	…
7	*ΔROA*	*MKT_CAP*	9.26***	…	…	…	…	…	…
8	*ΔEB/REV*		8.19***	1.74	1.65	−4.46[a]	−2.22	−1.84	6.24[a]
9	*ΔROS*		8.88***	2.29	0.32	−3.75[a]	−1.69	−1.81	4.88[a]
10	*ΔROA*		8.99***	…	−0.28	…	−3.23*	…	…
11	*ΔEB/REV*	*BG*	9.35***	−0.28	1.32	−3.16	−5.88**	0.17	5.82[a]
12	*ΔROS*		3.64	0.24	…	2.45[a]	…	…	…

Blank cells denote lack of a significant effect
*$p < 5\%$; **$p < 1\%$; ***p-value $< 0.1\%$
[a] $<10\%$

between internally-oriented capabilities and ROA (model 1), with improvements in operational efficiency leading to a greater profitability differential in more stable environments (hypothesis H2 is supported).

Dynamism also negatively moderates the impact of product development capabilities on ROA and ROS differentials (models 5 and 6). Similarly, market based capabilities have a smaller impact on EBITDA/Revenue and ROS differentials in more dynamic industries (models 8 and 9). Business growth capabilities are the only exception to this pattern as in more dynamic industries they generated higher returns on ROS (model 12). This is however consistent with the rare diffusion of this capability. Overall, these results confirm hypothesis H3.

Findings confirm hypothesis H1 in part. Munificence positively moderates the impact of product development capabilities on ROA and EBITDA (models 4 and 5). Moreover, in environments of both high dynamism and munificence firms that developed market-based capabilities or the entrepreneurial capabilities related to the "business growth" variable had a higher positive impact on differentials related to profit margins with respect to firms that experienced these outcome in industries with other conditions. This result sounds as a confirm of the non "destructive" nature of competition in less mature and more munificent industries, being competition more likely based on product innovation rather than on price wars.

5 Conclusions

Our study investigates the effects of IT-based capabilities on performance. Findings confirm both RBV and contingent theory. Indeed, the returns from capabilities based on IT use are higher in more munificent industries, when such capabilities

concern a firm's orientation toward the market. However, our evidence also shows that in less dynamic industries capabilities that support a firm's external orientation have a greater strategic value, despite contingent theory interprets them as less critical in these environments respect to improvements in operational efficiency. The reasons for this result may lie in the following RBV argument. In industries exhibiting less discontinuities firms are more likely to sustain superior economic returns when they differentiate by competitors by using IT to execute "proactive" strategies based on new products and capitalizing on new business opportunities. This occurs despite IT resources are widely available on the market.

This study also confirms the under exploitation of IT in Italian SMEs. In particular, the rare diffusion of the externally-oriented capabilities sounds critical for SMEs, as these firms are expected to base their business models on integration in networks with other enterprises, flexibility and responsiveness to customers' needs. Finally, results – by showing that in munificent industries IT-based capabilities can produce higher returns – stress the importance for SMEs in mature industries of a repositioning in market segments offering more growth opportunities.

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Open Ontology-Driven Sociotechnical Systems: Transparency as a Key for Business Resiliency

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Abstract Most business and social organisations can be seen nowadays as complex *sociotechnical systems* (STSs), including three components: *technical artifacts, social artifacts,* and *humans*. Within social artifacts, a special role have *norms,* which largely influence the overall system's behavior. However, norms need to be understood, interpreted, negotiated, and actuated by humans, who may of course deviate from them, or even decide to change them. STSs are therefore essentially prone to failure: critical situations are part of STS's life, and may sometimes lead to tragic outcomes. That's why *resilience* to failure must be built into such systems, and is a crucial parameter to determine their quality. We argue in this paper that, to achieve a high level of resilience, *transparency* is the key: actors within the system need to take a reflective stance toward the system itself. In other words, an STS must be *open* to its actors, which by observing and understanding its dynamics can take the appropriate initiatives in presence of unforeseen problems, possibly modifying the system at run time. Ontological models can play a crucial role in this context. However, we need to make a radical change in our modelling approach, shifting the focus of analysis from ontology-driven *information* systems to ontology-driven *sociotechnical* systems.

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1 Introduction

Most business and social organisations can be seen nowadays as complex *sociotechnical systems* (henceforth STSs), including three components: *technical artifacts, social artifacts,* and *humans*. The specific nature of STSs with respect to other sorts of systems has been studied recently in [15], where the differences and the mutual interactions between technical and social aspects are analysed. Technical systems are physical systems designed to achieve some human purpose. Accordingly, they are modelled and analysed as physical systems, consisting of interconnected components, whose behaviour is completely described by natural laws. Knowledge of these laws can be obtained to great levels of precision by careful experimenting, allowing the system's architecture to be predictable and controllable to the extent that is required for the desired functionality. Social systems, in contrast, are made up of human persons and social organisations and institutions, which can themselves be analysed as social systems. The behaviour of persons and institutions is not entirely determined by natural laws, but is also guided by private decision-making rules internal to persons as well as 'public' norms guiding social behaviour. The latter may pertain to different institutions, may or may not be legally enforceable, and may compete with one another and with the pursuit of individual or collective goals.

In *designed* STSs, intended to realize a certain pre-defined function, both technical and social artifacts – as well as human operators – are crucial for the overall functioning. Technical artifacts, like tools and machines, determine what *can* be done, amplifying and constraining opportunities for action; social artifacts, like norms and institutions, determine what *should* be done, governing obligations, goals, priorities, and institutional powers. Since institutions, in turn, are created by norms, STSs can be seen as *norm-governed* systems, whose structure and behaviour largely depend on norms. However, norms need to be understood, interpreted, negotiated, actuated by humans, who may of course deviate from them, or even decide to change them.

Designed STSs are therefore essentially prone to failure: critical situations are part of STS's life, and may sometimes lead to tragic outcomes. That's why *resilience* to failure must be built into such systems, and is a crucial parameter to determine their quality. We argue in this paper that, to achieve a high level of resilience, transparency is the key: actors within the system need to take a reflective stance toward the system itself. In other words, an STS must be *open* to its actors, which by observing and understanding its dynamics can take the appropriate initiatives in presence of unforeseen problems, possibly modifying the system at run time.

Ontological analysis and ontology-driven conceptual modelling [9] can play a crucial role in this context. However, we need to make a radical change in our modelling approach, shifting the focus of analysis from a piece of software (however *embedded* in an external system modelled as separated from the information system) to the *embedding* system, including the information system itself. In other

words, we need to move from ontology-driven *information* systems to ontology-driven *sociotechnical* systems, where the ontology becomes the key for making the whole system transparent to itself and to the external environment, facilitating communications within the various components and helping the concerned actors to make the required choices pertaining to system design, management and use. This paper aims to be a *manifesto* for this radical change of perspective. In the following, we shall briefly discuss the social and scientific implications of ontology-driven sociotechnical systems, and suggest some methodological direction lines for future research.

2 Sociotechnical Systems

From technical artifacts to sociotechnical systems. Concerning technical artifacts, modern design, development and management methodologies have increasingly recognised the need to take human and social aspects into account, embedding the technical dimension in the broader social context. Back in the 1960s, this was advocated by the *sociotechnical systems theory* (STS theory) [8]. Although originally focusing on labour organisation, the STS theory has had a substantial impact on information systems research, as well as on agent-oriented software engineering and multi-agent interaction systems, where the need to consider people and organisations as not just users but *actors* has clearly emerged [26]. More recently, the principles of STS theory have been applied to service-oriented computing, where a systemic approach to "service science" has been proposed [3]. However, the sociotechnical approach is not yet widely and effectively practiced. According to [2], one of the reasons of this is the lack of a *systematic engineering methodology*. In other words, it is not enough to propose sociotechnical *principles* urging engineers to adopt them: generic principles must be translated into formal engineering techniques [4], which in our understanding means we need first of all comprehensive formal *models*.

Legal and institutional aspects. Concerning social artifacts, disciplines such as philosophy, sociology, economics and law have provided theories and methods for analysing, modelling, and designing them [5, 18, 22, 25]. In particular, to capture the diverse ontological forms and functions of norms (stating obligations, providing permissions and rights, allocating roles, providing ways for achieving individual and social objectives) we need to take into account the work of philosophers, jurists [11] and legal theorists [10, 12, 21] that have anticipated in many regards recent ontologies of normative entities, providing theories of legal norms and acts, normative positions and entitlements, and legal systems. Legal theory provides indeed a rich conceptual frameworks for approaching normative phenomena, though often lacking the precision required by more analytical approaches. Moreover, only to a very limited extent studies on social-institutional systems pay due attention to the role of technological components in norm-governed and institutional action. No legal theory is available to deal with the commonalities and differences between

technical and legal artifacts and their mutual integration, even though it is now apparent that in many domains the objectives of the law (protection of individual rights, prevention of antisocial behaviour, facilitation of beneficial activities) can only be obtained by regulating the way in which technological objects and systems are designed [17]. We need therefore an adequate theory of STSs to address the ways legal norms may affect the use of technical artifacts, and how the intertwining of technical artifacts and laws can affect human behaviour, and the overall dynamics (and resilience) of STSs.

The role of social components. An important aspect that formal models of STSs should clarify concerns the role played by social components with respect to the technical components. For instance, focusing on human components, clearly we should distinguish the case where humans are just *users* of technical artifacts, being therefore *external* to the artifacts themselves, from the case where human operators play a functional role *internal* to technical artifacts, which are therefore *sociotechnical artifacts*. Similarly, we should distinguish between usage norms and internal organisation norms, which are constitutive of sociotechnical artifacts. Indeed, such clarification would help addressing the still open terminological ambiguities concerning the exact nature of STSs [2], especially with regard to their actual *boundaries*: while everybody agrees on the fact that an STS includes both a technical and a social subsystem, for many people (e.g., [1]) the social subsystem includes the users, while some recent work [15] suggests a stricter notion, holding that the social components of an STS are just those which are necessary for its functioning, namely human operators plus (indirectly) the norms that define their specific roles. We suggest to use the term *sociotechnical artifact* for this stricter notion, keeping the term *sociotechnical system* for the broader notion.

Failures and impasses. The presence of social components in STSs exposes them to failures in a peculiar way, very different from merely technical systems. Despite the functioning of human operators as system components is usually optimised by meticulous training and instruction, still they may not comply with the rules defining their functional role, as such rules may compete with other rules characterising their individual behavior. In addition, external users are much more loosely guided by system's rules than human operators internal to the system, and are more likely to experience conflicts between system's norms and external norms, often concerning the interaction between users and operators. This creates risks of system failure absent from technical systems, and puts severe constraints to the optimal design and control of STSs. In this perspective, understanding the nature and the different kinds of failures within STS is of utmost importance. Failures cannot be always avoided or mitigated by constraining human behaviour and limiting human intervention by means of laws. In fact, some failures are caused by mistaken human behaviour (as in the Chernobyl disaster) and others are caused by the rigidity of the system, which does not provide enough feedback or completely excludes human intervention in critical circumstances (as in Kubrick's Dr. Strangelove). Yet other failures originate from simple technical faults (a broken connection) or from unpredictable external circumstances (a natural disaster).

Without always resulting in failures, such events can lead to situations of *impasse* in which no further step can be readily imagined or taken.

3 Sociotechnical Systems and Information Systems

In information technology, adaptation and robustness have become central for software-intensive systems accounting for technological, social and legal aspects, such as social computing and socially-aware software applications, service-oriented applications, computational models of normative systems and norm-governed behaviour. The role of social organisation and interaction has been addressed in agent-oriented software engineering [26] and in artificial intelligence, especially in the multi-agent systems community. Considering in particular organisational models, the approach inspired to the language/action perspective [6, 7] has shed new light on previous work on enterprise engineering approaches based on the CIMOSA methodology [14], as well as on the early enterprise ontologies [24]. A further recent trend focuses on systems which not only can reconfigure themselves, but whose purposes can evolve to comply with the changing external constraints and stakeholders' needs [13]. This is a challenge in particular for *embedded systems*, especially if different environmental, technological, social and legal aspects have to be taken into account.

Altogether, we can conclude that several research trends, both from the technical side and from the social and institutional side, advocate the need for a unitary perspective that takes the social aspects as seriously as the technical ones (see also [16, 20]). Despite these efforts, however, no comprehensive theoretical approach provides for the integration between methods and theories supporting analysis and design of social artifacts and those addressing technological ones. In other words, no overarching "science of the artificial" [23] bridging the two dimensions is yet available. We believe that this is partly due to insufficient communication and cross-fertilisation between different groups of people, both within computer science, and between computer science, social science and legal science. In applied computer science, many researchers advocating formal engineering techniques (such as logic-based formalisms or semantic technologies), tend to neglect or over-simplify social aspects, while sustainers of the sociotechnical approach sometimes fail to appreciate the importance of formalisation, or are however still searching for robust and comprehensive formal techniques. Between technological and social disciplines there is an even broader gap, since researchers working in the two fields often ignore methods and results of their counterpart. In particular, technologists fail to understand how norms and institutions shape human behaviour (and thus the design and use of technical artifacts), while social scientists and jurists fail to capture opportunities and constraints embedded in technological architectures.

The inability to capture, in an overarching model, the subtle interactions between the social and the technical components makes it difficult to enable the

overall governance of STSs, as we cannot fully assess their benefits, risks and costs. In particular, without formal enough comprehensive models, we cannot anticipate potential crises leading to impasses or failures, and establish technical and institutional mechanisms able to cope with them, avoiding or mitigating dangerous or even tragic outcomes.

4 Research Challenges and Methodological Suggestions

We believe that only by precisely understanding the complex structure and dynamics of STSs we will be able to adequately design and manage them, and that only by making an STS open and transparent to the reflection of its agents we can make it resilient to unforeseen crises. Therefore, the main research challenge is to develop a *comprehensive, well-founded theory of sociotechnical systems which embeds failures, impasses and recovery attempts at its very heart*.

Right now, we only have separate modelling techniques for *isolated components or aspects* of STSs, such as design specifications for the technical components, interaction and organisational models for inter-agent communication and collective behaviour, deontic models for the normative component, theories of legal norms and institutions. On the contrary, we need a **c**omprehensive theory that *integrates together*:

1. an ontological analysis of STSs' nature and structure, in terms of their internal components and their mutual interactions, covering technical, social and legal aspects;
2. a declarative model of STSs' dynamics, accounting in particular for the constraints on expected behaviours and for the different kinds of anomalous behaviour, including critical situations and recovery patterns;
3. the identification of techno-institutional mechanisms enabling the self-governance of STSs, in particular providing them with the capacity to sustain, avoid or mitigate failures and impasses.

To integrate the above components into a comprehensive theory, we suggest to develop a methodology based on a combination of different approaches:

1. *Failure-oriented approach*, to focus on the most important practical needs concerning the actual deployment of STSs, namely understanding, controlling, and living with organisational *failures*, technical *malfunctionings, misconceived* rules or decisions, or overall system's *impasses*.
2. *Formal ontological analysis,* to establish a rigorous basis for understanding the *nature and structure* of STSs. Building on previous work in applied formal ontology, we can leverage on established results in analytic philosophy from the theory of essence and identity, the theory of parts, the theory of unity and plurality, the theory of dependence, the theory of composition and constitution, the theory of properties and qualities.

3. *Open declarative systems approach* [19], to model and design STSs while taking into account flexibility, adaptability, and transparency. In our view, the *openness* choice means that (1) agent interaction protocols and rules are dynamically *modifiable*, in order to cope with unpredictable and dynamic environments; (2) agents can *violate* the system's norms in an emergency response to a crisis situation; (3) agents have *transparent cognitive access* to the system's structure, goals and governing norms. The *declarative* choice means that norms and behavioural constraints are expressly stated, in order to enable reasoning about unexpected behaviour and malfunctioning cases.

We believe that the vision depicted above has a high social impact. While standard approaches to STSs focus on models, architectures and general recommendations to be adopted at the *design phase*, we insisted on the importance of having the system open also at *operational time*. In other terms, the structure and the functioning of an STS should be *transparent* and accessible to its users and stakeholders, not just to its designers or controllers. In this participatory perspective, where the ontology plays the role of a mediator of design, governance and social participation, the challenge is to give to both the STS's designers and participants the conceptual tools to reflectively understand and discuss the system's structures and operations. In particular, we envision the possibility for participants to anticipate or at least timely detect crisis situations, and identify ways to recover from a system's failure or impasse, while at the same time significantly shape the evolution of the STSs they live in.

Finally, of course, transparency needs to be compatible with privacy. Although we don't have any specific suggestions in this respect, we believe that the design of privacy measures will be facilitated by our approach, which enables to anticipate privacy threats as one of the problematic aspects of STSs, to be countered by a combination of technical, legal and social measures. In particular, our method can provide new support to the idea of privacy by design, whose effective and useful application requires understanding the various communication channels within STSs, the different roles involved and the nature of the data exchanged.

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Part XII
ICT4LAW: Information and Communication Technologies to Help Firms, Public Administrations, Legislators and Citizens to Operate in a Highly Regulated World

Supporting the Analysis of Risks of Violation in Business Protocols: The MiFID Case Study

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Abstract Enterprises and especially banks are subject to a number of regulations, with multilevel nature which continuously change. They must not only to adapt their business processes to the regulations and their changes but also to evaluate the risks of violation of the new rules and to account for responsibilities. This work proposes a formal framework for modeling business interactions ruled by protocols that, being based on the notions of commitment and responsibility, supports the analysis of risks of violation when a new regulation is issued. We provide a software tool for the visualization of the "risk space" and apply the approach to a real-world case study in the banking sector.

1 Introduction

Business processes involve autonomous partners with heterogeneous software designs and implementations. In many practical settings, the reality in which business processes operate is characterized by a high degree of regulation. This is, for instance, the case of banking and of trading services. The single organization needs to actively determine its processes on a permanent basis, to understand how regulations impact on the internal organization, to reason about possible *risks of violation*, and to ensure *compliance* to directives and laws. In such cases, the specification of the business interaction acquires a normative value and is commonly referred to as *business protocol*. Traditionally, business protocols are tackled by means of BPMS adopting standardized notations. Unfortunately these approaches are characterized by high rigidity; they do not account for the decisional processes nor for responsibilities. Instead, business protocols should enable a *flexible enactment*, to allow the interacting parties, who are heterogeneous,

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autonomous, and basically self-interested entities, to find the way of interacting that better suits their characteristics and requirements, and to profit of opportunities. Moreover, business protocols must be *modular* in a way that simplifies keeping them compliant to regulations, which often change along time. Let us consider the case of directives issued by supranational authorities and institutions, these *graft* onto protocols, by adding new activities which are interleaved with those of the previous protocols. Traditional approaches make protocols not suitable to easily take in new regulations because the composition techniques, that can be applied, easily impose unnecessary orderings of the interactions, by and large, require to rewrite the protocols from scratch.

In this work we propose to use *commitment-based protocols* that include temporal regulations [3]. These are fundamental in highly regulated contexts because they allow the specification of those behavioral constraints that are foreseen by norms. For this framework we developed a tool (available at http://www.di.unito.it/~alice/2CL) for allowing the business analyst to visualize and study all the possible enactments of a protocol, in order to detecting the possible violations. The interaction of a set of parties complies to a business protocol (i.e. it causes no violation) if, in the end, all the commitments they have taken were fulfilled and no temporal regulation was broken. The analysis of possible violations amounts to the identification of the risks the interaction could encounter. The evaluation of such risks will allow the definition of operational strategies, that will affect the business process, by, alternatively, preventing the occurrence of violations (*regimentation*) or implementing alerting mechanisms (*enforcement*) [8]. The tool was applied to the MiFID case study, which is one of the benchmark case studies of the ICT4LAW project (http://www.ict4law.org). MiFID stands for the Markets in Financial Instruments Directive, directive number 2004/39/EC [1], issued by the European Commission within the Financial Services Action Plan, which represents a fundamental step in the creation of an integrated and harmonized financial market within EU.

The paper is organized as follows. Section 2 introduces MiFID, models a sales protocol pre-existing MiFID, and then grafts MiFID into this protocol. Section 3 shows the outcome of the tool we developed and the kinds of reasoning that this supports. Conclusions and related works end the paper.

2 Modeling MiFID

In this work we adopt the approach to the representation of the *business protocol* that is discussed in [2, 3], and which is based on *commitments*. Commitments are directed from a debtor to a creditor. The notation $C(x, y, r, p)$ denotes that agent x commits to an agent y to bring about consequent condition p when the antecedent condition r holds. When r equals *true*, we use the short notation $C(x, y, p)$. The business partners share a social state that contains commitments and other literals that are relevant to their interaction. Every partner can affect the social state by executing actions, whose definition is given in terms of operations onto the social

state, see [13]. The partners' behavior is affected by commitments, which have a *regulative* nature, in that debtors should act in accordance with the commitments they have taken. Moreover, the proposal is characterized by a regulative specification that explicitly foresees the representation of temporal constraints among commitments/facts. Such temporal regulations represent, as we will see, those "grafting points" that allow the accommodation of a new regulation inside a business protocol.

Definition 1 (Business protocol). A business protocol P is a tuple $\langle Ro, F, A, C \rangle$, where Ro is a set of roles, identifying the interacting parties, F is a set of literals (including commitments) that can occur in the social state, A is a set of actions, and C is a set of constraints.

The set of social actions A, defined on F and on Ro, forms the *constitutive specification* of the protocol, while the set of constraints C, defined on F and on Ro too, forms the *regulative specification* of the protocol. We assume that facts persist in the social state, they denote observations about events that occurred.

2.1 Pre-MiFID Sale Business Protocol

Let us begin by presenting a sales business protocol, that was legal before the introduction of MiFID. The actions involve three parties: an investor (*inv*), an intermediary (the financial promoter *fp*), and a bank (*bank*). This protocol foresees an initial state containing a commitment, C(*fp*, *inv*, *invested*), from the intermediary to the investor to find a good investment. By the action *propose_solution*, the intermediary presents a selected financial product to the investor. The proposal is characterized by a risk level, and can be rejected (*reject_proposal*) or accepted (*sign_order*). In the first case, the commitment of the intermediary is released. When the order is signed, the investor commits to the bank to respect the purchase contract (C(*inv*, *bank*, *contract_ended*)). The bank is expected to countersign the contract (it does it by the action *countersign_contract*, which creates a commitment C(*bank*, *inv*, *executed_order*) from the bank to the investor to actually execute the order), and send a copy of it to the investor (*send_contract*). When the bank countersigns the contract, the initial commitment of the intermediary is discharged. Moreover, the bank is also expected to *notify* the intermediary the contract was countersigned. The notification guarantees to the intermediary that everything was fine and he/she will get his/her commission. This should be done after the contract was sent but before the natural end of the contract. The natural end of the contract is captured by the action *end* which causes the discharge of the pending commitments of the investor and of the bank.

The *constitutive specification* of actions is given by defining their meaning in terms of how they affect the social state. The *means* construct amounts to a *counts-as* relation [10]:

(a) *propose_solution* **means** *proposed_RiskL* **if** $\neg$ *proposed_RiskL* $\wedge$ $\neg$ *rejected_proposal*.

(b) *reject_proposal* **means** *rejected_proposal*, RELEASE(C(*fp*, *inv*, *invested*)) **if** $\multimap$ *accepted_proposal* $\wedge$ *proposed_RiskL* $\wedge$ $\multimap$ *rejected_proposal*.
(c) *sign_order* **means** CREATE(C(*inv*, *bank*, *contract ended*)), *accepted_proposal*, *order_signed* **if** $\multimap$ *order_signed* $\wedge$ *proposed_RiskL* $\wedge$ $\multimap$ *rejected_ proposal*.
(d) *countersign_contract* **means** *contract_countersigned*, CREATE(C(*bank*, *inv*, *executed_order*)), *invested* **if** *order_signed* $\wedge$ *proposed_RiskL* $\wedge$ $\multimap$ *contract_ countersigned*.
(e) *send_contract* **means** *contract_sent* **if** $\multimap$ *contract_sent* $\wedge$ *contract_ countersigned*.
(f) *notify* **means** *notified* **if** *contract_countersigned* $\wedge$ $\multimap$ *notified* $\wedge$ $\multimap$ *contract_ended* $\wedge$ $\multimap$ *contract abort*.
(g) *end* **means** *executed_order*, *contract_ended* **if** *contract_sent* $\wedge$ $\multimap$ *contract_ended* $\wedge$ $\multimap$ *contract_abort*.

The protocol also includes some temporal constraints:

(c1) *notified* $\rightarrow\bullet$ *contract_ended* (i.e. *notified* before *contract_ended*)
(c2) *contract_sent* $\bullet\rightarrow$ *notified* (i.e. *notified* in response to *contract_sent*)

These constraints give the bank the freedom to choose whether notifying the intermediary before sending the investor copy of the contract, or the other way around. In the latter case, (c2) imposes that after the contract was sent, the bank must perform the pending notification.

2.2 Grafting of MiFID

One of the main advantages of our proposal is that it supports a *modular composition* of the protocols, which is obtained by performing a simple union of the components of the protocols (after a renaming aimed at avoiding name clashes). Intuitively, this composition amounts to the *grafting* of a new regulation inside a protocol. Let us, therefore, consider the "Markets in Financial Instruments Directive" (MiFID) [1], issued by the European Commission, and, specifically, the regulation that applies to the offer of investment services off-site. This is the case when a bank promotes and sells financial products with the help of external collaborators (called "tied agents" or intermediaries). MiFID grafts onto the previously existing financial product *sales protocols*. In other words, it affects a previously existing reality and must be accommodated with activities, that are normed by already existing regulations. It requires the enrichment of the business protocol with new, specific actions aimed at:

- Identifying the investor and supplying the foreseen documentation (*interview*).
- Profiling the investor (*profile*). In the profiling process, the intermediary commits to evaluate, with the help of a simulation, financial products in order to identify one that suits the client (C(*fp*, *inv*, *evaluation*)), and assigns the investor a risk category (*investor_classified*).

- Classifying the financial products according to the possible risk levels (*classify*).
- Evaluating the proposed financial product through a simulation (*fi_evaluation*). This action commits the intermediary to propose a product with a risk level that is adequate to the investor's profile (C(*fp*, *inv*, propose_*RiskL*)).
- Discarding solutions that are not adequate to the profile (*fi_discard*). In this case the intermediary's commitments will be canceled.
- Verifying that the documentation, sent to the investment trust, does not contain errors or missing data (*order_verification*). If everything is right, this action commits the bank to the investor to execute.
- Withdrawing a contract (*withdraw*). This action concludes a contract by aborting it and by releasing the commitment from the bank to execute the order.

The selection and evaluation of a new proposal are modeled as a new interaction.

(h) *interview* **means** *investor_identified*, *document_supplied* **if** $\neg$ *investor_identified* $\wedge$ $\neg$ *contract_abort* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *rejected _proposal* $\wedge$ $\neg$ *fi_discarded*.

(i) *profile* **means** CREATE(C(*fp*, *inv*, *evaluation*)), *investor_classified* **if** $\neg$ *investor_classified* $\wedge$ *investor_identified* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *contract_abort* $\wedge$ $\neg$ *rejected_proposal* $\wedge$ $\neg$ *fi_discarded.*

(j) *classify* **means** *classified* **if** $\neg$*classified* $\wedge$ $\neg$ *contract_abort* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *rejected_proposal* $\wedge$ $\neg$ *fi_discarded* $\wedge$ $\neg$ *proposed_RiskL.*

(k) *fi_evaluation* **means** CREATE(C(*fp*, *inv*, *proposed_RiskL*)), *evaluation* **if** *classified* $\wedge$ *investor_identified* $\wedge$ $\neg$ *evaluation* $\wedge$ $\neg$ *contract_abort* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *rejected_proposal* $\wedge$ $\neg$ *fi_discarded.*

(l) *fi_discard* **means** *fi_discarded*, CANCEL(C(*fp*, *inv*, *invested*)), CANCEL(C(*fp*, *inv*, *proposed_RiskL*)) **if** *evaluation* $\wedge$ $\neg$ *proposed_RiskL* $\wedge$ $\neg$ *contract_abort* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *fi_discarded.*

(m) *order_verification* **means** *order_verified*, CREATE(C(*bank*, *inv*, *executed_order*)) **if** $\neg$ *order_verified* $\wedge$ *order_signed.*

(n) *withdraw* **means** *contract_abort*, RELEASE(C(*bank*, *inv*, *executed_order*)), CANCEL(C(*inv*, *bank*, *contract_ended*)) **if** *contract_sent* $\wedge$ $\neg$ *contract_ended* $\wedge$ $\neg$ *contract abort*.

Actions *(h–l)* should be executed before the actual sale occurs, while *(m–n)* complete the sales process but MiFID does not have the power to modify the actions which implement a sale. The integration of the new directive with the previous regulation is, therefore, done by means of a set of **2CL** constraints relating facts and commitments: in particular, those pertaining MiFID and those pertaining sales:

(c3) C(*f p*, *inv*, *invested*) $\bullet\!\!\rightarrow$ *investor_identified* $\wedge$*document_supplied*
(c4) *investor_classi f ied* $\rightarrow\!\!\bullet$ C(*fp*, *inv*, *propose_riskL*)
(c5) *evaluation* $\wedge$ $\neg$ *fi_discarded* $\rightarrow\!\!\bullet$ *proposed_RiskL*
(c6) *order_verified* $\rightarrow\!\!\bullet$ *contract_countersigned*

(c3) states that once the intermediary took the commitment to serve the investor, he/she must have the investor identified and must supply the necessary

documentation to him/her. (c4) expresses the fact that before committing to propose a solution with a certain degree of risk, the investor must have been classified. (c5) states that before proposing a financial product it is necessary to have it positively evaluated by the simulation. Finally, before the contract is countersigned by the bank, the data of the order must have been verified. The grafting of MiFID inside the sales protocol is given by the union of the respective components, in particular: actions (a)–(g) with (h)–(n); constraints (c1)–(c2) with (c3)–(c6).

3 Detecting Risks of Violation

The developed model allows reasoning about the risks of violation that are introduced by the introduction of new regulations. So, for instance, what happens if an intermediary buys a financial product for a client, violating some of the constraints imposed by MiFID? The *sale is valid*, the client results to be the owner of the product. This happens because MiFID does not define *sales* (sales are defined by a different regulation) but dictates how the interaction with the client should be carried on. So, the violation does not affect the sale directly but creates both a *risk of sanction* and an *risk of exposure* for the intermediary. This is witnessed by a sentence by the Italian Supreme Court (*Cassazione civile a sezioni unite*, num. 26724 and 26725 [6]) which decided that in case of violations, like the above, if the client was economically damaged he/she can ask for a compensation and, in the most serious cases, for the cancellation of the contract between the client and the intermediary.

Basically, in our model we identify two kinds of violation: a commitment is not satisfied, a constraint is not respected. The tool that we developed allows exploring all the possible executions of a business protocol, showing both kinds of violations. Technically, it is an extension of Winikoff et al.'s enhanced commitment machine [12], implemented in *tuProlog*, which can interpret **2CL** business protocols by means of a parser written in Java. The tool produces a graph that shows all the possible executions visualizing the "risk space". Figure 1 reports part of the graph obtained in the case of MiFID. Each state represents a possible configuration of the interaction. Arrows correspond to actions and are directed. The source is a state where the "if" condition of the action labelling the arc holds. The target is, instead, the state obtained by applying the meaning of the executed action to the source state. Basically, solid lines denote legal moves. States that are drawn as diamonds with an incoming dotted arrow (e.g. states 129 and 77) represent the fact that a *before* constraint, or a *cause* constraint or their negation has been violated. Some states are gray (e.g. 129 and 57), the meaning (independently from the shape) is that some *response* constraints or a *cause* constraint are not fulfilled yet. Gray states with a single outline (e.g. 1 and 149), independently from the shape, mean that there are some active commitments (not discharged, released or cancelled). States with a double outline (independently from the shape) do not contain

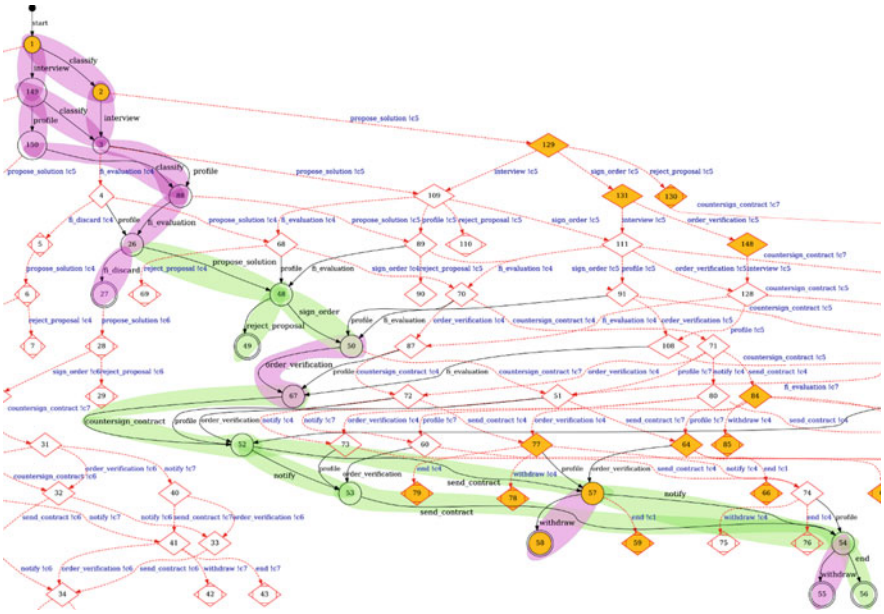

Fig. 1 Excerpt of MiFID risk space. High resolution images at http://www.di.unito.it/ãlice/

any active commitment (e.g. 27, 58, 79). Final acceptable states are, therefore, white and are denoted by double circles to express that there is no active commitment and all constraints are satisfied (e.g. 55, 56). A legal path connects the initial state with one of the final states and is made by all solid arrows.

The legal executions are highlighted in dark and light gray. Notice how the actions of MiFID (highlighted in light gray) are immersed in the original sales protocol (highlighted in dark gray). As the figure shows, *classify* and *profile* must be executed before proposing a product but since there is no relation between them, they can be executed in any order. The protocol, however, does not need to specify explicitly each of the interleavings. Moreover, state 58 is not final: its color tells us that some constraint is not satisfied yet but since no action is executable, this state is a *cul-de-sac* to be avoided. Instead, proposing a solution when being in state 3 (right after interview and classification) violates constraint (c4) imposed by MiFID.

By analyzing the graph, the designer can identify the points where it could be helpful to intervene to reduce the possible violations, for instance, by applying enforcement policies or by regimenting some steps. For example, one action on which it would make sense to intervene is *propose_solution*. The reason is that most of illegal paths start from a bad use of this action. Of course, this choice depends on many factors (e.g. the cost of implementing the prospected solution, the time needed to update the software) that are out of the scope of the directive.

4 Conclusion and Related Works

We have proposed a declarative approach to business protocol specification that extends [11] by explicitly including **2CL** temporal regulations. We implemented a tuProlog extended commitment machine, which was applied to the MiFID case study, whose output allows the analysis of the business protocol and of possible violations. Indeed, in these contexts it is important to define mechanisms for detecting possible violations and decide about possible regimentations/enforcements. One of the main advantages of the declarative approach, that we have proposed for the representation of business protocols, is that it supports a modular composition of such protocols, as hoped for in [9]. Another advancement w.r.t. the literature is that we developed an analysis tool, which supports the business analyst in performing task like: understanding the impact of new regulations on the business protocol or deciding about enforcement policies or regimentation.

Telang and Singh [11] proposed a commitment-based approach to representing business protocols and identified a set of common patterns of interaction, that can be used by the business analyst. Along this line, also [4] proposes commitment patterns that capture common business patterns, showing which robustness requirements are met by each of them. These requirements are supposed to guide the protocol designer in the selection and composition process. Concerning composition, [14] proposes temporal operators to compose the data flow in a commitment-based approach. The use of expressive temporal constraints allows going one step beyond the ones above thanks to a finer-grained representation of the regulations. This is an added value in the modeling of business interactions because it enables the embedding of regulations that stratify along time.

Recently, many works, like [5, 7], focused on the problem of verifying the compliance of a business process to a body of norms. This issue is different in that the business process is rigidly modeled as a (YAWL or BPM) workflow, and the verification aims at checking if this process strictly respects the norms, providing, in some cases, a yes or no answer and, in some others, a degree of compliance.

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Change the Law: A Simulation of the Reduction of Payment Period of Trade Debts on Italian Firms

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Abstract The late payment of trade debts is a bad practice diffused mainly in Mediterranean countries and triggered by large firms and above all by public authorities. In February 2011, the European Parliament and the Council of the European Union have adopted the directive 2011/7/EU on combating late payment in commercial transactions. The directive poses, generally, the limit of 60 calendar days for contractual payment period. In Italy, the average payment period is about twice this limit. The aim of this paper is to estimate the impact on Italian firms of the reduction of payment period to the European parameters. The simulation is based on more than 210,000 annual statements of Italian limited companies (year 2009). The expected effects involve both balance sheet and profit and loss account. The results show important micro and macro economical effects emerging from the application of the EU directive. The evidence regards the whole sample and becomes stronger for some particular groups of firms: size, sector, geographical area and rating class.

1 Introduction

Enterprises act in a complex system in constant transformation. Business conduct is influenced by non-formalised norms, i.e. implicit rules, or norms related to the market, i.e. the definition of the system price.

In spite of the fact that some changes are not predictable, as stock market crash or environmental calamities, companies and policy makers try to simulate scenarios even if the impacts of these events are not easily measurable.

Firm behaviour is also affected by new or updating laws, in some cases it is possible to forecast more precisely the consequences on the subjects involved in the

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event. Simulation can take into account only micro-macro economical effects, that interest mainly policy makers to evaluate the goodness of the new law, or may be agent-based to make prediction about the single firm behaviour in a context of business intelligent.

In February 2011, the European Parliament and the Council of the European Union have adopted the directive 2011/7/EU on fighting late payment in commercial transactions. The main purpose of the new directive is to improve the former directive and ensure the proper functioning of the internal market, thereby fostering the competitiveness of undertakings and in particular of SMEs.

The late payment of trade debts is a bad practice diffused mainly in Mediterranean countries and triggered by large firms and above all by public authorities. According to Intrum Justitia [1] European companies have lost 312 billion euro in 2010 because of delays and defaults payments. The payment period in European countries range from an average of about 30 days in Scandinavian countries and in Germany to more than 100 days in South Europe. SMEs, which account for about 56% to GDP in Europe are most affected by the increase in insolvencies and were forced to make a loss of 3% of their turnover compared to the average value of 2.6%. The written-off percentage on European level was less than 1% at the beginning of the decade.

Payment period of trade debts can be shared in contract terms and late payment. Both can vary country by country and depend on the penalties imposed for the delay, the means of payment, cultural factors. There is also evidence of unjustifiably long contractual payment periods in transactions involving public administrations. In the current context of economic recession, late payment in commercial transactions represents an aggravating factor for the business system.

The aim of this paper is to estimate the impact of the reduction of payment period to the European parameter on more than 210,000 Italian limited firms. The methodology is based on the simulation of the balance sheet and the profit and loss account taking into consideration the predictable single firm behaviour. Data acquisition and rating calculations come from AIDA database.

The remainder of this paper is organised as follow: Section 2 reports the payment period legislation framework at EU and at Member States level. Section 3 briefly examines stylized facts on trade debts from the financial, operational and commercial perspective. The next sections show the methodology and the results of the empirical simulation, whereas the last section illustrates the conclusions of the paper.

2 Payment Period Legislation Framework

There is overwhelming evidence that, despite the entry into force of directive 2000/35/EC late payment in commercial transactions is still a general problem within the European Union. According to the Commission, this is a serious impediment to a healthy business environment and to the functioning of the single market amplified

in times of economic downturn. Therefore, while safeguarding the main elements of this directive, the Commission decided to introduce additional tools to reduce the number of late payments in commercial transactions, to shorten payment periods for public administrations and to reinforce substantially the incentives for public administrations to pay in time.

The new directive (2011/7/EU) aims at improving the effectiveness and the efficiency of remedies for late payment through the introduction of an entitlement to the recovery of administrative costs and compensation for internal costs incurred due to late payment. The reduction in the number of late payments in commercial transactions is one of the ten principles cited in the Small Business Act for Europe as a means to help SMEs to deal with the difficult market conditions currently being experienced. This Directive lays down the specific deadlines for the payment of invoices and establishes a right to compensation in the event of late payment in all commercial transactions, whether they relate to transactions between private or public undertakings, or between undertakings and public authorities.

As far as the aim of this paper is concerned, the period for payment fixed in the contract must not exceed 60 calendar days, unless otherwise expressly agreed in the contract and provided that is not grossly unfair to the creditor. In transactions between undertakings and public authorities, derogation in the Directive allows certain public undertakings, as well as enterprises providing healthcare, to extend the statutory payment period up to a maximum of 60 calendar days. That is, in the case of business-to-business provision the limit is recommended, whereas for the supply by undertakings to public administrations the parameter is compulsory.

Nevertheless, there are significant differences in legislation, culture, practices and market size in the various European countries. Member States may bring into force laws and regulations, which are more favourable to the creditor than the provisions of the new Directive or impose penal or civil sanctions to debtors.

In France, according to *La loi de modernisation de l'économie* (2008), late payment is subject to a civil penalty and is punished with a fine of 15,000 € (natural person) and until 75,000 € (corporate). French legislation reports a list of derogatory agreements. Kremp and Lorenzi [2] show that the reduction of payment period has been effective also during the recent financial crisis.

In UK, the *Late Payment of Commercial Debts Act* (1998) does not make any provision for a failure to issue payment notice and the absence of any sanction is considered a significant void [3]. Some joint initiatives are working to help tackle late payment. Businesses that sign up to the code commit to paying their suppliers on time can display the logo on documentation and website. The code is developed by Government, and endorsed by banks and business organisations.

In Germany, late payment is governed by §§ 280 (2), 286 to 290 of the *Bürgerliches Gesetzbuch*. "The German legal system strongly encourages the settlements of trade creditors. The far-reaching legal claim, . . . , also assures the seller who has agreed such a clause with the purchaser the right of access to the processed product and a claim to the proceeds of a later resale and expands the reservation of ownership to claims on the corporate group as a whole or on existing current account debtors" [4].

In Italy, the directive 2000/35/EC has been notified with the *Decreto legislativo 231/2002*. It has had little impact due to a non-appreciable deterrent effect on late payments by increasing the risk on the trade debts granted to customers. Even today, this problem afflicts the Italian economy, slowing and weakening the activities of companies [5].

3 Stylized Facts on Trade Debts

Literature on late payment of trade debts is twofold. The former concerns macroeconomics aspects and mainly monetary policies [6], the latter, with regards this paper, concerns the payment behaviour of firms from the financial, operational and commercial perspective.

Many firms use trade debts as a substitute for bank credit due to credit rationing [7] in a context of high information asymmetries [8] or as a source of finance in the case their suppliers denote high creditworthiness to obtain funds to transfer to them [9]. Financing motives arise also from the resistance to using external equity [10] and from the comparison of costs in obtaining credit from suppliers rather than from financial institutions [11]. Trade credit is perceived cheaper due to implicit interest costs are not considered and high transaction costs of management time are placed to bank loans.

Operational motives are related to uncertainty about the level of cash that needs to settle payment and provide flexibility in terms of demand fluctuations [12]. Trade credit is characterised by a two-way nature in particularly for firms in the middle of the value chain, they use trade credit as customers and provide it as suppliers [13]. In the case of cash flow shocks, undercapitalised firm will be more sensitive to late payment and be part of a domino effect from one supplier to another [14]. Generally, SMEs spend little time on working capital management or monitoring net trade credit position.

On the customer side, lengthening the trade credit or offering the discount for prompt payment can be considered elements of price discrimination [7] and a mean of building trading relationship. On the supplier side, firms pay late where relationship is poor and many suppliers are available [15] or are affected by the power size of firms [14]. A feature that literature has not investigated yet regards the inefficiencies related to the waste of resources for the management of trade credit reclaim: mainly time, human resources and credit manager's bill.

4 Data and Method

The simulation is based on more than 210,000 annual statements of Italian limited companies (2009). The sample covers 4.0% of Italian companies, 23.4% of limited companies and 27.7% of the national value added at factor cost.

All sectors have been taken into account. The only selection condition has been the availability of all the statement items useful for running the simulation due to most firms do not properly itemize the balance sheet, in particular debts.

The first step is the reckoning of the average collection and payment periods, respectively trade credit on sales and trade debts on purchases expressed in days and including VAT, and, in case, their cutting to 60 days so to reduce trade credit and/or trade debts. Two situations arise: the reduction of the total amount of trade credits is larger than the reduction of trade debts (positive impact) or vice versa (negative impact). On average, in 2009 payment period lasted 104.6 days, significantly worse results were performed by micro firms (106.3), mining (139.3), utilities (124.8), construction (124.8), ICT (135.6), Southern firms (116.0) and low rating (CCC 149.2, B 140.0). Collection period lasted 121.3 days; significant worse results were performed by micro firms (124.5), agriculture (161.1), mining (155.8), utilities (154.2), construction (143.2), Southern firms (156.1), low rating (CCC 196.6, B 176.0). Firms with more than 200 million € of turnover denoted the lower results, but the higher gap between the two ratios (34.2 days pros payment period). 49.0% of the sample will take advantage of the new law against 38.3%. 12.6 of the sample will be not affected. Negative gaps are registered only by very large firms, agriculture sector and Southern firms.

The second step is the simulation of the balance sheet. The predictable single behaviour is based on the company rating, according to Basel II standards, and the deal with bank managers. The strict application of the regulation should demand new founds from shareholders and/or from banks if the effect is not favourable (after charging liquid funds and avoiding negligible capital increase) or, on the contrary, make available resources. In the negative case the higher the rating, the easier to demand funds to banks instead of shareholders (Table 1, column 2 and 3). In the positive case it is supposed that (Table 1, column 4) if the rating is low (B and CCC) the positive net trade position is used to reduce financial loans, if the rating is high (AAA and AA) there is no need to reduce them, whereas the deal with banks persist for the middle rating (A, BBB and BB). In the case resources remain, they are used in order to reduce other debts (with the same rule for financial debts), reduce shareholder funds (in case of middle and high rating with the ratio share fund

Table 1 Behaviour hypothesis based on rating company

Rating	Demand of new funds covered by shareholders (%)	Demand of new funds covered by banks (%)	Reduction of banks debts and other debts (%)	Interest rate
AAA	10	90	0	3.0
AA	20	80	0	3.5
A	30	70	20	4.0
BBB	40	60	50	4.5
BB	50	50	80	5.0
B	100	0	100	5.5
CCC	100	0	100	6.0

Note: Percentages and other bank deals issue from interviews with three managers

Table 2 Behaviour hypothesis based on collection and payment periods

Collection period	Expected sales and costs increase (%)	Expected human resources saving (%)	Payment period	Expected discount (%)
60	0.00	0.0	60	0.0
90	0.25	0.5	90	1.0
120	0.50	1.0	120	2.0
180	1.00	2.0	180	4.0
270	1.75	3.5	270	7.0
360	2.50	5.0	360	10.0
720	5.50	5.0	720	10.0
1.080	8.50	5.0	1.080	10.0

Note: Percentages issue from interviews with five companies and have been underestimated

on fixed assets higher than 1.5 and avoiding negligible capital decrease) and finally invest in fixed assets.

The third step is the simulation of the profit and loss account that is affected by the changes occurred in the balance sheet and by the removal of the operational inefficiencies due to late payment. The change in financial debt previously calculated results in a corresponding change in financial charges where the rate of interest depends on the company's rating (Table 1, column 5). The increase of investments previously calculated results in a corresponding rice in depreciation whose share was estimated at 10%. The reduction of collection period can reduce prices, consequently increase sales and variable costs in a fixed proportion, and involve less waste of human resources engaged in credit recovery. The percentage increase in revenues and costs and the percentage of savings in wages and salaries are estimated in proportion of the collection period (Table 2, column 2 and 3). The reduction of payment period allows obtaining discounts on purchases. The percentage of cost savings was estimated in proportion of the payment period (Table 2, column 5). The variation of these items leads to a new profit before tax and changes in taxes, thus, a new result and the simulation of a new rating [16].

5 Simulation Results

The analysis of the simulation results can be twofold: in terms of economic performance, how the business progressed after the law change, and in terms of rating analysis of risk, how the new law affected company reliability. The main question is "who gained, who lost?"

As a whole, banks should reduce loans by 2.3 and cash less interest by 3.2%, this cannot be a bad news for banks due to the loans in question are short term and affect tier 1 capital ratio. Positive results regards the national economic system due to investments should increase by 3.0%, value added by 0.3%, inefficiencies in human resources should fall by 0.7% and profit before taxes should increase by 31.4%, namely also Italian State should gain.

This evidence regards the whole sample and becomes stronger for some particular groups of firms (size, sector, geographical area and rating class). The same algebraic sign occurs in all subgroup except bank loans for very large firms (+0.7%), agriculture (+3.3%), construction (+0.5%) and rating A firms (+1.6%). The quantitative analysis of profit before taxes can sum up the results at short time, whereas the investments in fixed assets at long-term as expected of future positive results. With regard to size and to geographical area it seems that the new law should benefit more fragile firms like micro and small companies (84.1% and 10.1%; 72.0% and 7.0%) and the ones located in Southern Italy (67.0% and 5.1%). Both variables are sensible higher than that of the other subgroups. Referring to sectors only manufacturing (45.0% and 4.1%) should be advantaged both in the short and in the long-term, whereas firms with high rating denote significant growth only in investments (AAA 5.0%, AA 4.9%, A 6.2%).

The first result to mention in risk analysis is that shareholder funds should raise by 3.1. More risk capital will be demanded to micro and small firms (8.5%, 4.7%), Southern firms (6.3%), ICT (6.5%) and firms with low rating (CCC 20.0%, B 15.3%). The risk refers to the inability to detain the funds requested. For this reason two thresholds of at least 10% or 50% of increase of capital has been considered so to detect who should denote troubles. They are respectively 15.6% and 9.7% of the sample; both levels seem to be affordable by Italian economy. This aftermath could also promote a positive merger process triggered by the firm with available resources by the new law.

A more precise analysis of company reliability refers to the change of rating class after coming into effect of the new law. The firms shifting in default are 0.5%, mainly small firms (0.7%) and law rating (CCC 5.7%, B 2.3%). The firms that improve the rating are 43.1% (medium and large firms, Southern firms and low rating) and the ones that worsen the rating are 24.6%.

6 Conclusions and Information Systems Implications

Payment period of trade debts can be shared in contract terms and late payment. The length of both affects the performance of suppliers. Nevertheless, contract terms can be negotiated and manly require good working capital management, whereas the payments made later than agreed negatively affects liquidity, competitiveness and profitability of creditors. The solutions adopted by the other European countries are hardly applicable to Italian context for cultural and structural factors. Nonetheless, in Italy, the role of banks in commercial transactions is crucial, they could be involved with committed state bodies in the setting of a dedicated remote banking platform where payments are insured and laggards are highly discouraged. The information system could be defined a sort of postponed factoring and, by the way, could foster the research of the new customers, worthy to be part of the platform, and regulate financial resources.

The aim of this paper has been to estimate the impact on Italian firms of the reduction of payment period to the European parameters. With regard Italian economic system, the impact seems to be positive overall. The firms that will take benefit of the new law are significant more than the ones will be disadvantaged. Investments should sensible increase, value added and profit before taxes as well.

An aspect that needs more analysis concerns the effects on weak Italian firm samples: small, Southern and or low rating. In these cases, the reduction of payment period seems to act as an "avenger". These firms perform better than other similar subgroups but suffer more risk default and the probable lack of new shareholder funds to sustain the change. The law would cleanse the economic systems, distinguishing good companies from bad ones.

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Business Process Compliance Verification: An Annotation Based Approach with Commitments

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Abstract In this paper we present a framework to support business process compliance verification. A process model, provided in a Business Process Modeling tool, is annotated with information relevant for compliance verification. In particular, if a condition is mentioned in a regulation, an activity that makes that condition true, or that requires it as a precondition, should be annotated accordingly. In our approach, annotations are defined by specifying the effects of atomic tasks, including the obligations they generate, using Artificial Intelligence techniques for reasoning about actions and the notion of commitment developed in the context of a social approach to agent communication. Verifying the compliance of a business process to a regulation includes checking that, in all executions of the business process, all the obligations triggered by the norms are fulfilled. Such a verification is performed using model checking techniques for Temporal Logics. Two approaches are explored, one based on Colored Petri Nets, and one based on Answer Set Programming.

1 Introduction

Verifying the compliance of business processes with respect to normative regulations has become an important issue to be addressed. Many organizations (banks, hospitals, public administrations, etc.), whose activities are subject to regulations are required to justify their behaviors with respect to the norms and to

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show that the business procedures they adopt conform to such norms. In the financial domain, in particular, the Sarbanes-Oxley Act (commonly named SOX), enacted in 2002 in the USA, describes mandates and requirements for financial reporting, and was proposed in order to restore investors' confidence in capital markets after major accounting scandals. MiFID (Markets in Financial Instruments Directive) is a EU law, effective from 2007, with similar goals, including transparency.

In this paper we present a framework to support business process compliance verification based on the following ideas.

1. The business process is modeled in a Business Process Modeling tool; such a modeling should be useful independently of compliance verification purposes.
2. The process model is annotated with information relevant for compliance verification. In particular, if a condition is mentioned in the norms ruling the business process, an activity that makes that condition true, or that requires it as a precondition, should be annotated accordingly. Here we exploit Artificial Intelligence techniques for reasoning about actions for defining such a semantic annotation.
3. Compliance verification is performed using formal methods from Computer Science, based on Temporal Logics and on Model Checking.

In the following sections we provide some more details on the basic ideas.

2 Process Modeling

Business Process Modeling (BPM) is becoming widely used for several purposes. Specifically, BPM may be both a powerful tool to represent business processes and to support a manager during his decisional activities, as well as a powerful programming environment. Whereas in the former case we need only a BPM notation, in the latter one, an executable code is generated, based on the graphical specification provided by the chosen notation, in order to be executed by a workflow engine.

Several BPM languages and tools have been developed, for example Business Process Modeling Notation (BPMN), Business Process Execution Language (BPEL), Unified Modeling Language (UML), XPDL, and so on.

In particular, YAWL (Yet Another Workflow Language) [24] is suitable to be adopted in a general framework because it is an open source system, and it is a result of a deep analysis of business process modeling practice [25]; it comes with a formal foundation, allowing for well-founded formal analysis for achieving validation and verification goals.

As a running example we consider a fragment of the business process of an investment firm, offering financial instruments to an investor. Its YAWL description is given in Fig. 1. We may be interested in verifying its compliance to current regulation, which might include norms requiring, for instance, that:

(1) The firm shall provide to the investor adequate information on its services and policies before any contract is signed;

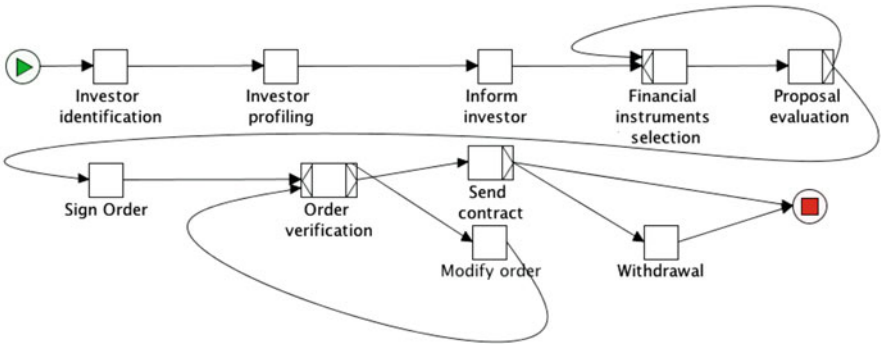

Fig. 1 Example business process in YAWL

(2) If the investor signs an order, the firm is obliged to provide her a copy of the contract.

Due to the presence of norms like these, the execution of a task in a business process may require that some obligations have been fulfilled and may generate new obligations to be fulfilled. For instance, according to norm (2), signing an order generates for the firm the obligation to provide a copy of the contract to the investor.

In our approach, verifying the compliance of a business process to a regulation requires to check that, in all executions of the business process, all the obligations triggered by the norms are fulfilled. To this purpose, a specification of the effects of atomic tasks on the state the business process execution is needed, as well as a specification of the obligations triggered by the execution of atomic tasks themselves.

3 Process Annotation: Defining Effects and Preconditions of Atomic Tasks in an Action Theory

The description of the atomic actions occurring in the business process provides the background knowledge common to both the business process and the norms. The effects and, possibly, the preconditions of the atomic tasks are defined by introducing propositions representing the properties of the world that are affected by the execution of the tasks and are subject to the norms. They are the properties whose value is to be checked for compliance verification. Such properties are sometimes used in the literature [9, 13, 26] as annotations that decorate the business process.

In our approach, annotations are defined by specifying the effects of atomic tasks, by using Artificial Intelligence techniques for Reasoning about Actions and Change [8, 22]. We define annotations by rules that describe effects and preconditions of the atomic tasks (boxes in the YAWL specification).

For instance, the atomic task *inverstor_identification* can be regarded as an action with effect *investor_identified*; the atomic task *profiling* as an action with *effect*

investor_classified, the task *inform_investor* has *effect informed* and so on. We can represent these effects with the following rules (in the A language [8] notation):

investor_identification(*I*) **causes** *investor_identified*(*I*)
profiling(*I*) **causes** *investor_classified*(*I*)
inform_investor(*I*) **causes** *informed*(*I*)

Rules defining executability conditions for atomic tasks can also be given. For instance,

non executable *sign_order*(*I*) **if** ¬ *informed*(*I*)

states that an order can only be signed if the customer has been informed. Observe that in this case the precondition represents a "good property" that the modeler would like to verify on the business process (and it actually holds in the example).

According to the normative specification, the execution of each task in the business process can trigger some normative position (obligation, permission, prohibition). In the example, the *sign_order* task generates the obligation to provide the investor a copy of the contract. For the process to be compliant, this obligation must be fulfilled during the course of execution of the business process.

In our approach, we use causal rules to represent norms in the action theory, and we introduce a notion of commitment to model obligations, following a social approach to agent communication [6, 14, 23]. Here, as in [11, 27], we use *(base) commitments* of the form $C(i, j, A)$, meaning that agent i is committed to agent j to bring about A, and *conditional commitments* of the form $CC(i, j, B, A)$, meaning that agent i is committed to agent j to bring about A, if condition B is brought about.

For instance, the requirement that, if the investor signs an order, the firm is obliged to provide her a copy of the contract, can be captured by the causal law:

order_signed(*T*, *I*) **causes** *C* (*firm, I,sen_contract*(*T*, *I*))

saying that when an order is signed by I, the firm is committed to I to send her the contract. The commitment C(*firm, I,sen_contract*(*T*, *I*)), which is generated by the execution of action *sign_order*, remains active until some action is executed, which makes *sent_contract*(*T*, *I*) true. In the business process above, the commitment is fulfilled by the execution of the action *send_contract*(*T*, *I*).

To model the weaker requirement that, when an order is signed by I, the firm is committed to I to send her the contract only in case the order is confirmed, we can use, instead, a conditional commitment, introducing the causal law:

order_signed(*T; I*) **causes** *CC*(*firm, I, order_confirmed, sent_contract*(*T, I*))

In this case, the commitment to send the contract will become active only in case the order is confirmed.

In [5] we have provided an encoding of process annotations as well as an encoding of the norms in a temporal answer set programming language with commitments. It must be observed that norms may have exceptions: recent norms may cancel older ones; more specific norms may override more general norms and, in other cases, explicit priority information is needed for eliminating conflicts

among norms. The problem of representing the defeasible nature of norms is one of the central issues when dealing with the representation of norms [13, 20]. In [15] the defeasible nature of norms is captured by using *default negation*.

4 Compliance Verification

As shown above, causal rules triggering new commitments/obligations can be used to model those norms which generate obligations to be fulfilled. Other norms may define preconditions on the executability of some actions (as for instance norm (1)) or may impose ordering constraints on the executions of atomic tasks. Such norms can be encoded by general temporal formulas. For instance, in LTL [19] we can encode norm (1) above with the temporal formula $\neg(\neg \mathit{informed}\ (I)\ \mathbf{U}\ \mathit{order\_signed}\ (T, I))$, saying that it is not the case that investor I has not been informed until she has signed the order T. In general, in our approach, the specification of a set of norms is given by specifying a set of temporal properties to be checked. As a specific case, the requirement that commitments are fulfilled can be captured by introducing, for each commitment $C(i, j, A)$, a temporal formula to be verified, namely the formula $\mathbf{G}(C(i, j, A) \rightarrow \mathbf{F}(A \vee \neg\ C(i, j, A)))$, meaning that, after any action sequence, if the commitment $C(i, j, A)$ becomes true, then A will eventually become true, unless the commitment is cancelled (for instance, if the client withdraws, the commitment to send the contract is cancelled).

Given a business process, as the one in Fig. 1, and given the annotations describing the effects of atomic tasks and the commitments that their execution generates, the problem of verifying compliance of the business process to the norms is defined as a problem of reasoning about the annotated business process.

In order to verify the normative compliance of business processes in a formal and (semi)-automatic manner, we include in our framework several alternatives to be evaluated; in particular, we have formulated an approach based on Petri Nets technology [16] and one based on Answer Set Programming (ASP) [7]. Both of them exploit model checking techniques [4]. Figure 2 describes the framework.

In the model checking approach, a model checker receives as its inputs a formal representation of the system (the annotated process, here) to be analyzed (the so-called model), a set of requirements (properties to be checked), specified in a temporal logic (as, for instance, CTL [4] and LTL [19]), and provides, as its output, a positive answer, if the model satisfies the specification, or a negative one, with a counter-example, if it does not.

As concerns the approach based on Petri Nets, we chose to translate the YAWL processes into Coloured Petri Nets (CPNs) [16], for a number of reasons: the underlying semantics of the YAWL constructs is naturally defined by CPNs; the colour mechanism, which characterizes a Coloured Petri Net (CPN), provides a powerful way to annotate it, according to the semantical annotation; finally, a mature, stable and well-known tool, named CPNtool [21] has an embedded ASK-CTL model checker. CPNtool is open-source and available for free. The ASK-CTL logic [3] is

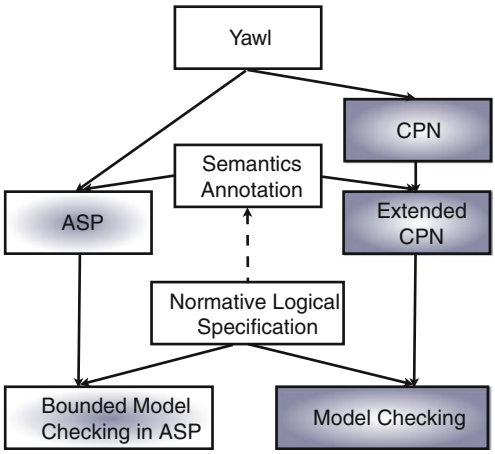

Fig. 2 Overview of the normative compliance verification framework

a CTL-like logic which is interpreted over the state spaces of CPNs, and it has been designed to express properties of both state and transition information. The basic idea is that of associating with each token occurring in the net the information concerning the annotations. To this purpose, in the CPNtool we have associated with each transition in the Petri net (broadly corresponding to an atomic task in the workflow) specific functions (written in the ML language), which compute the annotations according to the action theory, each time the transition is fired.

The other approach, based on Answer Set Programming (ASP), exploits bounded model checking (BMC) techniques, and, more precisely, LTL bounded model checking [15], for the verification of temporal properties of the business processes. In this approach (described in detail in [5]) both the business process and the annotations are encoded in a temporal ASP program which is used to generate the transition system (the model) over which the verification is performed. Norms are encoded by means of causal rules and commitments, as described in Sect. 3, which are mapped into ASP rules. Default negation in ASP rules is used for modeling priorities among the norms. The implementation has been run in DLV [17].

An experimental evaluation of both of the approaches is currently under development. While the Petri Nets approach exploits efficient and optimized state of the art model checkers, ASP technology has the advantage of allowing a greater flexibility in the specification of norms and annotations and, in particular, it allows for the specifications of priorities among norms, which can be expressed in CPNs with less flexibility.

5 Conclusions and Related Work

The paper presents a framework for the verification of the compliance of business processes with norms. The approach is based on the idea of providing a semantic annotation of the business process through the specification of the effects of atomic

tasks and of the obligations they generate, using AI techniques for Reasoning about Actions and the notion of *commitment*. Compliance verification can be performed by model checking techniques. We shortly describe an approach based on Answer Set Programming and an approach based on Colored Petri Nets.

Several proposals in the literature introduce annotations on business processes for dealing with compliance verification [9, 13, 26]. In particular, [13] proposes a logical approach to the problem of business process compliance based on the idea of annotating the business process. Process annotations and normative specifications are provided in the same logical language, namely, the Formal Contract Language (FCL), which combines defeasible logic [2] and deontic logic of violations [12]. Compliance is verified by traversing the graph describing the process and identifying the effects of tasks and the obligations triggered by the task execution. As a difference, our approach does not require the definition of ad hoc algorithms for propagating obligations, but it exploits standard model checking techniques. Besides the verification that commitments are fulfilled, model checking allows for the verification of a wide range of temporal properties, including structural properties of the business process.

In [26] a formal execution semantics for annotated business processes is introduced. The proposed semantics combines a Petri-net like (token passing) semantics for BPMN process execution, coming from the workflow community, with a declarative specification of actions preconditions and effects in clausal form, coming from the AI literature of actions and state changes. Several verification tasks are defined to check whether the business process control flow interacts correctly with the behaviour of the individual activities. However, [26] does not address the problem of verifying compliance of the business process with norms.

In [18] the Abductive Logic Programming framework SHIFF is exploited in the declarative specification of business processes as well as in the (static and runtime) verification of their properties. In [1] expectations are used for modelling obligations and prohibitions and norms are formalized by abductive integrity constraints.

Temporal rule patterns for regulatory policies are introduced in [10], where regulatory requirements are formalized as sets of compliance rules in a real-time temporal object logic. The approach is used essentially for event monitoring.

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Eunomos, A Legal Document and Knowledge Management System for Regulatory Compliance

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Abstract Legal ontology is one of the most researched areas of Artificial Intelligence & Law, but is less applied in the commercial world. This is mainly due to a historical focus on general purpose legal ontologies that do not capture the variety of definitions and interpretations that apply in different contexts, and a focus on automated extraction over manual verification in a domain where accuracy is of utmost importance. In this paper, we show how the use of a domain-specific ontology within a sophisticated legal monitoring software managed by legal experts can help compliance officers in banks and insurance companies comply with strict regulatory duties in a highly complex and constantly evolving area of law.

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1 Introduction

Legal informatics is experiencing growth in activity. Lately, articles have begun to appear in specialist[1] and even mainstream[2] press about an increased interest in bespoke ITC solutions, and in particular, human language technologies, for legal domains. Legal ontology is one of the most researched areas of Artificial Intelligence & Law, but is less applied in the commercial world. This is mainly due to a historical focus on general purpose legal ontologies that do not capture the variety of definitions and interpretations that apply in different context, and a focus on automated extraction over manual verification in a domain where accuracy is of utmost importance. In this paper, we describe the application of a sophisticated, user-driven ontology within a sophisticated legal monitoring software that helps banks and insurance adhere to strict responsibilities. We show how the use of a focussed domain-specific ontology can help compliance officers manage information in a highly complex and constantly evolving area of law. We also describe how a collaboration between legal and informatics experts has resulted in a body of knowledge that compliance experts can trust and a sustainable workflow for ensuring that the knowledge is constantly updated and verified with a combined software and services package that makes intelligent user of technological advances while providing annotation and verification by legal experts at every step.

2 Motivations

Banks and insurance companies in Italy are required by law to ensure compliance with strict regulations. Until 10 years ago,[3] if the director of a bank or insurance company committed a crime, he would be incarcerated, but the company would not be liable. Legislative Decree 231/2001 was a radical piece of legislation that changed the nature of legal obligations for banks and insurance companies. Now such organisations can be held responsible for the criminal activities of their employees that were not prescribed or authorised. Now the companies have a duty of care to ensure compliance with strict regulations. Not only must they respond promptly to changes in their legal obligations, they must demonstrate that they have systems and procedures for searching for legal changes, and monitoring employee activities. There is a strong business motivation to do this. If a financial organisation has demonstrated that they have a responsible monitoring

[1] http://legalinformatics.wordpress.com/2009/08/07/susskind-on-the-end-of-lawyers/.

[2] http://business.timesonline.co.uk/tol/business/law/article7003373.ece.

[3] *Societas delinquere non potest (Savigny – nineteenth Century)* was the dominant doctrine in Italian law throughout the twentieth Century. However, there were other scholarly doctrines that supported the modern point of view *Societas delinquere et puniri potest*.

system in place but an employee still managed to engage in criminal activity under their watch, the organisation can avoid paying out substantial fines. It is also better from a reputation management perspective for the financial institution to be absolved of any wrongdoing.

Compliance with financial regulations is an extremely complex area of law, and there are not many legal experts in this field. Financial institutions may employ compliance officers to monitor activities, but they are not really expert in the law. Even graduates of law who studied compliance before Legislative Decree 231/01 came into force have real difficulty understanding the law. All the compliance regulations are stipulated in Legislative Decree 231/01. However, every year several clauses and sub-clauses are added to the legislation. The great complexities of Legislative Decree 231/01 is largely caused by a very chaotic and heterogeneous law. For example, the regulation of so-called *"Reati Presupposti"* (Articles 24 et seq.), has always been characterized by continuous references (explicit and implicit) to articles in the Penal Code, Civil Code and the Code of Criminal Procedure, as well as articles in other legislation. As can be imagined, this has often proven to be a major obstacle to those who need to interpret and apply the law. To make matters worse, the articles are under constant revision by the Italian parliament who, in only the first 10 years after Legislative Decree 231/01 came into force (June 2001), have gradually added a series of so-called *"Reati Presupposti"*, resulting in a complex and incoherent framework. Fourteen articles are now in place of the original Articles 24 and 25. Secondly, from a content point of view, the wide range of disciplines referred to more or less explicitly in each new article is often very problematic for legal officers. An emblematic case of this complex web of disciplines is evidenced by article 25/7, which is an almost entirely veiled junction of the already chaotic discipline of "liability of institutions" (Legislative Decree 231/01) and more complex matters concerning "the protection of employers at work" (Legislative Decree 81/2001).

At present, financial institutions do not make the best use of technology or legal expertise in order to manage their legal obligations. Financial institutions employ legal researchers who trawl through various sources to find new *adempimenti* (prescriptions, obligations and prohibitions) and manage information about legislative changes and influential cases. For particularly difficult areas, they seek the guidance of expensive lawyers expert in this field. But the information is sought on an ad-hoc basis, is not stored and managed effectively, and not linked to terminology and relevant legislation that are crucial to a true understanding of the law.

We believe that there is a need for an innovative product that addresses the increasing complexity of the law on compliance within financial institutions. The Eunomos software described in this paper was developed in the context of the ICT4LAW[4] project with the requirements of the financial sector in mind.

[4] ICT4LAW: "ICT Converging on Law: Next Generation Services for Citizens, Enterprises, Public Administration and Policymakers" funded by Regione Piemonte 2008–2013, call Converging Technologies 2007.

The software enables users to structure to not only view relevant legislation from various sources from the same web interface, but also to access a database of duties and prohibitions, annotated with explanations in natural language, as well as anontology of terminology of terms that are relevant for the domain of Legislative Decree 231/01.

3 Eunomos: A Package for Managing Legislative Information

Eunomos is a knowledge management system that enables users to research laws and legal concepts, and make sure they comply with their legal obligations. It is a web-based interface for legal researchers and practitioners to manage knowledge about laws and legal concepts in different sectors and different jurisdictions. By offering a highly structured framework with legislative XML, norm classification and ontologies, Eunomos can be used as an in-house software that enables expert users to search, classify, annotate and build legal knowledge and keep up to date with legislative changes. Alternatively, Eunomos can be offered as a combined software and services package so that legislation monitoring is effectively outsourced. Eunomos knowledge engineers would be responsible for maintaining the data, while practitioners would be able to search for information and receive updates on legislative changes. Eunomos is being developed as a commercial software part of a wider suite distributed by Nomotika s.r.l., a spinoff of Università di Torino.

4 An Ontology Suitable for Compliance

The Legal Taxonomy Syllabus ontology on which Eunomos was built was designed to be multilevel from the start. The ontology was originally modelled on European Consumer Law, where terms can mean different things in different languages, within European versus national jurisdictions, and within different domains. As such the main assumptions of the Legal Taxonomy Syllabus ontology on which Eunomos is built come from studies in comparative law [9] and ontologies engineering [5]. Making a clear distinction among terms and their interlingual acceptions (or *axes*) is a standard way to properly manage large multilingual lexical databases [6, 10]. This approach is also well suited to the domain of Legislative Decree 231/01, which links to articles in the Penal Code, Civil Code and Administrative Law, and freely uses terminology from all these domains. Each concept in the ontology therefore requires a clear explanation, links to the source definition, and information about court decisions and scholarly interpretations where applicable. Eunomos allows this information to be held in a structured way.

Each concept in the terminology has the following fields: language, jurisdiction, domain, description in natural language, references to relevant articles, notes and links to related concepts (Fig. 1).

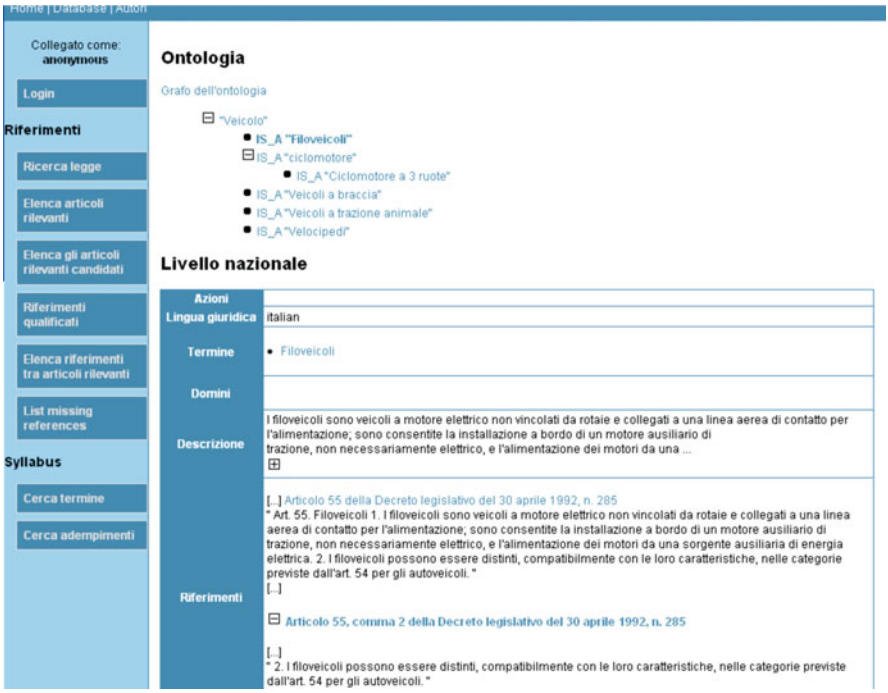

Fig. 1 Legal taxonomy syllabus within the Eunomos system

The descriptions in natural language are made by legal experts. They explain but do not over-simplify compliance issues.

References to relevant articles are made via legislative XML in-document hyperlinks. Each piece of legislation in the Eunomos database is stored in accordance with the Norme in Rete (NIR) legislative XML standard using the ITTIG CNR parser.[5] Each piece of legislation, document, article and paragraph is assigned an XML tag with an Unique Reference Number (URN). This makes it easy to link to the source at any level of granularity.

The notes field carries information about court decisions, scholarly interpretations or other information of interest.

The ontology is hierarchical and allows hyperonomy/meronomy/synonomy relations to be made. But the information is held for navigation by humans rather than intelligent systems. The conceptual tree allows users to easily find the information they require.

[5] The conversion in the current version of the software is done using the XMLeges Marker tool developed by Istituto di Teoria e Tecniche dell' Informazione Giuridica (ITTIG) of Florence (http://www.xmleges.org).

5 Using an Ontology to Navigate Prescriptions

Legislative Decree 231/01 and related legislation stipulate what financial institutions have to do. In the workflow of these enterprises, the legislation is summarized in a series of so-called prescriptions on what financial institutions should and should not do. These prescriptions are used to keep explicit links on the one hand between internal regulations and legislation, and on the other hand between regulations and procedures inside the enterprise.

We use the ontology of Eunomos to describe prescriptions too. Within Eunomos, each prescription is stored as a concept within the ontology. But rather than changing the typical slots of a concept the prescriptions is defined as a concept which is obligatory connected by relations with other concepts:

Deontic clause: the type of the prescription: obligation, prohibition, permission, exception.
Active role: a concept subsumed by the concept role (e.g., citizen, director) which is the addressee of the norm.
Passive role: the beneficiary of the norm.
Crime: the concept in the ontology of crimes resulting from the violation of the prescription (if it is an obligation or prohibition). This concept is often defined in other legislation, like the penal code.
Sanction: the concept describing the sanction resulting from the violation.

Other information, like the context, are inherited by prescriptions from the fact of being concepts. Figure 2 illustrates a prescription together with its links to other concepts.

The constraints between prescriptions and the related concepts are not modelled in the ontology, being it a lightweight one. Such constraints are rather implemented via the insertion interface of a prescription and maintained by the database.

The structuring of prescriptions in terms of concepts enables the user to make fine-tuned searches such as ‘List the prescriptions for which the director concept has the active role’, a most useful feature for the compliance officer.

Self-contained prescriptions are defined within the legislation but can span several paragraphs and/or articles; conversely a single paragraph within one article can include more than one prescription. A macro-prescription can also be stored which specifies a general principle and contains links to specific prescriptions that come under this principle. For each prescription instance, the relevant text are quoted and then described in natural language. The prescription instance also links to in-text references to other articles and concepts defined in the ontology. For instance, the relevant fields for active role (e.g. director), passive role (e.g. consumer), punishment (e.g. one *quoter*) are all defined within the ontology and are linked to from the prescriptions. To clarify, a *quoter* is a monetary amount that varies with the size of the financial institution and increases with inflation. It is handy to have this concept defined within the ontology. As the rates change, the data can be changed in one place while made accessible to prescriptions referring to it.

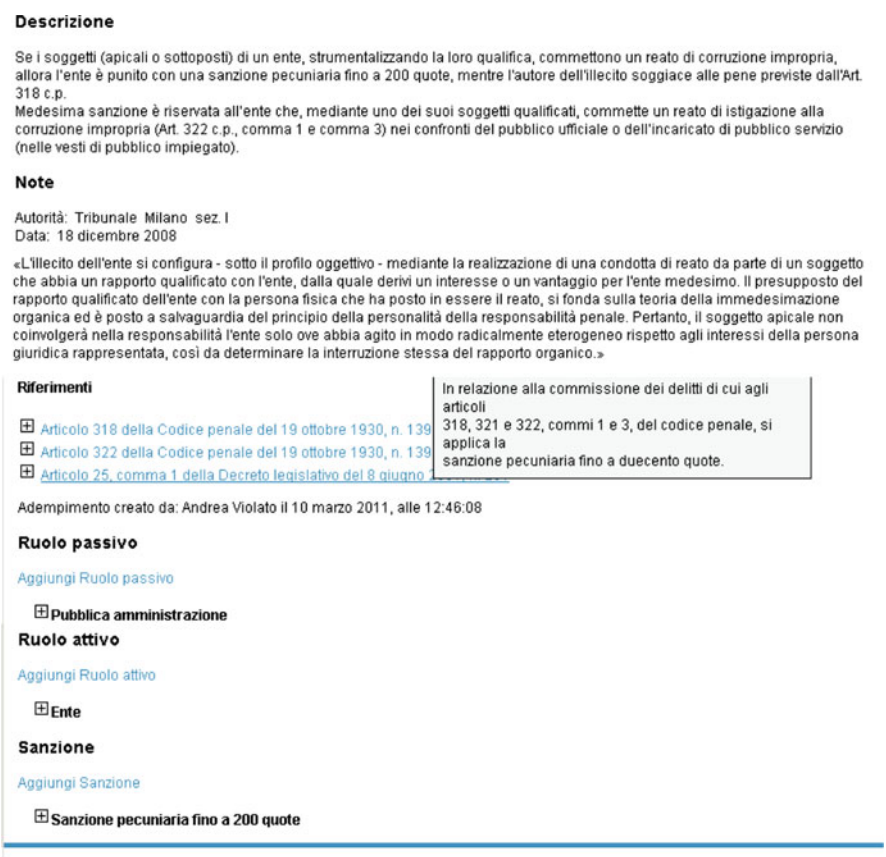

Fig. 2 The description of a prescription with the related concepts

6 Related Work

Peters et al.'s [7] LOIS database of legal terms adopted the structure of WordNet [4] and EuroWordNet [8]. It can be particularly suitable for information retrieval for which the LOIS database was developed, as the collapse of terms into synsets aids the recall if not always the precision of document retrieval.

Agnoloni et al. [1]'s FrameNet ontology departs from the WordNet structure, emphasising that meaning depends on "under which *Circumstances*, which *State of affairs* is sanctioned under which *Principle*". Like the Legal Taxonomy Syllabus ontology, Agnoloni et al. [1] separates concepts from terms, but assumes that translated terms are exact and that equivalent multilingual terms map onto the same concept.

Agnoloni and Francesconi [2]'s Provision Model work on semantic profiling of legislation is also relevant. Legislative provisions are stored in XML format with

semantic tags, rendering it possible to create SPARQL queries to find all paragraphs where e.g. the RightBearer is a Consumer. This is not dissimilar to the Active Role or Passive Role searches that can be made on prescriptions.

7 Conclusions

Information technology is a natural ally for legal research, characterised as it is by constant cross-referencing, updates and obscure terminology. In this paper we have described the application of an ontology tool within a legal monitoring system. We have shown how the multilevel ontology structure is suitable not only for navigating conceptual terms and linking to source legislation in a highly complex area of law, but also for managing structured information about the ever-evolving series of prescriptions that apply to the financial sector. Future work on this product include using semantic technologies to map prescriptions to Business Process Management (BPM) activities. Banks manage thousands of BPM activities and this new component is the next stepin ensuring that these banking processes are compliant. We are also developing the conceptual model of roles in prescriptions using the model of Boella and van der Torre [3].

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