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Information Systems, Management, Organization and Control

Smart Practices and Effects

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Introducing and Discussing IS, Management, Organization and Control

Daniela Baglieri, Concetta Metallo, Cecilia Rossignoli and Mario Pezzillo Iacono

This chapter focuses on the reciprocal relationship between information systems and organizational control. It introduces the volume, describing both the theoretical frameworks and the topics analyzed and discussed. In particular, the volume is divided into three sections, each one focusing on a specific topic: organizational control, accounting and information systems; organizational change, innovation and ICT; and information, knowledge and project management practices.

The influence of Information Systems (ISs) on organizational structures, processes, and people as well as how these organizational forms impact technology design, functionality and management has a rich history within the managerial literature [1, 2, 3]. In particular, the relationship between ISs, management and organizational control has been a regular subject of analysis in literature over the past thirty years.

Organizational control is a fundamental issue in a variety of contexts, from a socio-political and corporate governance perspectives, as well as from a managerial point of view within organizations. In the managerial debate, the concept of control is normally used in broad, non-discriminating way to identify diverse policies, ideologies and practices that have been developed to organize productive activity [4]. Theories on organizational control typically describe how managers measure and monitor the work of organizational actors by comparing their

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performance against established standards and providing rewards or sanctions based on these evaluations [5]. It comprises a fundamental set of mechanisms that managers use to address agency dilemmas in organizations by fostering collaborative relationships with subordinates who may be unwilling or unable to fully cooperate with them in the pursuit of organizational objectives. It is definitively evident that without the right typologies of control mechanisms it becomes impossible to be sure that worker will decide to submit to the logic of the firm, in order to get the maximum commitment at the lowest cost [6]. Managerial interest in control mechanisms stems from their use as a means of securing the objectives attributed to organizations by their most influential stakeholders usually, owners, managers and administrators [7]. At a very general level, organizational control refers to a coalition of agents that implements a set of coordinated and cooperative actions in order to perform individual objectives by means of the organizational objectives [8].

ISs are often described as a disciplinary technology intended to regulate the actions of workers and produce information to improve the ability of managers for surveillance of the outcomes of those activities [9]. ISs both create new conditions of possibility, e.g. new ways of organizing, and are implicated in different control mechanisms, e.g. they enable and constrain what we do and how we do it. They also influence the way we see things and think about them, or indeed what we perceive and think, and in doing so they frame organizational reality [10]. IS research on organizational control has typically focused on the dynamics of control, why and under which circumstances specific controls, control modes, or control types are selected and used, how controls are combined into a portfolio, and/or how the use of technological controls impacts performance [11, 12].

The volume focuses on the reciprocal relationship between Information Systems (IS) and organizations and the impacts that these relationships create. In particular, it explores the diversity of topics, views and perspectives focused on the interplay between ISs, organizations and control, pointing out "smart" practices and mutual effects. It brings together theories and practices by a diverse group of scholars working in different disciplines: organization, management, accounting, IS development, and human-computer interaction.

The volume collects 20 papers that are based on a selection of the best paper submitted to 10th Conference of the Italian Chapter of AIS (ItAIS, Bocconi University, Milan, Italy, December 14, 2013) and related to mentioned issues. The 2013 ItAIS has attracted contributions far beyond the Italian IS community. In fact, more than 200 authors, from four continents, have contributed to the Conference, whose 100 papers were selected for presentation at the Conference by means of a double-blind review process.

The volume is divided into three sections, each one focusing on a specific theme: organizational control, accounting and IS; organizational change, innovation and ICT; information, knowledge and project management practices.

1 Part I: Organizational Control, Accounting and Information Systems in Public and Private Sector

The central notion of organizational control is assuring that behaviors are oriented to organizational objectives [13, 14]. Key organizational control concepts utilized within the management science tradition include control mechanisms, formal and informal controls, control systems, control targets.

This part brings together approaches to organizational control theory and practices by a diverse group of scholars with different viewpoints—from Organizational theory to Accounting Information Systems, from mainstream to Critical Management Studies (CMS) approach. It is focused on the links between information technology with management control, accounting, auditing, reporting, and related disciplines.

Such contributions provide insight on the relationship between Performance Management Systems (PMSs) or Management Control System MCSs) and IS [15]. PMSs are a complex tool, composed of different parts and with different goals typically adopted by private and public organizations as a means for engaging in policy and management organizational change [16]. Following a previous enquiry by Otley [17], Ferreira and Otley [18] have compared the concepts of PMS and MCS, building their conceptual model empirically by drawing on an analysis of control systems in a range of organizations. According to these scholars MCS has become "a more restrictive term than was the original intention and we prefer to use the more general descriptor of PMS to capture an holistic approach to the management and control of organizational performance. We see this term as including all aspects of organizational control, including those included under the heading of management control systems" (p. 264). As Otley argues, PMS provides an integrating framework, both academically and practically, that goes beyond the traditional boundaries of accounting related with the traditional banner of management control system. In other words, PMS is a new label for an old concept: it represents a way to describe a new theoretical framework, whose aim is the design and the implementation of the package of controls.

The first three papers provide some examples of empirical researches realized in public organizations. In particular, adopting a critical perspective, Mercurio, De Nito, Pezzillo Iacono, Esposito and Silvestri investigate the relationship between PMS and IS in a single Italian Public University, starting from the gap that exists between what is declared in University policy statements—ostensibly oriented towards empowerment—and what is actually implemented by public managers. The authors are particularly interested in understanding how ICT could support PMS in the control process. In the empirical analysis they observed that the role of IS depends on the strategy adopted in planning and implementing the PMS.

Paolini and Soverchia analyze MCSs in the same domain: the Italian public universities. The recent reform in Italian public organizations includes two important changes: the adoption of accrual accounting and the introduction of a MCS. The paper provides a description of the current situation of Italian

universities, which allows to understand the reality in which the reform will be implemented and to evaluate whether universities are ready to realize these important changes. Survey results indicate that not many universities possess budgeting and accounting reporting systems aligned with the new legislation; however, most of them have executed different types of efforts for the transition process.

Lazzini, Anselmi, Lo Schiavo and Falanga offer a contribution to the debate on how to implement PMS in the Public Administration by proposing a model based on an integrated information system where planning (strategic and operational) and measurement systems are supported by a single application that drives the whole process. The research is based on the case study method and analyses the characteristics of ICT systems in supporting the MCSs developed by the Italian regulatory authority for the energy sector (AEEG). The results suggest that a single measurement metric may be identified for the assessment of the output produced by both core and accessory structures, in complete integration with the planning and control process.

Afterwards the focus moves from public to the private sector. Iacoviello, Lazzini and Nanetti investigate the role of IS in the field of luxury fashion. This type of industry has been characterized by significant transformations in the quality and quantity of information needed to manage the practices of outsourced manufacturing. The results of the empirical research shot that information and communication technologies could support companies that decide to outsource part of their production in foreign countries by acting on the damage to reputation and image due to counterfeiting. By using IS, luxury fashion companies could measure their activities more precisely and control processes, thus motivating suppliers to operate correctly.

Mazza and Azzali discuss the level of IT and the quality of IT Controls (ITC) in outsourcing. The authors collected data through a questionnaire sent to a sample of Italian listed companies and performed robustness tests. The results show that in Italy: IT in outsourcing is widespread; and ITC in outsourcing complies with USA frameworks.

Lamboglia and D'Onza analyze the characteristics of IT auditing in banks. Based upon two Italian case studies, the article provides a qualitative assessment of the objectives of the IT audit, the activities performed, the stakeholders served and the critical success factors that influence the capability of IT auditing to add value. The results show that the scope of the IT auditing function has extended. The interviewees revealed that the main stakeholders are executive managers, while the critical success factors are the characteristics of the control environment, the capacity of the IT auditor to stay in touch with the business, and behavioral skills.

Finally, Trucco and Corsi analyze the influence of ERP systems implementation on accounting improvements and on organizational, social and governance benefits, and to extend the existing literature on this topic. According to the authors, it has not still been paid enough attention to the overall improvements that an ERP implementation can bring about on financial, organizational and social ratios. So, it is carried out an empirical study from a sample of the UK and Italian listed

companies, using regression analysis and Chow test. Results show that the implementation of an ERP positively affects some relevant key performance indicators, as structural break analysis highlights.

2 Part II: Organizational Change, Innovation Management and Impact of ICT

ISs are part of corporate transformations in today competitive environments, often enabling new organizational forms and business models both in Public and Private Sector [19]. The vast majority of change projects imply redesign and adaptation of ICT solutions, and in many cases they are entirely centered around these technologies. Organizations expect to use the new ICT to run new processes, innovate products and services, gain higher responsiveness, and implement new corporate environments aimed at transforming their internal structures into better achieving organizations [20, 21, 22, 23]. To date [24, 25], both practice and literature have widely shown that the effective implementation of new IS is one of the most challenging tasks faced by managers, since it requires people to understand, absorb and adapt to the new requirements. The capacity to absorb and to fully implement the adoption of new ISs is a key factor to gain extra competitive abilities, because the ultimate impact of IS is mediated by a number of factors, many of which require an in-depth understanding of the organizational context and human behavior.

The contributions included in this part of the volume are focused on the interplay between change management—theories methodologies, techniques and tools—and IS. Furthermore, the paper of Brumana, Decastri, Scarozza and Za aims to contribute to the debate on technological change, organization and work. A bibliometric analysis has been conducted, adopting also Social Network Analysis tools. The results reveal a significant growth of the technological innovation literature over the investigated period, the multi-disciplinarily of the field and, particularly, the relevance of management and business contributions. Overall, this study offers a broad overview of the literature on technological change and emphasizes the opportunity to investigate the role of technological innovation within the organizational life.

Bochicchio, Livieri, Longo and Di Cagno analyze the role of performance management and performance measurement in the assessment of alliance's goals achievements and of the impact of alliances on firms. In particular, the innovative aspect presented consists of the creation of an online service which enables KPIs monitoring and benchmarking, thus simplifying a possible reconfiguration of network dynamics.

Resca and Spagnoletti investigate this evolution focusing on the concept of platform and the concept of infrastructure as metaphors of the business/environment relationship and of the reframing of business sectors. In the case discussed

(Amazon) an overlapping between the concept of platform proposed and the technological platform emerges so that it has become the backbone on which Amazon's businesses run. On the other hand, the concept of infrastructure outlines an environment in which customers can turn into suppliers and also into partners.

The paper of Caporarello, Magni and Pennarola demonstrates that when looking at the evolution over time of mobile phone interfaces—as an example of a widely adopted technology by millions of customers—variance and genuine innovation is very limited, and competitors prefer to follow their enemies instead of taking the risk of being disruptive into the marketplace. The study investigates why it is such and it explores the reasons why competitors get stuck with pre-existing user interfaces.

Cantoni, Zardini, and Rossignoli investigate outsourcing in terms of the long-term relationship between customer and supplier. The authors' aim is to examine simultaneously the client's and supplier's perspectives through the psychological contract that, by assimilating the contents of the legal contract, focuses on (1) the implicit (not formalized) and reciprocal (mutual) duties between the two parties, (2) the equivalence of psychological obligations and contractual values and (3) the importance of the individual commitment level. While the legal contract is managed and based on an organizational level, the psychological contract is individual and perceived as such: from the authors' point of view, all workers, regardless of whether they work inside or outside the company, are part of the psychological contract. The authors employ a case study represented by an outsourcing center belonging to a group of Italian banks, using the "qualitative and quantitative" mixed method. The two themes, the psychological contract on the one hand and the outsourcing governance on the other hand, represent a highly relevant matter that has received scant attention in the literature.

Martinez, Mangia, Galdiero, Bonacci, Cicellin and Toraldo explore the importance of the complementarities between ICT and organizational change in order to plan new forms of organization. The study is based on the analysis of the relationship existing between the application of ICT solutions that facilitate BPR. Results from our empirical research indicate that ICT solutions and initiatives play a significant role in improved information management and therefore re-engineering of business processes. The authors show how traditional organizational models and coordination are no longer consistent and sufficient in turbulent environments such as that of the Italian health. ICT provides new ways of coordination and control. So the traditional coordination mechanisms are scaled or enhanced with the use of ICT.

Finally, Cesaroni and Consoli present a three-dimensional framework (named Cube of Corporate Technological Level—CCTL) to evaluate the technological position of small enterprises from different points of view. This framework has been developed from existing tools with similar goals, already proposed by other authors. Compared to existing ones, this framework differs primarily for the inclusion of a collaborative perspective. It reflects the distinctive features of the latest interactive and web 2.0 tools, that allow companies to manage their relationships with the external stakeholders of the supply chain. The proposed framework has been applied to a sample of small businesses to test its validity. Some business cases with different positions in the Cube are described.

3 Part III: Information, Knowledge and Project Management Practices

Advances in ICT, data explosion and information overload, employee turnover, and the need for organizations to better utilize their intellectual capital have led to increased interest in knowledge management domain. With massive amounts of information being added to corporate databases and the Internet every day, effective and efficient knowledge discovery and its management has become imperative. Thus, organizations are increasingly motivated to develop systems to leverage their knowledge and information for intelligent decision making and competitive advantage. Modern organizations need advanced effective methods and tools to take advantage of the ways that information is driven by cloud, social and mobile platforms. New data sharing and management models can allow people in organizations to achieve a number of aims: to improve business processes; to extend business knowledge; to collaborate with potential partners; and to develop, share and access huge quantities of available resources from different sources [26, 27].

This part of the volume presents studies focused on the relationship between IS and knowledge management in modern organizations, discussing on the ways in which new technologies and systemic tools and techniques may contribute to "extract", represent and organize "knowledge" and provide effective support for collaboration, communication and sharing of information and knowledge.

The turbulent environment in which organizations operate requires to effectively manage information. Previous studies highlight that the quantity of digital information is rapidly increasing and it requires to be effectively stored and managed. Data compression methods represent a possible solution for facing these issues. Through conducting an experiment based on the exchange of compressed data, the authors offer managerial insights useful for a more effective and efficient data management.

The paper of Caporarello, Magni and Pennarola studies data compression techniques in order to improve information exchange effectiveness. Previous studies highlight that the quantity of digital information is rapidly increasing and it requires to be effectively stored and managed. Data compression methods represent a possible solution for facing these issues. Through conducting an experiment based on the exchange of compressed data, the authors offer managerial insights useful for a more effective and efficient data management.

Boffoli, Castelluccia and Visaggio explore the benefits of the application of decision tables, finding additional advantages in detecting and fixing several anomalies that may affect the business knowledge. They show that decision tables are able to guarantee non-redundancy, consistency and completeness. The authors have implemented a software tool to automate decision tables in practice and describe a running example to give perception of these advantages.

Cremona, Ravarini and Sutanto provide empirical results of Knowledge Management Systems (KMS) adoption within a cluster of firms. The study presents the preliminary results of a multiple case study conducted on six SMEs within a

cluster of firms adopting a digital platform, a KMS, aiming at generating innovation and internationalization opportunities. The authors carried out a systematic literature review over 200 articles by identifying three main research areas: knowledge management, joint activities and business value of IT. They built an a priori theoretical framework that extends the limitations of previous studies by focusing on the adoption within a cluster of firms. For scrutinizing the theoretical framework on knowledge sharing, a multiple case study approach was chosen and carried out on the six firms. The preliminary results contribute in explaining the role of digital platforms and the strength of interpersonal connections in influencing the performances improvement of the whole cluster.

Following the theoretical framework of e-leadership, Poliandri, Mattarelli, Bertolotti, Tagliaventi and Grandi explore how emergent and formal leadership processes co-evolve with the use of collaborative technologies in globally distributed teams (GDTs) and their influence on team performance. The authors conducted a multiple case study in five GDTs engaged in scientific collaborations. The analysis suggests that the attainment of consistency between leadership processes and technology use is related to better knowledge integration, which is an important antecedent of overall team performance.

Adopting a theoretical perspective, Bertei and Marchi examine possible future developments of accounting-based business simulation models applied to business planning as knowledge generators. They tried to elaborate a theoretical framework by integrating system dynamics models and agent-based models. The papers points out that although such integration has already been put in practice for general purposes, it is still a new issue for planning and control systems.

Finally, Calabrese and Di Nauta propose an alternative interpretation for professionalization and dissemination processes for project management among those prevailing in literature. The thesis is that, starting from the mid 1950s, originating from the Anglo-Saxon world, and due to the action of some institutional entrepreneurs, the construction of an organizational field, as the result of which the 'practice' project management began to be institutionalized, was undertaken. Subsequently, it has been spread triggering a process called 'contagion of legitimacy'. The processes of professionalization and dissemination of project management practices, therefore, appear not so much and not only as an implementation technique, but as a complex web of interaction ritual, held together and stabilized not by sharing cultural values to which individuals have joined, but by way of reducing the uncertainty arising from practical knowledge of behavior deemed appropriate, pro tempore, in a context of organized action.

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Part I
Organizational Control, Accounting and Information Systems in Public and Private Sector

The Role of IS in Performance Management: The Case of an Italian Public University

Riccardo Mercurio, Ernesto De Nito, Mario Pezzillo Iacono, Vincenza Esposito and Lucia Silvestri

Abstract The article investigates the relationship between Performance Management Systems (PMS) and IS in a single Italian Public University, starting from the gap that exists between what is declared in University policy statements—ostensibly oriented towards empowerment—and what is actually implemented by public managers. We are particularly interested in understanding how ICT could support PMS in the control process. In our empirical analysis we observed that the role of IS depends on the strategy adopted in planning and implementing the PMS.

Keywords Performance management systems · Information systems · Organizational control · Public university

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1 Introduction

Public universities are under constant pressure to increase their effectiveness and quality with fewer resources, while simultaneously being expected to show greater accountability and transparency in their processes [1, 2]. Academic departments are among the institutions facing rapid change as a result of a need for more efficient utilization of human resources due to cut-backs in basic funding, as well as the introduction of new accountability measures by government [3, 4].

New Public Management [5, 6] proposes that public organizations should introduce managerial processes from the private sector, following the success of such practices there. In particular, this approach emphasizes operational efficiency driven by the rationality of managerial systems, showing how both the concept and the practice stemming from private companies can be used in the public sector.

Adopting a critical perspective, this study focuses on the role of Information Systems (IS) in the process of implementing a Performance Management System (PMS), a managerial tool recently adopted by many Italian public universities and here interpreted in terms of power of control. We investigate this relationship starting from the gap that exists between what is declared in university policy statements and what is actually implemented and enacted by public managers. More specifically, we reflect on the impact of IS on the process of control and power centralization.

We set out to explore the following two research questions: (1) Is there a difference between what is formally declared in the design of an Italian University PMS, ostensibly oriented towards empowerment and accountability, and what is actually put into practice? (2) How does the design and use of IS in PMS influence control processes?

The empirical focus of the paper is the recent changes in PMS reflecting the "modernisation agenda" of the Italian public sector. We made an in-depth analysis of a specific case study, showing the distance between the PMS design goals and the implementation results. The analysis concentrates exclusively on the performance of university managers, excluding other categories (i.e. academics).

The paper is set out as follows: the following two sections offer a literature review concerning (a) the role of PMS in public universities and (b) *the issue of control* in Critical IS Research. In Sect. 4 the research context and the methodology adopted for the empirical study are described. Lastly, the results of the empirical research will be discussed, summarising the conclusions and the main findings of the study.

2 The Role of Performance Management Systems in Public Universities

PMS are a complex tool, comprising various parts and with different goals, typically adopted by private and public organizations as a means for engaging in policy and management organizational change. They present an attractive

proposition to politicians, citizens and public spending supporters, opening up the black box of public organizations and greatly enhancing their transparency and manageability [7]. Over the past decade public management scholars and practitioners have taken a growing interest in the use of performance management tools to increase government accountability and effectiveness.

Nonetheless, the literature typically suggests that public-sector applications of PMS are limited and have been implemented with only limited success, primarily due to inadequate performance evaluation methods and underfunding of data management systems and rewards for performance [8]. Prior researches on public sector performance management [9, 10] typically describe shortcomings in both the design and the results of these systems. Moynihan [11], for example, states that, with the implementation of PMS, public managers have been more likely to realize the "symbolic benefits" of creating an impression that "government is being run in a rational, efficient and results-oriented manner".

Recent public sector reforms (in Italy, for instance, the "Brunetta Reform") have aimed at improving public organization performance: the achievement of program outcomes reflects the approach to measuring, evaluating and regulating performance [12]. As we said, under the umbrella of the new public management, public organizations have been engaged in a systematic attempt to control performance over the last few years. In the opinion of Cavalluzzo and Ittner [13] the basic assumption of these initiatives is that the strategic performance indicators can improve public efficiency and effectiveness by increasing the accountability and improving the decision-making of public administrators.

According to Broadbent and Laughlin [14], the University system is a specific area of the public services where this approach is needed and where there is a growing interest in performance measurement. Recently Corcoles et al. [15] conducted a study on the stakeholders' need for information in higher education organizations in Spain. The need for universities to have a greater involvement with their wider community and to ensure information transparency makes it advisable to present information on performance in their current accounting system. The academic departments competing for teachers, researchers, students and funds are getting used to managerial practices and producing reports which allow internal and external bodies to evaluate their performance [16]. Minelli et al. [17] identify and compare the structure and impact of control systems implemented in Italian public universities, showing that they have given rise to effective results particularly in the area of organisational learning: thus the evaluation experience has brought an increase in transparency and control. Finally, according to Secundo et al. [18], the increasing cooperation between universities and firms has resulted in the demand for similar processes of evaluation for both players.

In order to explore the concept of control and monitoring in public universities, a preliminary aspect is related to the conceptualisation of PMS. A PMS is "the set of metrics used to quantify both the efficiency and effectiveness of actions" [19] (p. 81). As stated by Otley [20], PMS provide the information that should be useful to managers "in performing their jobs and to assist organizations in developing and maintaining viable patterns of behaviour" (p. 364). Gruman and Saks [21] suggest

that although performance evaluation is at the heart of PMS [22], the full process extends to all organizational policies, practices and design features that interact to produce employee performance. Aguinis [23] has proposed a broader understanding of performance management that includes organizational planning, performance assessment and behavioral review. Consistently with the approach of Fitzgerald and Moon [24], we interpret Performance Management as a system concerned with defining, controlling and managing both the achievement of outcomes or ends and the means used to achieve these results at the organizational level.

Building on a previous enquiry, Ferreira and Otley [25] have compared the concepts of PMS and management control systems, building an empirical conceptual model by drawing on an analysis of control systems in a range of organizations. According to these scholars, 'management control system' has become "a more restrictive term than was the original intention and we prefer to use the more general descriptor of PMS to capture an holistic approach to the management and control of organizational performance. We see this term as including all aspects of organizational control, including those included under the heading of management control systems" (p. 264). PMS provides an integrating framework, both academically and practically, that goes beyond the traditional boundaries of accounting under the traditional banner of management control system. In other words, PMS is a new label for an old concept: it represents a way to describe a new theoretical framework, whose aim is the design and implementation of the "package of controls".

In this sense it could be interpreted as an integrated technical system to gather and provide information to help managers in their work and decision-making activities, in order to efficiently and effectively achieve the desired organizational goals, acting on both the employees' motivation and performance assessment [26].

3 Theoretical Background: Critical IS Research and Control

Information Systems (IS) are often described as a disciplinary technology intended to regulate the actions of workers and produce information to improve the ability of managers and/or organizations in monitoring the outcomes of those activities [27]. In particular, CISR aims at revealing, criticizing and explaining how the development and use of IS in organizations and society in the pursuit of efficiency and rationalization increase social and organizational control, with potential detrimental consequences for some stakeholders and society as a whole [28]. Adopting an inclusive view, Howcroft [29] encompasses critical research on IS as the branch of IS studies in opposition to technological determinism, which assumes that technological development is autonomous and that societal development is determined by technology. On the contrary, the critical approach seeks to challenge (rather than justify) technological imperatives as natural and inescapable, interpreting the adoption of IS by recourse to a wider social, political, historical, economic and ideological context [30].

CISR typically emphasizes the effects of ICT on people (on their thinking, working conditions and identities, for example), organizations and societies (e.g. by highlighting the fetish of statistics and preoccupation with targets which ICT facilitates and nurtures).

The basic assumption of this view is that technology—interpreted as both a body of artifacts and practices and a specific artifact/object—is not neutral but is "socially shaped". In other words, it has embedded beliefs, values, culture and perceptions deriving from both the designers and the consumers. In this context, technological artifacts can be viewed as culturally constructed and interpreted, not only in how technology is thought of but in its design and implementation [31]. In the opinion of Cecez-Kecmanovic [32], the main aim of CISR is to transform the social/organizational systems in terms of actors, IS and organizations (including their dynamic and relationships), by revealing and explaining how an IS, supposedly implemented in order to increase efficiency and effectiveness, actually increased power of control and decreased autonomy and human agency.

In CISR literature interpretations of power and control are significantly influenced by the post-structuralist approach [33], and our analysis is developed according this view.

The post-structuralist perspective bases its essential theories on social constructivism [34], subjectivist studies [35], and the theoretical elaborations of structuration theory [36]. Applying this approach, social reality is not objective (it is not a thing or a reification), but represents the interaction between individuals and emerges as a conflict of power and construction of meanings, in a logic in which the creation of meaning and organization are characterized as interchangeable concepts. The basic concept behind a post-structuralist approach is to be found in power of control as an interpretative key to processes, analyses and organizational design. These studies typically explore the shift from simple control to technical control to bureaucratic control and, most recently, to normative control [37–39].

The Foucauldian literature on IS and control [40, 41] suggests that the design and implementation of ICT can affect organizational control in at least two interdependent ways: (i) controlling the workforce and (ii) controlling the organizational processes/structures. Consistently with the purpose of our paper, we are interested above all in the latter issue. According to CISR, in fact, an important way in which IS affects organizational control is linked to the influence on organizational processes and/or structures, facilitating control and coordination of activities at different levels, simultaneously enabling and constraining those activities. This concept is based on the idea that the integration of information determined by ICT facilitates the process of standardization and centralizing of organizational power, increasing the polarization between a broad range of "controlled" actors and a tight range of "controlling" subjects. Moreover, this concept appears to be consistent with the Weberian approach that identifies the availability of data, information and skills as the primary source of organizational power.

Furthermore, in terms of control relating to organizational processes, it is worth noting Ciborra's [42] work. In contrast to the prevailing view in IS literature, he suggests that IS artifacts may drift, i.e. "they deviate from their planned purposes

for a variety of reasons often outside anyone's influence" (p. 4) and puts forward a notion "of technology with a certain degree of autonomy and inner dynamics; of technology both as a drifting system and as an organism to be cultivated" (p. 32).

In short, ICT infrastructures tend to have a life of their own: they drift as a result of their usages, design choices, organizational routine, human resource management, user resistance, and/or other unforeseeable behaviors of both systems and humans [43]. Building on this perspective, Rajao and Hayes [44] claim that this drift can be understood as a result of power relations and negotiations between diverse conceptions of controls [45]. According to this idea, the design and use of ICT artifacts tend to reflect the dominant conceptions of control [46]. In other words, ICT both creates new conditions of possibility, e.g. new ways of organizing, and is implicated in different control mechanisms, i.e. they enable and constrain what we do and how we do it. Introna [47], for instance, interprets the relationship between IS and organizations not only as an electronic panopticon but also as embedded in the "micro physics" of everyday life, power relations, discourse and knowledge

Finally we have to point out that some critical studies have shown that IS are designed to support existing structures and that their use tends to strengthen the structures and ways of organizing which are already in place [48]. In order to understand where the power of control is embedded (or where it should be embedded) in an organization, first the distribution of decisional power, or rather the level of centralization/decentralization, has to be analyzed. Conversely, evaluating an organization's level of centralization or decentralization requires discovering where the decisions that influence its characteristic activities are made.

4 Research Context and Methodology

The recent guidelines to reform the Italian public administration passed into law on 4 March 2009—Law 15/2009—approved with the Legislative Decree 150 (the Reform Decree), known as the "Brunetta Reform". The reform strategy rests on three pillars: (i) modernization of the public administration, (ii) innovation and digitalization within the public administration and the country at large, and (iii) improvement of the relationship between the public administration and citizens and businesses [49]. In coherence with the new public management, the overall purpose of the reform is to ensure the highest level of accountability for the state towards its citizens and to improve the efficiency and effectiveness of Italian public sector work by raising the quality of public services and boosting productivity factors. The reform emphasizes the need to reach these ambitious goals through a new management approach oriented towards a continuous improvement of performance, the adoption of the benchmarking method and the measurement of customer satisfaction. In the lawmaker's opinion this requires an integrated system of evaluation, incentives and rewards based on results. This view is consistent with the idea of competitive selection of the best individuals and organizational units,

who are rewarded in monetary and non-monetary terms on the basis of innovative capability and excellence in performance.

Under Law 15/2009 it became obligatory to adopt PMS concerning the performance of organizational structures, individual employees and groups of them. In the absence of these systems, the law prevents public administrations from funding and/or adopting important organizational policies such as hiring staff, providing monetary incentives for managers and awarding bonuses to employees.

In the university sector, in particular, a strong tendency towards change has emerged around the issue of performance assessments. Over the last 5 years the national government has invested in training projects that support organizational change so that universities adopt suitable performance assessment systems in relation to training and research.

Particular attention has been paid to the topic of evaluation, providing support for the development of broad nationwide systems for monitoring services offered to students (teaching and study support) and evaluation of the teaching (see the AlmaLaurea system for assessing teaching and the more recent VQR 2013 system for evaluating productivity of research structures).

Moreover, in the university sector the reform process has been heavily supported by the government. It financed two projects to carry out an analysis of the contexts and planning of the new PMS, which then came into force in the academic years beginning in 2010 and 2011. The two projects adopted different working methodologies and PMS designs that the individual universities subsequently adapted and implemented: the European Common Assessment Framework (CAF) and the Balance Scorecard (BSc) method.

The analysis focuses on the performance of university managers (excluding technical and academic categories) in the Italian public context. There were two reasons for restricting the study to the public universities: (a) the external (normative) pressure to adopt PMS was the same in all cases; (b) they have a more homogeneous experience in performance evaluation compared to private universities. The focus on the administrative staff is coherent with the idea that universities are moving from a traditional academic organization to new forms of useful knowledge to support cooperative activities and relationships with external stakeholders and funders [50]. In the opinion of Boyer [51], the increasing emphasis on integration—such as university-industry cooperation—calls for new forms of academic and administrative management.

The empirical analysis consists of a specific case study, carried out in the period April-December 2012, showing the distance between the PMS design goals and the implementation results. The collection of data was carried out using a heterogeneous plurality of instruments. Such pluralism is coherent both with the theoretical framework and with the differentiated nature of the information required by the multiple case studies method. The case study was developed, in the first phase, through 2 unstructured interviews (with the General Director and Evaluation Committee President), to investigate the purpose and rationale of design that characterizes the PMS. Subsequently, the investigation continued with participant observation in 7 different organizational units, involving two of the authors in all

stages of the PMS. During this period the authors have been actively involved with the management and employees in planning and communicating objectives (8 meetings with about 80 employees), as well as in the intermediate monitoring meetings (2 meetings and 20 monitoring talks) and in measuring and evaluating performance (2 meetings and 25 evaluation talks). In each of the phases of the PM process 9 interviews have been carried out (with the General Director, 4 managers and 4 employees) to discuss the main concerns raised by the implementation of the system.

5 Data Analysis and Discussion

5.1 Case Study

The university analysed in the case study is a small university (about 200 researchers and professors, 200 administrative staff units and almost 8.000 students) located in the South of Italy, founded in 1998 and organized in 3 Departments (Law and Economics, Engineering and Science). In the last 5 years this University has been committed to important programs of inter-university cooperation and internationalization of teaching and research.

As stated in the official approval document, the purpose of the PMS is to improve decision-making processes, the connection with the territory and enhancement of the skills of employees (Guide to PMS, p.11). To support the introduction and adoption of an effective PMS, the university body of governance decided to define a strategy to link PMS with IS. The basic idea was to facilitate the information management through the adoption of an IS coherent with the PMS design.

Information systems of these university are governed by a central administration unit (Sector Resources and Systems) interacting with decentralized structures dedicated to research and teaching (Departments). Among common management systems of overall structure the most important are:

1. Accounting management system—CIA;
2. Human resource management—CSA;
3. Student Management System—GISS.

All these systems, even if provided by a national consortium (CINECA) show characteristics of low integration. For example, the data processed by the Salaries Office can only “migrate” in aggregate form and in a specific moment into the management system responsible for accounting and payment activity.

In addition to these systems, there are other management information systems designed in-house: attendance of the staff, online payroll, services for students, part-time. In 2013 this university developed a road map aimed at developing and integrating IS dedicated to education and students careers management, currently

suspended due to lack of financial resources (€ 400 thousand) and to internal resistances.

Consistently with the NPM approach, the university adopted a PMS to manage information flows carefully and to improve relations with external actors and internal staff.

According to this interpretation the university considers the PMS as an effective tool to guide decision-making processes, communication activities and managerial systems towards relevant performance measures produced by independent organizational units.

This has meant concretely (a) defining and measuring performance using heterogeneous and complex information and (b) promoting interaction between organizational actors, especially for complex tasks and non-routine or innovative activities.

In this sense the PMS has been viewed in official statements as a tool able to create and foster interactivity and decentralization in decision-making (including the measurement and evaluation of job performance).

Official statements concerning the main purpose of PMS can be found in the introduction of the university Guide to PMS (p. 13):

> Through the design and use of the PMS, the Administration aims to create, in a participatory way with its employees, integrated sets of performance objects and measures that could support the institution's executive functions and development of human resources… the creation of integrated sets of indicators and a measuring range used for evaluating the salient aspects of the University's organizational life, which over time may become "standard" indicators, allowing, at the same time, employees to participate in the institution's decision-making processes and the Administration to compare the results obtained with the results obtained over time and those achieved by other universities.

5.2 Discussion: Interconnections Between IS and PMS

In line with official goals the University adopted a PMS model that is strongly focused on interaction between the subjects involved and

> fosters coherent processes for evaluating the Administration's performance; … fosters internal and external communication processes; … compares performance in terms of benchmarking, through characteristic indicators used by international and national universities.

The IS Manager participated in the designing of the PMS as a member of the Task Force responsible for defining the characteristics of the processes of planning and measuring operational activities.

The following are the main organizational solutions, identified by analyzing the official documentation, relating to the PMS and focalized on integrating information flows: orientation meetings on the criteria and techniques provided by the PMS, open database, individual and group interviews for the definition of objectives, individual and group interviews for the analysis of intermediate results, and individual interviews for assessing performance.

The idea stated in the official documents, which was confirmed during the interviews with the General Director and Evaluation Board, is that by using interactive methods, PMS can enhance the development of managerial skills and, above all, can support the onset and sharing of new knowledge that will lead to a better understanding of the characteristics, opportunities and constraints typical of the reference context. In fact, these skills and knowledge were considered essential for the survival of a small university in a competitive environment marked by strong national uncertainty and turbulence, as well as in a local context in which large universities with a venerable history constituted a strong and constant threat.

The decentralization of the decision-making power relating to the definition of operational objectives, consistent with overall policy objectives created by the governing bodies, and the active collaboration of employees in the definition of indicators and measurement of results have been interpreted as suitable organizational solutions to activate sharing of explicit knowledge as well as tacit support of innovation processes.

In general, the information system included in the PMS of the university is configured as a system designed to proactively manage information flows between different organizational units, both central and peripheral units (departments). Its specific purpose was to foster both the definition of performance targets in the planning phase and the collection and data analysis for measurement in the closing stages of the annual process.

During a PMS start-up meeting, the IS Manager said:

> It will allow effective interaction between different organizational referees, regardless of their hierarchical position and their functional position in order to achieve strategic business objectives. Objectives and indicators must clearly indicate the different contributions of workers and be consistent with the strategic vision outlined in the three year strategic plan.

The IS Manager added:

> When we started to define the functions of the application dedicated to PMS, I immediately complained that there would be serious difficulties in design and implementation for two reasons: our major information systems to support operational management were very isolated; and people were not used to interactively managing computerized information flows arising from their specific activities. We had to push colleagues to operate actively in the definition of the objectives, work programs and especially indicators of achievement, breaking down existing barriers especially in the dialogue between different hierarchical levels.

In the absence of a common and integrated platform, data relating to specific work programs have been loaded in subsequent steps by the different groups of actors involved in a specific target.

In the planning phase, therefore, an effective interaction was sought between the organizational actors with varying degrees of responsibility that would participate in the realization of the strategic objectives.

During the first year of implementation, however, some characteristics of the IS dedicated to the PMS showed limits and produced a significant gap between official objectives and managerial behaviors.

At the end of the first year of operation of the PMS in relation to an investment project in university building, a worker from the Technical Bureau said in an interview:

> I have occurred permissions issues by public institutions to carry out some external work, and this has prevented me from spending the entire budget allocated. I informed my superiors in the course of informal meetings, but the information system was not able to record these facts. My boss had to justify, however, a financial figure that represented a failure.

In a different situation a worker from the Research Office revealed:

> In the closing phase of PMS we could just upload the raw data for the measurement of our performance on dedicated IS. Talks and other communication techniques used in the initial stages of PMS were not carried out. Yet I wanted to specify some things that led to my results. I suspect that my bosses did not want to deal with the direct comparison among workers when it came to the moment of evaluation. We always talk about quality and meritocracy and then…!

When this revelation is matched against our theoretical framework, a significant difference emerges. While the literature stated that the higher the level of integration, the higher the level of centralization, our case study shows how even when the IS is decentralized and isolated, the level of centralization could still be very high. This is due to the fact that what really influences the centralization versus decentralization process is the strategy adopted to implement the PMS and in particular, the way the information flow is built up and managed. In this sense the gap between the formal intention of the University and the real implementation of the PMS is clear for all to see.

The decentralisation of the decision-making power relating to the definition of operational objectives consistent with overall policy objectives created by the governing bodies and the active collaboration of employees in the definition of indicators and measurement of results have been interpreted as suitable organisational solutions to activate sharing of explicit knowledge as well as tacit support of innovation processes.

However, during the last phase of the PMS (measuring and evaluation of performances), in many cases the nature of the interaction mechanisms was forced or invalidated in favour of approaches and methods inspired by a strong centralisation and dynamics of power that were inconsistent with the purpose stated during the launching of the system.

In particular, we detected two types of dynamics or behaviours that contrast with the *interactive* approach and with the purposes meant to contribute, through the PMS, to the sharing of knowledge to support innovation and organisational development at the university analysed.

1. Interviews were not used for analysing results and their causes, and the score that the employee received was only communicated through formal channels, in order to avoid situations of conflict within the team. Measurements were not differentiated even in the presence of different levels of performance.
2. The PMS was used as an instrument to adjust the power distributed among the groups and organisational units: the team manager changed the way the

individual scores were used, making assessments that were not coherent with the actual performance levels in order to counter the risk of opportunistic behaviour by other groups.

In particular, in some cases, the evaluation interviews were not carried out and the discussion with the employee was replaced by a mere formal notification of the final judgment on his performance.

> "Every co-worker knows exactly the contribution he has made to our team. … I have the responsibility to make balanced judgments. … I can't communicate all the considerations I make during the evaluation of their performance", was the comment of the Administrative Staff Services manager.

In other cases, managers did not differentiate properly the judgments on the individual performance, even in the presence of different levels of achievement of employees, often due to differentiated organizational practices. The reasons given to explain this behavior were the difficulty of formally "justifying" the differences in score and the desire to contain the levels of conflict in a team. In this sense, the PMS has been interpreted as an instrument for consensus and regulation of power within a group.

During an interview carried out at the end of the evaluation a process manager from the ICT unit stated:

> Yes, this year we started working on the definition of meaningful performance indicators for measuring individual performance, but in the end I'm interested in the overall performance of the Area… I have a large number of collaborators and I manage many projects. I realize that a more careful analysis of the performance would be an interesting contribution to the development of our employees and for planning processes in the future, but I have to worry, today, about their willingness to be engaged, tomorrow, in new projects before I involve them.

In specific situations the PMS was used by the middle management to deal with power issues between different groups and organizational units. In the Economic and Financial resources Area, for example, at the end of the evaluation process the manager gave very high individual and absolutely homogeneous scores. During the talks with his employees and during the interview he said repeatedly:

> Everyone in this organization knows how much we are harassed, constantly trying to solve emergencies and to deal with all-important matters of economic management of our universities… My staff carry out this work as a mission… now everyone must accept an assessment consistent with this situation. Above all I have to avoid instances of injustice. Our organization is small and I can't allow my staff to be evaluated less than others who work with colleagues who are self-promoting and unscrupulous!

These two implications (the higher degree of centralization and the use of PMS as a way to manage power) are directly related to the real goal the management wanted to achieve: to have a higher level of control inside the organization. The centralization of data and the absence of an interaction process among the different members of the organization (even across different hierarchical levels) are clear signs of seeking new opportunities for monitoring and managing personnel performance.

6 Conclusions

The case study shows how the characteristics of IS dedicated to PMS from being an instrument of decentralization and integration came to be used instead as an instrument of control and centralization. In particular we underline two main aspects.

The University analyzed had to deal with specific design choices of IS in the process of wider design of its PMS. These technical choices were geared to a principle of interaction in information management needed to "conceive", measure and evaluate performance. The limits existing in the general architecture of the information systems of the University required the design of a specific and highly innovative application in-house compared to the existing ones, characterized by high degrees of connection between a variable number of operators for each specific strategic objective. The IS architecture still requires a major effort to improve the possibilities of interaction in the process of performance management. Currently the IS cannot support contradictory practices of centralization in the process of measurement and evaluation.

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Public Italian Universities Towards Accrual Accounting and Management Control

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Abstract The paper analyzes the accounting, financial reporting and management control systems of the Italian public universities, according to the new legislation (Law 240/2010, Decree 18/2012). This reform includes two important changes: the adoption of accrual accounting and the introduction of a management control system, both mandatory from 1st January 2014. The paper provides a description of the current situation of Italian universities, which allows to understand the reality in which the reform will be implemented and to evaluate whether universities are ready to realize these important changes. For this purpose, an empirical analysis has been conducted, based on the results of a semi-structured questionnaire that was applied to the 67 public universities during the first half of 2013. Survey results indicate that not many universities possess budgeting and accounting reporting systems aligned with the new legislation; however, most of them have executed different types of efforts for the transition process.

Keywords Accrual accounting in public sector · Management control in public sector · Italian universities

1 Introduction

This paper focuses on analyzing budgeting, accounting and management control systems of a particular type of public entities (PEs), which are Italian public universities (PUs).

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The accounting systems of PEs have become a highly debated topic in recent years, with particular reference to the need for accounting harmonization, both nationally and internationally [1, 2].[1]

Also Italian Pus are facing relevant changes on their budgeting and accounting systems, responding to the reform introduced by Law 240/2010 and Decree 18/2012. This reform includes two relevant points: (i) a change of the accounting system, from cash accounting (CA)—which in the case of most PUs is a modified CA system, based on commitments—to accrual accounting (AA); and (ii) the introduction of a cost accounting system to improve management control.

These changes have been introduced within the framework of an overall renewal process concerning the entire PEs accounting systems mentioned above, even if universities, in terms of accounting system, will have to abandon CA, unlike other PEs.

Considering that PUs will be obliged to adopt the reform by 1st January 2014, the research has two interrelated goals:

1. First, the study seeks to present an in-depth analysis of the renewal process of the PUs budgeting, accounting, financial reporting and management control systems, which result from the reform mentioned above. This part of the study holds a descriptive approach, which puts in evidence the most critical issues of the law change and its implications.
2. Second, the article presents the results of an empirical analysis aimed to describe the current situation of Italian PUs in terms of budgeting, accounting and management control systems, in order to understand the reality in which the reform will be implemented and to evaluate whether PUs have already done appropriate efforts to realize these important accounting and managerial changes.

This second objective of the study can be consider as relevant and innovator, since only very few authors have covered this specific matter [3, 4]. In the same sense, any of the research studies developed so far have included in their analysis the complete population of Italian PUs. The empirical analysis presented in paragraph 4 of the present study, does consider the entire population of Italian PUs and its evolution in a such peculiar period of analysis, close to a so important legislative deadline.

The results presented bellow attempt to consolidate a contribution for the academic community, as it allows knowing better the actual situation of PUs regarding accounting and management issues. In the same sense, the article can be considered as useful as well from the perspective of policy makers, since they might have to take into consideration the possibility of extending the deadline for

[1] During 2009, important laws that reforming the accounting aspects of PEs were introduced. They are: Law 196/2009—law of public sector accounting and finance—and Decree 91/2011, that refers to all PEs except regional, local governments and healthcare entities; Law 42/2009—regarding fiscal federalism—and Decree 118/2011, that changed the budgeting and accounting models of regional, local governments and healthcare entities.

the implementation of the accounting changes included in the new law. If they do so, they will need to establish the conditions and coverage of the new deadline (for example, giving different deadlines to different groups of PUs).

2 Literature Review: The Renewal Process of Public Sector Accounting Systems

In the context of New Public Management literature, many authors have focused their analysis on accounting aspects and particularly on the introduction of AA within public sector, alongside or in place of CA, the traditional accounting systems of most PEs.

Some of these studies highlight the advantages of utilizing AA, such as: the application of profit and loss model and equity analysis, from a qualitative and quantitative point of view; the possibility of drawing up the consolidated financial statement assessing the economic result of the year and the financial position; the mid and long-term assessment of policies and public programs and their financial sustainability; the possibility of improving the data entry process of management control [5–10]. In summary, and in the light of the aspects mentioned above, AA produces more complete and accurate information that benefit the accounting analysis in an internal and external perspective. The improvements can lead to more transparency, an enhanced performance assessment and a higher level of accountability towards stakeholders.

The advantages of AA mentioned above correspond to the most critical weaknesses of CA system. It produces information that is not accurate because only based on cash flows, as this kind of accounting system does not reflect the link between consumption of resources and results [11]. Though CA gives information about cash equilibrium, it does not reflect potential erosions in the equity of PEs. Moreover, the utilization of CA has led to a misconception of the efficiency concept, since PEs that postpone ordinary maintenance costs reflect healthier cash equilibrium conditions than those that reflect on their budget an immediate reduction of their resources by not postponing their ordinary expenses [12].

Although the AA has many advantages, some theoretical and empirical studies have highlighted the difficulties that PEs can face while utilizing this system. Some authors, for example, claim that CA is more suitable for the case of some particular activities that are developed by PEs, which mainly work by fund transfers to other public or private organizations. Some other authors consider that financial performance is not the most significant measure to represent the results of PEs, since they have a non-profit approach [13–18].

From a practical point of view, there is evidence that PEs have faced some operative challenges while changing their accounting system from CA to AA, which has been related with some PEs' peculiarities. On one hand, the fact that PEs generally do not work within "normal market conditions" has led to difficulties in

defining, measuring, classifying and presenting some balance sheet's items (think about cultural heritage), as well as in measuring the production of PEs (for the income statement). On the other hand, PEs' managers and employees have struggled for interpreting and utilizing correctly the new type of reports. In this sense, the transition involves for PEs time, financial and human efforts [14, 19–22].

With particular reference to the kind of PEs in this study, that are Italian PUs, a vast amount of specific literature exist.

While some authors have analyzed the phenomenon of public universities from a general perspective, that includes funding sources, governance, sustainability, etc. [23–28], some others have focused their attention on managerial issues such as strategy, budget planning, and management control [29–40].

Then, some studies have focused on the main activities carried out by universities, such as educational activities, research, student services [41, 42], while some others have been more specific and have explored the accounting systems of universities and the potential implementation of an AA system, both from theoretical and operative perspectives [43–48]. Indeed, since Italian universities have accounting autonomy—almost unique within the public sector—it is possible to find different accounting experiences in order to test the viability of AA systems within single departments of universities and/or in these entities as a whole [45, 49].

3 The New Budgeting and Financial Reporting Systems for Public Universities According to the Recent Law

Law 240/2010 changed the old accounting approach of PUs, which was established by D.P.R. 382/1980. At first sight, the process of moving from an accounting system to another one can look simple, only a technical issue. In fact, introducing AA, moreover alongside to a cost accounting system, is a real revolution within a PE, because this impose a different way in which activities are programmed, improvements in management control and, in general, efforts towards the organization's feasibility.

3.1 The Content of Law 240/2010

The Law 240/2010, which reformed the Italian university system, devotes only few parts to the universities' financial documents, but that will strongly modify the way of "keeping accounts" by PUs.

According to this law, four main objectives should be fulfilled with the introduction of the accrual accounting and cost accounting system:

1. *To enhance connection and coherence between annual planning, three-years planning and reporting.* The fulfillment of this objective will allow to establish

logical links between the different planning activities and to avoid to have isolated information.[2] This will be possible through the utilization of an appropriate planning and reporting system, deriving from the combination of AA and cost accounting systems.
2. *To increase transparency and homogeneity.* These two characteristics should be present in all the accounting documents: budgets, statements, reports, etc., having as goal to provide more and better information to internal and external PUs' stakeholders. Transparency should increase from previous levels and should assure communication between different universities, also thanks to a unique chart of accounts, specific accounting principles and financial documents formats.
3. *To assure evaluation and representation of the equity consistency*, which was not possible with the previous accounting systems.
4. *To monitor the general trend of management.* In other words, to monitor the various process and operations developed within universities and its financial results. This objective complements the previous one and makes reference to a weakness of the previous CA system.

3.2 The Content of Decree 18/2012

Decree 18/2012 has been the only implementing decree of Law 240/2010 that has been focused on the move to an AA system. The decree reinforces the objectives mentioned above and the instruments of the new accounting system, specifying the activation of "…systems and procedures of cost accounting towards management control". The norm is the only that refers specifically to the topic and from our perspective it is particularly relevant as it makes reference to one important instrument of management control (cost accounting system). Moreover, the new system allows entering general accounting data, according to AA principles, which has to be done just once and can be utilized for both, general financial reports and management control ones.

The Budgeting and Reporting Documents to Be Presented. The budgeting and reporting documents that PUs will have to present are similar to those that private companies need to build, according to the law.

BUDGETS (four documents):

(a) *Yearly "single" and "authorizing" budget* (in Italian "bilancio unico di previsione autorizzatorio annuale"), which comprise:

    (1) economic budget;

[2] Since 2005 Italian universities have had to elaborate planning documents relating to their main activities, staff recruitment, etc. However, these documents do not have a specific source of accounting data as any formal reporting form has been provided for doing so.

(2) investments budget.

(b) *Three-years"single" budget* (in Italian "bilancio unico di previsione triennale"), which comprise:

(1) economic budget;
(2) investments budget.

FINANCIAL STATEMENTS (five mandatory documents plus three eventual documents):

(c) *Yearly "single" financial statements* (in Italian "bilanciounicod'esercizio"), constituted by:

(1) balance sheet;
(2) income statement;
(3) cash flow statement;
(4) notes;
(5) management report.

(d) *Consolidated financial statements*, which includes all controlled entities, no matter their juridical nature. It is composed by:

(1) balance sheet;
(2) income statement;
(3) notes.

Then, in order to aggregate and monitor better public expenditures, the legislator considered that for the case of PUs, it is also necessary to present in CA system:

(1) "single" and "non-authorizing" budget (in Italian "bilancio preventivo unico non autorizzatorio);
(2) "single" budget accounts.

Other documents need to be attached: a prospect that contents the classification of the total expenses for missions and for programs. The missions, according to the legislator, are the main activities and strategic goals that PEs should aim through the utilization of financial, operative and human resources. The programs are homogeneous sets of activities, which are aligned towards the fulfillment of the missions. Each program has a corresponding code in the list of COFOG (Classification of the Functions of Government) of second level. Planning and programming processes within universities should be developed in consistency with the plans and programs but also with the taxonomy mentioned above.

These normative aspects could have a determinant role in the application of management control processes within universities, moreover taking into consideration that these processes are designed in a customized fashion. This is, management control is developed taking into consideration the specific objectives of each university and having as base standard instruments with homogenous classifications that allow horizontal comparisons.

The yearly "single" financial statements of universities need to be approved by an auditing committee. The committee's notes make part of a complete package of reports that need to be completed by 30th April of each year.

Table 1 presents a summary of all the budgeting and reporting documents that Italian PUs have todraw up.

The Concept of "Single" Budget and Financial Statements and the Managerial and Administrative Autonomy of Universities' Departments and Centers. The Decree 18/2012 does not provide a specific meaning for the "single" characteristic of both, the budget and the financial statements. The SIDREA[3] group of work holds that it is necessary to eliminate any ambiguity of the meaning of "single" statements and suggests defining the concept in a clear and standardized way. Otherwise, this can become a limitation for the process of harmonization and will make difficult to make comparative analysis within the Italian universities system.

In the light of this, it can be said that "single" statements refer to the consolidated budget and accounting reports of the entire institution. In this sense, the statements should present in a complete, unitary and systemic way the cash, financial and economic information regarding the university, taking into consideration the future management (budget) and the previous one (financial statements). It covers as well all departments and centers that belong to the institution, even those that have financial, logistic and decision-making autonomy.

This could not be made in other way, because the Law 240/2010, instituting the Departments, has granted them a significant size and various responsibilities related not only to the operating function of teaching and research activity, but also with the administrative area. Among the various administrative tasks, there will also be those regarding accounting records.

Within a financial accounting system based on AA, it might be possible that the departments' administrative staff carries out accounting recording relating the use of the resources that have been previously identified with the approved budget. It is not an impediment, the presence of the "only" treasurer to eliminate the activities of purchase and payment, as well as the supply and cash collection relevant to a department. Information technology applied to bank accounts functioning allow to use a single account to develop, with appropriate codes, the activities of collection and payment of more subjects, obviously enabled.

In the context of AA, autonomy does not mean building separate budgets or financial statements for each university department, but to have a flexible accounting framework that allows reporting and controlling the programmed

[3] SIDREA is the acronym for the Italian Society of Accounting and Business Administration professors. The document is the result of a subjunctive research work of the professors: Lidia D'Alessio (University of Roma), Riccardo Mussari (University of Siena), Antonella Paolini (University of Macerata), Ugo Sòstero (University of Venezia Ca' Foscari) and the president of SIDREA, Angelo Riccaboni (University of Siena). The working document was sent to the commission of "Camera deiDeputati", who also listened professors D'Alessio, Riccaboni and Sòstero [50].

Table 1 Budgeting and reporting documents

6 Budgeting documents (deadline 31/12/n−1)	
Yearly single and authorizing budget	1. Economic budget 2. Investments budget 3. Classification prospect of expenses for missions and programs
Three-years single budget	4. Economic budget 5. Investments budget
Single and non-authorizing budget	6. Annual budget in CA system
12 Financial statements (deadline 30/04/n + 1)	
Yearly single financial statements	1. Balance sheet 2. Income statement 3. Cash flow statement 4. Notes 5. Management report 6. Classification prospect of expenses for missions and programs 7. SIOPE report 8. Auditing committee report
Consolidated financial statements	1. Balance sheet 2. Income statement 3. Notes
Single budget accounts	1. Budget accounts in CA system

activities in the most convenient way. Furthermore, from the perspective of the authors of this paper, the planning of management control processes should arise from each of the universities' department and center since each of them is autonomous and can use the classifications of their programs for building their own budget. The resultant budgets could be controlled using data taken from the AA and cost accounting system.

The Concept of "Authorizing" and "Non-Authorizing"Budget. The legislator has ruled that the "authorizing budget" does not correspond anymore to the budget in CA (that is in nature an "authorizing" report), but to they early economic budget and the yearly investment budget. The new definition of "authorizing budget" is more flexible and allows giving reason about the distribution of the resources and its utilization. However, is important to notice that the budget in CA continues to exist and its elaboration is still mandatory. This persistency in the existence and elaboration of this traditional tool could invalidate the new approach of the "authorizing budget" that contains the advantages mentioned above.

The fact that the CA budget cannot be considered anymore as authorizing, introduces a further difficulty. It is still mandatory for universities to draw up and send to the MIUR (Ministry of Universities and Research) the budget ad budget accounts in CA. Then, the question is: it is still necessary for PUs to keep accounting records in CA, in addition to those ones in AA? Or should PUs build these CA documents in an extra-accounting way?

As mentioned above, CA will be replaced by the AA and therefore the first one is not anymore "authorizing". In the light of this, maintaining the CA records can only have the purpose of allowing a more immediate and proper preparation of the related documents: the budget and the budget accounts, so that they can be used for the consolidation of the accounts of PEs by the central government.

The law does not conceive that is necessary to maintain two accounting systems in a parallel or integrative way (even if the empiric analysis shows that several universities are doing so). If it would be like that, the CA system should be the "main" system, and this would be inconsistent with the new dispositions concerning the "authorizing" role of the yearly economic and investments budgets. In that hypothetical scenario, universities will have the same accounting system of most of other PEs (which maintain the authorizing CA system). However, this is not the case and the only reason for PUs to present the CA documents is, according to the law: to be part of the harmonization of PEs accounting processes. Therefore, the incongruence is still present.

The Transition Period and the Expected Implementing Rules. The Decree 18/2012 recalls a list of other related implementation decrees that have not been issued. These decrees mainly involve the Ministry of University, the Ministry of Economic Affairs and the CRUI (Conference of Italian Universities Rectors).

Table 2 shows the deadlines and the involved entities that are considered in the Decree 18/2012.

Currently, the drafts of two decrees included in Table 2 are circulating. These are drafts of decrees number 2 and 3, which are indeed the most important and necessary for the preparation of budgets and financial statements.

4 The Empirical Analysis' Findings

4.1 Research Methodology

The second objective of this research focuses on analyzing the implementation state of the new accounting system of Italian PUs.

On the website of MIUR we found the list of the 67 Italian universities and higher educational institutions that are public (funded by the Italian government), which constitute the total population of the study. A semi-structured questionnaire was sent to each of these institutions in order to collect information regarding the adopted accounting system in the last three years (2011–2013). In some cases the questionnaire has been filled in by academics (professors of Accounting and business administration), in other cases information has been completed by administrative staff (general directors or heads of financial offices). The main purpose was to verify the number and nature of the universities that has already made the accounting system changes. Furthermore, it was aimed as well to validate the instruments that universities have used in this transition process.

Table 2 Expected implementing rules, their deadlines and involved entities

Decrees	Involved subjects	Article of the decree 18/2012	Deadline
1. Decree designating commission for the AA system	MIUR	art. 9	23/04/2012
2. Decree for accounting principles and schemes of budget and statements	MIUR aligned with MEF and CRUI	art. 2	23/06/2012
3. Decree for missions and programs	MIUR aligned with MEF and CRUI	art. 4, c. 4	23/06/2012
4. Decree for consolidation accounting principles	MIUR aligned with MEF and CRUI	art. 6, c. 3	23/06/2012
5. Decree of accounting principles and scheme of budget and financial statements for transition period (for PUs still with a CA system)	MIUR aligned with MEF	art. 10	23/06/2012

The research was developed from January to June 2013. A total of 64 from the list of 67 PUs successfully sent back the completed questionnaire (the 95.5 % of this study's population). The following institutions were the only three that did not answer the requested survey: Università per Stranieri di Perugia, Università degli Studi di Roma "Tor Vergata" and Università per Stranieri di Siena. In addition, to processing the information contained in the 64 questionnaires, the research is also based on a documental analysis of budgets and financial reporting documents relating to the evaluated period.

4.2 General Accounting Systems

From the 64 universities that sent their feedback, only 3 showed to apply an AA system in 2011 (Camerino, Politecnico di Torino and Trento). In 2012 the number increased to 5 as University of Udine and University of Trieste implemented the system; in 2013 these institutions reached 15 (the 5 universities mentioned before plus: Cagliari, Genova, Molise, Napoli Federico II, Pisa, Pisa Sant'Anna, Sassari, Siena, Urbino, Venezia IUAV).

The results also showed that in 2011, 14 universities started to apply the AA system in a parallel way to the CA system, that has been maintained. This number arrived to 17 institutions in 2012 and to 19 in 2013 (Bergamo, Bologna, Cassino, Ferrara, L'Aquila, Lucca IMT, Modena-Reggio Emilia, Parma, Pavia, Pavia I.U.S.S., Pisa, Politecnica delle Marche, Roma Foro Italico, Roma La Sapienza, Salerno, Torino, Tuscia, Venezia, Verona). Consequently, in the correspondent period, the rest of institutions utilized exclusively the CA system, as showed in Table 3.

The questionnaire also enquired about the accounting software that universities utilize, which is relevant not only from a technical perspective, but also for

Table 3 Transition to the new accounting system

	2011	%	2012	%	2013	%
Only AA	3	4.7	5	7.8	15	23.4
AA + CA	14	21.9	17	26.6	19	29.7
Only CA	47	73.4	42	65.6	30	46.9
	64	100	64	100	64	100

evaluating whether universities have the effective possibility of implementing the accounting changes. Regarding this topic, it was found that most of the Italian Pus utilize the software of CINECA (Consortium for the automatic computation between universities) in its CIA (Integrated Accounting for Universities) version and in the advanced version called U-GOV accounting. In 2011, universities of Camerino and Politecnico of Torino already were using the package U-GOV, while other 43 institutions used CIA, as well as in 2012. In 2013 instead, the results shows that the users of U-GOV increased to 17 universities (7 of theme abandoned the use of CIA).

In the light of this, it can be said that the role of CINECA is almost monopolistic in terms of providing programming, controlling, monitoring and research evaluation software tools. However, the results reflect that some other software packages are also used. EASY from Tempo s.r.l. for example, was used during the evaluated 3 years-period by the following institutions: Bari, della Basilicata, del Piemonte orientale and Salento. University of Trento used SAP and Trieste University followed this option as well until 2012. The following universities used SUFIN software from Data Management s.p.a.: Brescia, Cagliari (until 2013), Milano and Milano Bicocca. CAMPUS software instead, was prefered by Univeristy of Genova during 2011 and 2012. Ferrara University has used CIELONEXT software from Seleste. JCOFI from Unitech was the selected software by the University of Foggia. Finally, the universities of Catania and Teramoopted for developing their own internal accounting software.

The questionnaire also enquired whether universities have implemented experimental initiatives for dealing with the transition process from CA to AA. Excluding the universities that use AA system (exclusively or together with the CA), 19 universities didn't develop any kind of experimental projects. The initiatives are very diverse in terms of strategies and impact, as it will be shown in the final considerations of the paper.

4.3 Financial Statements

Universities were requested to specify the type of financial statements that resulted from their accounting system.

Taking into consideration the universities that adopt the AA, exclusively or together with the CA, it was found that only 4 of theme (Camerino, Modena-

Reggio Emilia, Politecnico di Torino and Trento) presented in the considerate three years the complete package of financial statements: income statement, balance sheet, notes, cash flow statement and management report.

These results imply that there is no link between the type of accounting system and the financial statements that universities are able to produce. This is mainly due to two circumstances that have arisen:

1. The institutions that are using CA and AA systems at the same time opted for building report documents in both systems.
2. In cases in which AA system was adopted exclusively (from 2012 and 2013), the accounting documents have gradually moved to those that typically result from this system.

It is relevant to mention that the financial reports published during the analyzed 3 years-period correspond to the operational period 2010–2012, which include a year that was not analyzed in this study. Therefore, it is important to specify that the universities that have adopted the AA system, exclusively or together with the CA one, were in total 17 in 2010 and 2011 and 22 in 2012.

Table 4 summarizes the percentage of universities that presented the different financial statements' documents during the evaluated period.

To complete the results regarding financial statements, the questionnaire asked to the institutions that only apply the CA system whether they present, in addition to the traditional budget accounts, a balance sheet based on inventories. For 2011 and 2012, 89.4 % of these universities answered positively and for 2013 this number grew to 90.5 %.

4.4 Management Control

Another part of the questionnaire enquired whether universities have adopted any instruments (accounting or non-accounting ones) of management control, in the light of the introduction of a cost accounting system, the budget approach and the utility of these tools.

For the question of whether universities have used acost accounting system, 39.1 % of the institutions answered positively for 2011, 42.2 % for 2012 and 53.1 % for 2013.

The data for building the cost accounting system can be taken from CA system, from AA system, from both CA and AA systems or from non-accounting information. Table 5 shows the different sources of data of cost accounting system and the percentages of universities that utilized each of them in the evaluated period.

To complete the analysis of management control, the questionnaire enquired whether, apart cost accounting system, universities have applied any other management control tools (for example: budgets, reports, indicators, etc.). The open answers for this question indicated different types of situations. Therefore, the only quantitative results related to this question, are the percentages of institutions that

Table 4 Financial statements' documents of PUs

Documents	2011 (%)	2012 (%)	2013 (%)
Income statement and balance sheet	47.1	58.8	72.7
Cash-flow statement	29.4	41.2	59.1
Notes	41.2	52.9	63.6
Management report	35.3	41.2	50.0

Table 5 Data sources for cost accounting system

	2011	%	2012	%	2013	%
PUs that have implemented cost accounting system	25	39.1	27	42.2	34	53.1
CA source (PUs having only CA)	13	27.7	14	33.3	10	32.3
CA source (PUs having CA and AA)	3	21.4	3	17.6	3	15.8
AA source (PUs having CA and AA)	7	50.0	9	52.9	12	63.2
AA source (PUs having only AA)	3	100.0	5	100.0	14	93.3

have not used any other management control tool during the analyzed period: 62.5 % in 2011, 54.7 % in 2012 and 50 % in 2013, making evident a decreasing trend.

As follows, some other outcomes will be presented without mentioning specific universities. It was found that the instruments utilize for managing and controlling universities are: economic and financial ratios, indicators related to the project "Good Practice" and performance plans, budget and ratios referred to the central and departmental administration, balanced scorecard and other tools (cash budget, data warehouse for human resources, students and educational programs, software for maintenance costs and infrastructure administration). In the same sense, also procedures for allocating human resources costs, indicators elaborated by the internal assessment committee (Nucleo di valutazione), efficiency and effectiveness indicators, ABC analysis for costs and deviation analysis.

4.5 Accessibility of Budget and Financial Reporting

The last focus of analysis of the survey is the accessibility of the budgeting and accounting information of PUs. Indeed, all budgeting and accounting changes we are talking about will produce modifications within the financial disclosure of PUs, which have both internal and external relevance. Specifically, it was evaluated whether it has been possible to access to the reports of universities through their institutional websites, in the evaluated period.

In the case of budgets, it was found that 53.1 % of universities published them on the website in 2011, 59.4 % in 2012 and 57.8 % in 2013. Updating processes on the sites probably caused the decrease in 2013.

For the case of the financial statements, the percentages of accessibility through website are only available for 2011 and 2012, due to the approval period of the reports. In 2011 and 2012 the percentage of online publication of financial statements was 64.1 %. Additionally, 15.6 % of the universities also published their social reporting.

5 Synthesis and Conclusion

The results of this study confirm that the Law 240/2010 has radically changed the approaches of Italian PUs, from an accounting perspective.

Only in few circumstances the change could derive less strong implications. This is probably the case of pioneer universities that are conforming their general accounting and cost accounting systems according to Decree 18/2012. However, even these institutions will need to do appropriate efforts for adapting their budgets, reports and accounting principles to the new law, with particular reference to those decrees not yet issued. Other case in which the transition process will be easier is in those universities that have developed training programs and suitable software. From the 3 universities that applied AA from 2011, just University of Camerino has successfully approved an "authorizing" budget (economic and investments budgets) in line with the new law. Politecnicoof Torino and University of Trento have approved these documents but have not qualified them as "single" and "authorizing" ones.

In 2013, a considerable amount of universities (17 of 64, this is 26.6 %) have adequate their accounting systems towards the fulfillment of the Decree 18/2012 regulations: Cagliari, Camerino, Genova, Modena-Reggio Emilia, Molise, Napoli Federico II, Pisa Sant'Anna, Pisa, Roma La Sapienza, Roma Tre, Salerno, Sassari, Siena, Trieste, Udine, Urbino e Venezia IUAV. The University of Cassino instead, adopted the AA system and the economic budget but is still missing the investments budget.

Future research work could analyze further the cases of the pioneer universities mentioned above, in order to verify the way in which they have interpreted and applied the meagre laws, moreover with no presence of accurate financial documents (budgets and statements) and accounting principles. In the same sense, it would be interesting to extend the period of analysis of the present research work, including the developments of 2014 and in general, the scenario after the 1st January deadline.

The analysis also showed that in 2013, many universities have referred to their budget as "single" document even if they prepared it within the traditional CA system. This phenomenon can be explained by the existent ambiguities related to the term "single". Some institutions have wrongly considered that a "single document" (budget or statement) can be drawn up with the mere aggregation of the CA reports produced by the different departments and centers of each university.

As wrote in paragraph 3.2.2, the lack of a formal definition for the adjective "single" has led many relevant actors (general managers, heads of financial offices of universities, etc.) to ambiguity about the concept. More importantly, it has driven them to consider that they should centralize all the activities related to budgeting and accounting records. The execution of this centralization that derives from the misconception of the word "single" could generate different kind of issues, not only technical ones, reflecting negatively on the overall organization of universities, as well as on their management and control activities. In the absence of departmental autonomy, will be less specificity for the planning, managing and reporting units of the overall system. This would include, for example for departments, the inability to set a budget, to develop a self-management and to check the economic opportunity of choices and, between others.

The amount of institutions that have realized the implementation of the new accounting system and its relative requirements during 2012 and 2013 is still very limited. Although the deadline for the change is 1st January 2014, many PUs that continue to use the old accounting system, and 19 of them say that no experimental projects have been carried out.

Based on the information gathered, we believe, however, that there are also substantial differences. On the one hand there are many universities that have set that goal in a rigorous manner: they have prepared their internal Rules of administration, finance and accounting for the term prescribed by law; have established a precise program of training of administrative staff; have made choices regarding the software to use. On the other hand, there are universities (not many) who hope, given the delay of the legislator, in a deadlines' postponement, to have the time to design and implement what the others have already done.

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The Role of Information Systems to Support Performance Management in Public Administration: The Case of the Italian Regulatory Authority for the Energy Sector

Simone Lazzini, Luca Anselmi, Luca Lo Schiavo and Anna Maria Falanga

Abstract The objective of this paper is to offer a significant contribution to the debate on how to implement performance measurement systems in the Public Administration by proposing a model based on an integrated information system where planning (strategic and operational) and measurement systems are supported by a single application that drives the whole process. The research is based on the case study method [1] and analyses the characteristics of ICT systems in supporting the management control systems developed by the Italian regulatory authority for the energy sector (AEEG). The results of our work suggest that a single measurement metric may be identified for the assessment of the output produced by both core and accessory structures, in complete integration with the planning and control process.

Keywords Performance management system · Information system in public administration · Authority

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1 Introduction

The recent Italian legislation requires central and local public entities to manage organizational and individual performance. At present, several Italian entities have to adopt Performance Management Systems (PMS). There is a great controversy in the main literature concerning this reform and the effective implementation of these systems in public administrations [2].

The aspect that seems to pose the greatest challenge to an effective measurability of performance in public administrations lies in the existence of a close link between the processes of producing and providing a service. The finalist approach to output measurement, which has always characterized enterprise, becomes rather difficult to apply to the public framework precisely due to the close correlation between the intermediate process and the final service [3]. As these two items are inseparable, it is hard to achieve a global assessment of the efficiency of the administrative action [4], whose appraisal can be undertaken only through the use of blatant approximation mechanisms.

More generally, issues related to the configuration of information systems in public administrations have sparked a debate on several themes: the bases of accounting; the methods and metrics of performance measurement, the architecture of systems in support of PMS.

The studies carried out in the context of information and communication technology systems (ICTs) in support of planning and control processes in the public administration highlighted the following problems:

- Issues regarding the design and integration of ICTs [5–8];
- An increase in the workload of the administrative staff [9];
- Difficulties in identifying the activities that make up the processes [10–12];
- Difficulties in implementing changes related to ICTs [13–15]
- A low correlation between strategic planning and budgeting [16–18];
- Difficulties in measuring outputs [19, 20];
- Difficulties in identifying performance measurement indicators, with the consequent problems of measuring the levels of effectiveness and efficiency of organizations [21, 22];
- A weak ability to support decision-making [23]

While the literature is unanimous in recognizing the instrumental role of information systems, their capacity to support performance management is still in question. This work fits in the wide area of studies based on a "holistic" approach. It assumes a correlation between the architecture of information systems and the plurality of variables that characterize the organizational framework and the cultural, social and institutional context in which the administration operates [24–26].

To understand the role of the variables involved in ICTs, we should simultaneously take into consideration the characteristics of the environment and the organizational context, without neglecting the evolutionary paths or the "history" of those systems [27].

The Italian Authority for Electricity and Gas has resolved many of the issues raised by preview studies and researches concerning the methods and techniques to be used to define and measure strategies, politics and actions.

2 The Characteristics of the Authority

AEEG is the first independent regulatory body established in Italy with Law no. 481/1995. This law, which is also the regulatory framework for other bodies operating in the fields of telecommunications, mail, water and transportation, was approved by the Parliament with an extremely large majority, reflecting the relevance of such a role in the liberalization and privatization of public services that had traditionally been delivered by public companies. The main target of the new independent regulation is to promote fair competition and foster the efficiency and quality of public services that, after the privatization process, are now delivered not only by the central State or local government-owned companies, but also by private organizations.

Over time, the progress of a European legislative framework towards a full liberalization of energy markets (electricity and gas) has reinforced the need for independent regulation. Since 2003, any EU Member State must appoint an independent regulatory authority for electricity and gas (with Germany as the last large State to introduce such a new public body) and since 2007 all energy consumers have the right to choose their electricity or gas supplier in a framework of regulated, EU-wide competition. Since 2011, a new European Agency (ACER—Agency for the cooperation of energy regulators) has been working for the harmonization of the national regulatory frameworks through the development of Single Market rules and technical codes. ACER's board members represent all the national EU regulators.

Independence from national Government directives and rulings is the key feature of the new regulatory authorities. For instance, AEEG may adopt resolutions without the consent of the Government, only being subject to procedural rules for decision-making, in particular public consultation on draft proposals for any new regulation and, for the most complex cases, a regulatory impact analysis. Special procedural rules are also requested for individual decisions on enforcement and sanctioning measures. Moreover, the regulatory authority plays a role of institutional adviser and can provide both Parliament and Government with opinions on draft legislation or any other issue, as each case may require.

Just to make a real, very simple but meaningful example, regulatory independence is of utmost relevance for setting tariffs, especially if the former incumbent service provider is still owned by the State, even only partially. Tariffs, indeed, have a direct impact on share values and therefore on dividends for the Treasury. In the past, before the creation of independent regulatory authorities, tariffs were set by the Government with an eye to general inflation and another eye to market

share values, whilst now the only focus of independent regulation are efficiency and effectiveness (service quality and innovation).

Some institutional rules protect the regulator's independence in crucial circumstances like the appointment of the Board members of the regulatory authority (bi-partisan majority is required in the Parliament), their long-term mandate (7 years) without being entitled to hold any other post during the mandate and to have the mandate renewed, in order to avoid conflicts of interest. However, it clearly appears that the regulator's independence is not only a once-every-7-years event, but should be grounded in the real everyday life of these new public bodies.

Therefore, independence means continuous and extensive accountability. The provisions of institutional Law no. 481/1995, which require an Annual Report to be submitted by the regulatory Authority to the Parliament and Government, are already significant, but still not enough. Another important tool for accountability is that, being the authority a public administrative body, all its decision can be appealed in the Administrative Court with a two-step jurisdictional process. Nonetheless, the fact that the same public body can both issue regulations for a specific sector and enforce them through sanctions and other orders is a reason for concern in a democracy traditionally based on the separation of powers. This implies that the regulator's accountability must be reinforced with respect to other "ordinary" public bodies, to which the separation of powers applies in the traditional forms.

Although not strictly required by the institutional law, AEEG has set its own procedural rules since its first proceedings in 1997. Wide consultation of all stakeholders on each draft proposal for new regulation or for major regulatory changes has been, since then, a distinctive mark of regulatory authorities like AEEG. In 2009, public consultation rules were updated after a specific "consultation process on the consultation process".

A further important step forward in the improvement of accountability was taken by AEEG in 2005 with the disclosure of its Strategic Plan for the first time. That 3-year Strategic Plan contains strategic objectives defined for the entire organizational structure, whose major goal is to stimulate competition in the energy markets and drive an efficient development of energy infrastructures. This Strategic Plan is publicly discussed in yearly general hearings with market participants, customer association representatives and all the other interested parties/stakeholders, and it is regularly updated. Moreover, a more detailed operational plan was also published at least until 2011, with a regulatory agenda for the most significant public consultations and final decisions to be made for the reference year.

Both the consultation process and strategic-operational planning are real-life examples of the accountability of the independent regulatory authority and impact both its budget and organizational layout. The actual operation of the planning process can be assured only through the implementation of internal information systems. Since the beginning of its operations, AEEG focused its attention on the development of its website (www.autorita.energia.it), with a special care to ensure transparency, friendliness for different targets (operators, final consumers and

media/investors) and full search features for the portal contents. The AEEG website is now a very authoritative resource on energy issues in the Internet in Italy, being among the first companies listed upon entering the word "energia" (Italian for: energy) in Google.

In order to better explain the organizational impact of the new "intranet" information system, it is worthwhile to briefly explain the organizational structure of the regulatory authority. First of all, we should point out that institutional Law no. 481/1995 acknowledged the "organizational autonomy" of AEEG as an essential component of its independence. Therefore, AEEG is one of the few public bodies in Italy for which changes in the organizational chart do not require a legislative act to be introduced, but only a decision of the Board.

As in other public bodies (e.g. the European Commission), there is a formal distinction within AEEG between the Board (the "Collegio") and the Services (the "Structure"). The Board is the decision-making body that substantially makes all the regulatory decisions of the Authority; it consists of a President and members with equal voting rights, who adopt resolutions with the simple majority voting method (actually, almost all decisions are made unanimously). All the five Board Members are appointed by a complex procedure that involves the Government for the initial nomination, then the Parliament for approval with a highly qualified majority (two-thirds of the relevant Parliamentary Committees), and eventually the President of the Republic to issue the final appointment act. As already said, each member of the Board has a 7-year mandate, during which he/she cannot cover any other public or private position. The mandate cannot be renewed and a 4-year term is foreseen after the end of the mandate, during which former members cannot have any direct or indirect relationship with regulated entities.

3 The Theoretical-Doctrinal Models for the Configuration of the System

The case of AEEG bears witness to the possible development of a methodology based on the approaches of theoretical models and on the most sophisticated assessment tools to reflect the peculiarities of the administration and become a real instrument for guidance. The configuration of the performance measurement system is based on two closely interrelated elements: the first is the logical-conceptual framework of the assessment system and is expected to comply with the requirements of the administration and its distinguishing features; the second concerns the development of a tool to be used to support the operation of the system itself.

The objective pursued when developing the measurement system was not to limit the scope of the assessment to the sole final result of the administrative action, but rather to highlight the determinants of that action and examine their global impact.

This leads to the need to define performance measurement systems capable of correlating the use of resources, that have an economic value, with the results achieved, not all of which can be captured by monetary metrics because they are related with the fulfilment of needs and with the judgement of their global institutional usefulness. Therefore, there is a need to use a logical system of tools allowing for the improvement and/or better knowledge of the economic effects of the decisions and choices made.

The prerequisite for a functional architecture is the joint examination of the different players (the individuals and the progressive aggregation structures where they operate) and of the relationships between them, which may be interpersonal, intra-organizational or inter-organizational [28].

The complexity of intra-organizational governance may be described by using two variables: on the one side, the degree of predictability of the activities to be carried out and, on the other side, the degree of subdivision of the structures into sub-units. The more the activities are difficult to predict, as they are affected by contingencies, the greater the need for a constant problem-solving effort, the coordination of individual actions and the reconfiguration of processes to respond to any emerging situation. Conversely, for the second variable, the intensity of coordination is reinforced in connection with the number of units that make up each structure. The higher the number of sub-units, the greater the complexity connected with their governance, that is to say the need to establish a greater variety of tasks, set a system of responsibilities or introduce internal specialization processes.

The legislative innovation of the beginning of the Nineties brought about the passage from a bureaucratic, self-referential kind of public administration, soaked in a culture of mere compliance with legal requirements, to a managerial-like public administration where the focus was progressively shifted towards economic and financial efficiency, and the relationship between the resources used, and the goods and services produced.

With the reforms of the years 2000, managerial logics were integrated by an approach centred on public governance: the emphasis of performance measurement systems today is on outcomes and the ratio of the use of performance information is to increase the level of knowledge on the value created by the administrative action.

But in spite of the cultural evolution that took place after the changes made to the regulatory framework, the operating reality remains complex.

Even though the key steps of the logical path that leads to the construction of a performance measurement system can be easily identified:

- Analysis of the institutional mission, i.e. the needs of the community to which the administration is accountable and expected to provide answers by defining strategic objectives and its action policies,
- Operating objectives, which give form to the abovementioned strategic objectives through planning and budgeting,

- Inputs, i.e. the resources required for the implementation of the activities aimed at achieving objectives,
- The processes that make up the flow of activities and the way these activities are coordinated and interrelated,
- The outputs, i.e. the goods and services produced,
- and finally, outcomes.

The path to be trodden is still steep and affected by a number of factors, such as the emphasis of the measurement system, the method used to build the measurement system, the frequency of information collection, the approach to the use of information on performance, the users and the frameworks where the information will be used.

The implementation of the performance measurement system has stemmed from the analysis of the organizational architecture, or better, of the size of the organization: the degree of specialization of the structures; the degree of centralization of decision-making; the professionalization of work; the governance system; the availability of personnel and resources; the degree of formalization of the system.

The organizational layout of the Authority substantially reflects the coordination mechanism described by Mintzberg [29] as the professional bureaucracy model, whose constituents are further strengthened by:

- An intense degree of specialization, accompanied by the availability of significant technical competencies;
- A deep influence of the institutional context and of specific sector regulations, at both national and international level;
- The measurement of the values under the Authority's responsibility, which confirm the distinctive independent nature of the institution;
- The functional structure developed around a central core consisting of the Board, with its branching out facilities and directorates that control simple or complex functions, with directorates being re-aggregated into departments based on the consistency of their action frameworks.

The analysis of the organizational layout requires not only the characteristics of the governance to be taken into consideration, but also the principles based on which activities are implemented. On the whole, processes are developed through the Board, with the result that the functional instrumentality of operating processes is emphasised with respect to the activity of the Board. The implementation of functions, even complementary to one another, is ensured by the structures, each one a carrier of its own competencies and professional skills, and responsible for specific steps and/or aspects of the process.

Always within the framework of our preliminary analysis, we surveyed the sources from which data and knowledge in support of measurement activities have been taken and we identified information requirements:

- The financial size of the administration,
- Economic-equity magnitudes,

- Evidence deriving from budget allocation,
- Strategic policies,
- Information on the decision-making activities of the Board,
- The assignment of tasks by objective,
- Evidence regarding the management of human resources, and
- Accounting evidence concerning some expense categories.

As regards the conceptual reference model of our analysis and in the light of the considerations developed, we proposed the use of Porter's value creation model.

The features of the organization, of the generated output and outcomes, the intangibility and discretionary nature of many activities, as well as the difficulty of measuring them have generated the need not to focus the assessment action exclusively on the measurement of costs, but rather to extend the assessment metric to a comparison between the value absorbed and the value generated by the activities of the Authority.

The benefits created by this choice can be summarized in the possibility of performing this analysis without having to use a cost allocation system to identify costs through cost and responsibility centres, but also in the availability of a unifying measurement criterion that can be globally recognised by the different structures, albeit different by organizational layout and type of resources used.

The shift from cost measurement by structure to the notion of a 'value absorbed by activities' allowed accountants to isolate the weight of individual processes, correlate intensity to the output achieved and, finally, clarify the contribution offered by the structures to the value created for the Board and, consequently, for the external community.

According to Porter's original approach, the production of value by an individual organization has to be connected with the activities it performs. Therefore, examining the value creation process becomes a necessity because the different types of activity must be identified and isolated within each specific combination [30].

The value chain of an organization is the expression of the individual activities that are carried out within it and, most of all, of how the individual activities are interrelated, integrated and coordinated: only one value chain corresponds to each organization and the value chain of each organization differs from the value chain of another organization.

Porter's notion of 'value chain' leads to two considerations.

The first is that the value generated by an organization depends on the configuration of its processes in the perspective that:

- Each activity is implemented with the purpose of producing value;
- Each activity is connected to at least another activity;
- Each activity absorbs resources and generates outputs.

The second consideration is that each administration has its own value chain as the utmost expression of its peculiarity and specificity (Fig. 1).

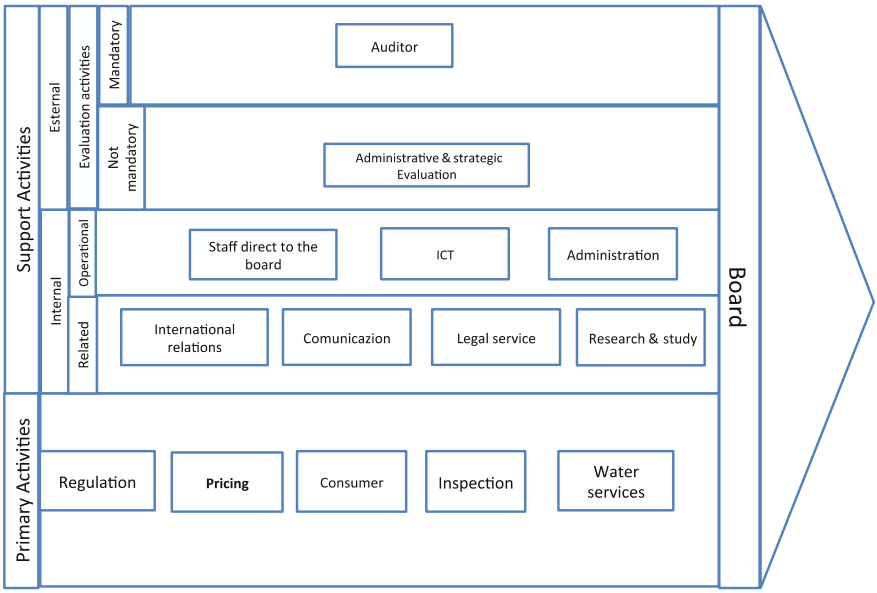

Fig. 1 The value chain in AEEG

The feature that characterizes the value chain of the Authority we are examining is the presence of the Board, which acts as connector of the value created by the organizational structures. The Board catalyzes the generated output, captures its value and, through the exercise of its powers, fulfills the functions attributed to AEEG, thus generating the social value of the institution.

The Board is therefore simultaneously the receptor of the value generated by the organization, the propellant of the administrative action and the generator of the social value that stems from the very role of the Authority.

4 The Structure of AEEG's Information System

AEEG is very complex both in terms of measurability of its output (regulatory function) and in terms of organizational structure.

The complexity of an administration depends on the action of two types of environmental determinants: the "institutional" and the "technical" forces [31].

The intensity of their action may produce a lesser or greater degree of complexity.

The high level of complexity requires increasing capacities in structuring processes and programming tasks, as well as in measuring the generated outputs and outcomes.

A huge investment was made in the years 2009–2010 tore-engineer the "extranet" platform used by the Authority to capture the data flow from market and grid operators that can provide AEEG with the information required by the regulations through secure credentials. Data is an essential resource for ensuring informed and robust regulatory decisions; this explains why the information system layer devoted to external users was deemed a higher priority with respect to the internal information system layer.

Initially, only simple and not integrated applications were developed to support strategic and operational planning processes, but over the last 2 years (2011–2012), an important investment was made to re-engineer the whole "intranet" layer of the information system of the regulatory authority with a threefold purpose: first, to enhance the information flow from the services to Board, and viceversa; second, to efficiently distribute knowledge resources in a skilled environment with severe limitations to quantitative HR developments (due to State law); third, to improve horizontal communication in order to ensure the internal circulation and discussion of cross-departmental issues and avoid excessive vertical specialism.

The Board selects strategic objectives and defines both the organizational chart and the budget of the Services, but has relatively limited power in day-to-day management. Almost all managerial decisions are taken by directors, under the supervision of the Board. Services are currently organized into three Departments (legal and coordination; regulation; enforcement and consumer affairs), further subdivided into Divisions and Units. The total amount of HR for energy regulation is capped by law at 180 people (of whom 25 are executives), even though a very recent legislative act entrusted AEEG also with water regulation and allowed it to hire 40 additional units (vacancies are currently under selection with public procedures).

Most of the Services' activity is aimed at the preparation of draft Board decisions. The assessment of the proposal prepared by Directors is performed with in a two-step process (which may be reduced to a single step when urgent measures are required) (Fig. 2).

Every week, an informal meeting of the Board and Services is held to scrutinize draft decisions and make any amendments requested by the Board. When the proposal is finalized, the Department for Coordination proposes the President to include it in the weekly agenda of the formal Board meeting, where the formal decision is eventually made and finally published (and notified to the interested parties, if it is an enforcement act).

The new intranet-based integrated information system supports all the processes involved (Fig. 3).

The Strategic Planning process is supported by managing "strategic objective" entities. Each strategic plan is a collection of several strategic objectives and is associated to a given timeframe. When a new Strategic Plan is launched (or amended according to the annual update process), the system allows for a reclassification of its contents without any loss of information ("Change Plan" feature).

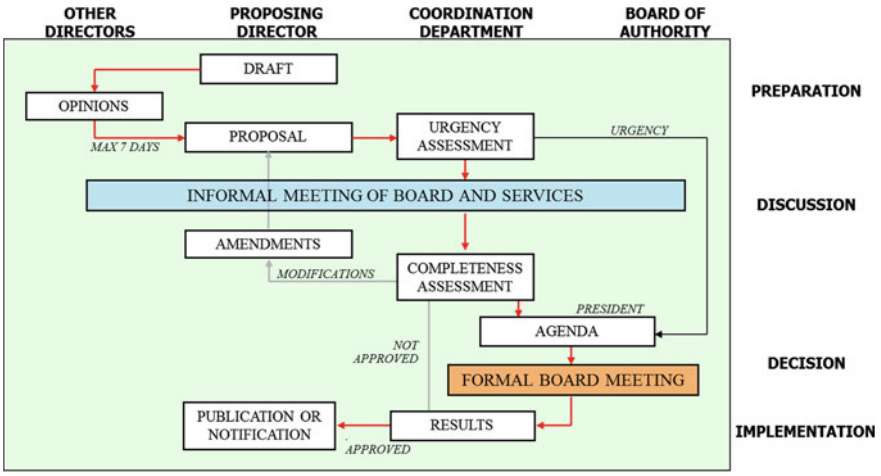

Fig. 2 The process of the assessment of the proposal

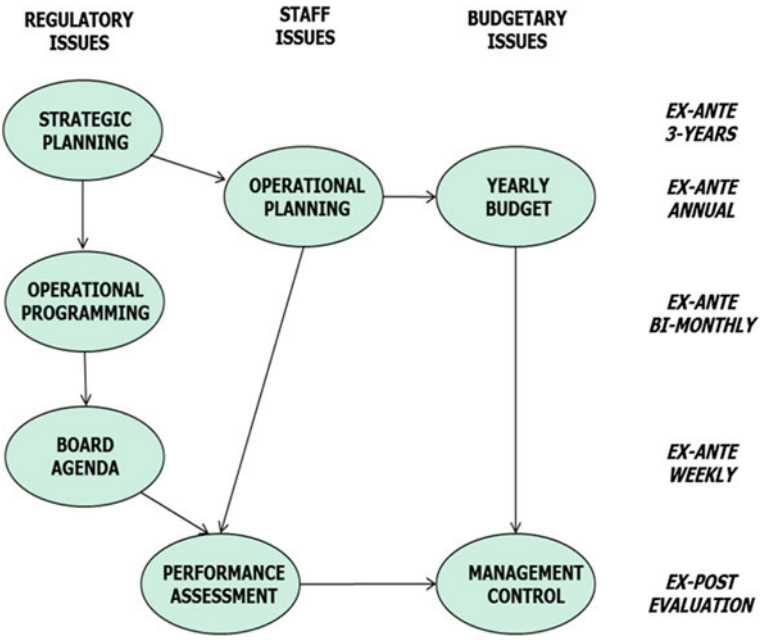

Fig. 3 The planning and control system

The Operational Planning process is supported by deploying each strategic objective into more detailed "specific objectives", each of which is assigned a deadline and associated with a description (also including cooperating units,

requests for special legal advice, and so on). For internal functioning, where specific objectives cannot be easily referred to strategic objectives, intermediate "operational objectives" are defined (these can be implemented by the Services without a formal decision of the Board—e.g. payroll management, procurement and expenditure process, communication and external relationships, and so on).

Each specific objective can be managed throughout its lifecycle. The most important action is rescheduling, according not only to HR congestions, but also to exogenous variances (changes in upward legislation, priority reformulation, and so on). Directors are entitled to re-schedule the specific objectives of their direct competence and monitor all changes even in different departments or divisions. Additional possible actions that can be performed only by the Department for Coordination are the merging of two specific objectives or the cancellation of a previously scheduled specific objective (with indication of the reason).

Every month, a two-month ahead detailed scheduling (Operational Programming) is required in order to identify, for each decision, a Commissioner due to play the role of 'referee' Each week, the agenda of the Board (for both the informal and the formal meeting) is prepared by using the same information system used to follow and track each change.

Every week, the owner of each scheduled specific objective can upload the documentation for the informal and formal Board meetings; features for easy download are developed and document versioning is managed in order to keep track of all documentation versions and changes.

On an ex-post basis, the information system is now integrated with the performance assessment tool that enables the director of each Department or Division to assess outputs according to the performance assessment methodology adopted. Not only the 'regulatory Board's output' classified according to Strategic Objectives is assessed, but, with the same tool, staff divisions and units can also assess their own 'internal operation output', which is classified according to Operational Objectives. A suite of reports enables both strategic and management control.

From a technical viewpoint, the access to the integrated information system is based upon LDAP security credentials and integrated with the intranet portal with Single-Sign On (SSO). All the system is built with a fully web-based architecture, meaning that it requires only a standard browser, without any client component, therefore allowing for a high level of mobility access, not being necessary to be physically connected to the internal network. High security standards are ensured through encryption.

The information system integrated as described above offers a clear and concrete representation of the connection between the political and the administrative-management dimensions. Although the experience described is still far from reflecting the establishment of a performance cycle, we may observe that the system allows some light to be shed on some essential aspects:

- The effectiveness of the administrative action, intended as the achievement of strategic objectives, including from the internal point of view;

- The efficiency of the administrative action through the periodic monitoring of the human and economic resources used for the implementation of the activity, aimed at achieving strategic objectives and implementing ordinary management,
- The strategic level, in each administration on the whole and with respect to the degree of implementation of strategic choices;
- The management level, in first-tier responsibility centres (Departments, Directorates and Offices);
- The operation level, at second-tier responsibility centres.

5 The Measurement System

The creation of the tools for the collection of the necessary information for assessment activities was based on the organizational characteristics of the Authority.

Concerning the scope of said activities, in the awareness of the complexity of the assessment of external effectiveness or outcome of the performance of the Authority—i.e. the ascertainment of the cause-effect link between implemented actions and results achieved—the focus was restricted on efficiency and size of input and output, through the determination of indicators expressed in terms of global costs of the organizational units, lines of activity and, in some cases, products manufactured.

Taking into account the nature of the regulatory function carried out by the Authority and the necessary use of resources with technical skills and a high degree of specialization, the input was determined as a function of the workforce expressed in terms of person/time used by each organizational unit and line of activity.

For the collection of data and the related information, a survey form was prepared consisting of two sections: the first offering a picture of the organizational structures under the management's responsibility (Department, Directorate or Office), with indication of the internal organization(second-tier units), functional competencies (activities/objectives "declared" in the annual operating plan) and resources assigned (personnel and forms of externalization consisting in flexible employment opportunities and and/or external services/agreements).

The second section of the survey form regards the use of the resources allocated in the structures in terms of portions used of the allocated resources: considering one hundred as the maximum total use of any resource considered, regardless of the amount of time during which the resource has been used (see the case of part-time employees or staff hired during the year or contractors legally not required to keep to specific working hours or whose professional service cannot be considered

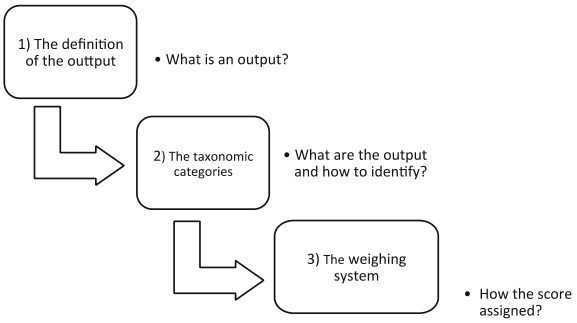

Fig. 4 The process to define and measuring output

as an obligation of means), the percentage of application of the resource to the activity/objective considered is determined. Clearly, the purpose of such a kind of measurement is not to highlight the rate of use of the resources, i.e. the intensity of use of the resources as a function of the time worked or of customary average work times, but rather the percentage of each resource allocated to the structures and used for each individual activity/objective, as well as the amount globally used of each resource.

The output measurement procedure includes three steps, as shown in Fig. 4.

As regards the output, the first issue was to define its meaning.

Two approaches may be followed to define outputs: the first is a finalist type of approach that defines the output as the conclusion of a production process that is implemented with the contribution of different factors; the second approach, on the contrary, defines a final output as the result obtained after a sequence of intermediate outputs.

The output has been conceived on the basis of the second approach as any factual element that can be enucleated being the result of specific contributions or, in any case, the result of an activity or multiple activities which may differ from one another, but that remain teleologically interconnected.

The second aspect concerned the construction of a taxonomic system that reflected the types of operations carried out by the Authority.

In connection with the considerations developed concerning the organizational and functional characteristics outlined in the preliminary analysis, two parallel measurement models could have been created: one for the organizational structures related to primary activities, for which a measurement system focused on more easily identifiable outputs could have been conceived (the finalist logic), and the other related to accessory activities, for which the classical indicators inferred from documental evidence with reference to the budget system could have been used, thus developing only an analysis by approximation of administrative efficiency.

Instead, a single measurement model appropriate for all corporate structures was selected and supported by a taxonomy consisting of two main categories, according to the dichotomy between primary and support activities: the acts and measures adopted by the Board, on the one hand, and actions under the

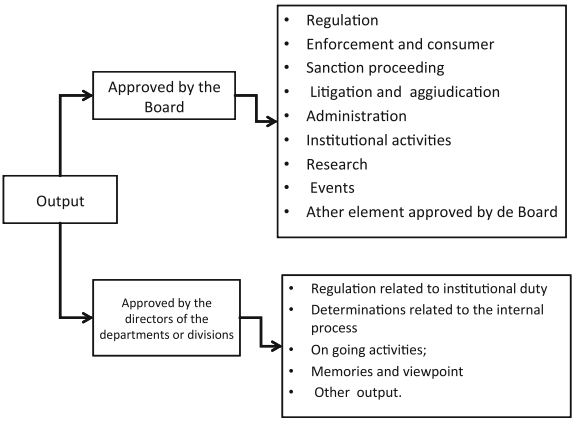

Fig. 5 The taxonomy of outputs

management's responsibility undertaken by the structure, on the other hand—where each category is to be seen within a wide and cross-sectional framework, and distinguished into subcategories (Fig. 5).

The qualitative analysis of outputs, i.e. the appraisal of the intrinsic complexity of their achievement, is performed by using four explanatory parameters:

1. Problem-solving,
2. Effort,
3. Inter-directionality,
4. Time compression.

Every parameter is, in their turn, translated into attributes. The classification mechanism uses Likert's restricted-field scales, where weights are not assigned based on mere subjective perception, but for each output the presence or absence of all the requirements/attributes is evaluated by progressively scaling down the score in connection with their actual existence.

The measurement so obtained allows researchers to obtain a representation of the output expressed with a score determined with a consistent metric for all the head offices and departments. Such a measurement system, being the expression of all the main components of the value chain, has led to the creation of a large pool of indicators to monitor the efficiency of the administrative action on its whole.

In particular, the experimental research highlighted some essential features, such as:

- The capacity of the system to reflect the degree of value absorption by the individual activities/objectives and to facilitate the appraisal of their structure in the reference organizational units;
- The possibility, through the measurement system prepared, to understand the global level of efficiency of the administrative action of the Authority;
- The potential of the model to assess efficiency in the perspective of developing an integrated personnel assessment system;

- The possibility to integrate the analysis model with the planning and control process.

The administration has seen some opportunities in this latter aspect and decided to grasp them by integrating the existing operational planning system with the performance measurement system and extending it to all activities, both those aimed at strategic objectives and those connected with operating objectives.

6 Discussion

This paper belongs to the broad research field of the methodologies for the measurement of performance in public administrations and contributes to the debate by proposing a quali-quantitative method for the measurement of the inputs and outputs of the processes implemented in complex public administrations.

Scientific production has formulated very heterogeneous positions on the theme, that oscillate between two conceptual extremes. The first extreme assumes that the performance of public administrations should be the expression of the capacity of generating public value and, since it cannot be measured by monetary metrics, it is misleading to propose any approximation measure. The risk in electing a forced extension of financial indicators as approximates of public value consists in detecting that which is easy to measure, even if not of primary importance, and loosing that which really characterizes the public service for its intrinsic difficulty in reaching a quantitative translation.

The second extreme, of a rationalist nature, restricts the performance of the administration to its attitude in managing public resources, and consequently the efficiency dimension prevails, being the only one, in substance, that is worthwhile appraising. Both positions lead to potentially harmful conclusions.

While the former could generate the opinion that, since important things cannot be measured, it is better not to measure anything, the latter, by measuring only one partial aspect, could lead to invert the relationship between means and purposes. Resources, considered as a restriction, become the objective of administrative action and the real objective—meeting a public need—is reduced to a merely incidental dimension.

The dominant managerial doctrine tried to find an intermediate way. A ware of the impossibility to appreciate the attitude to generate public value in monetary terms, it developed quali-quantitative methodologies where typically financial dimensions are considered together with qualitative indicators that express internal operating conditions, on the one hand, and estimate the effectiveness of the service, on the other.

This paper starts from an analysis of the needs expressed by some particularly complex public administrations in terms of performance measurement.

The inadequacies that have emerged in said frameworks are, inter alia, those associated with the availability of information with respect to measurement

requirements, the difficulties in allocating costs to individual organizational units, and the complication of identifying the outputs correlated to processes.

Starting from these needs, the paper proposes a methodology for the allocation of resources to the activities carried out in the structures, an output weighing system capable of describing the commitment connected with their implementation, and a final correlation to the institutional objectives of the administrations, to link the current dimension with the pluriennial one.

AEEG has developed a web-based integrated planning and performance measurement model starting from the identification of the institutional purposes from which a number of strategic objectives derive. The model allows for the identification of an output level to be achieved for each strategic objective. It uses a weighing mechanism that takes into account the level of complexity required by every output. The "weighing method" is based on a Likert scale, whose metric differs for each item involved.

The assumptions of our work, therefore, originate from the awareness that, in delivering public services, the problem of measuring outcomes, and consequently the public value generated, is still topical and perhaps far from being resolved. However, it proposes a quali-quantitative method that makes it possible to extend a consistent measurement model to all the organizational structures without debasing their different functions and simultaneously ensuring a unitary appraisal metrics.

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Information Systems and Managerial Control in the Era of Globalization: Evidence from the Fashion Industry

Giuseppina Iacoviello, Arianna Lazzini and Sara Nanetti

Abstract The paper concerns the role of information systems in the field of luxury fashion. Over recent decades, this type of industry has been characterized by significant transformations in the quality and quantity of information needed to manage the practices of outsourced manufacturing. The analysis of a case study verifies the impact of ICTs on control systems and information management. The results of the research are quite interesting: information and communication technologies could support companies that decide to outsource part of their production in foreign countries by acting on the damage to reputation and image due to counterfeiting. By using information systems, luxury fashion companies could measure their activities more precisely and control processes, thus motivating suppliers to operate correctly.

Keywords Information systems · Managerial accounting · Control systems · Fashion industry

1 Introduction

Over the last 20 years, the fashion industry has been characterized in particular by profound changes in both its structure and strategy. After an initial period, in the '90s, characterized by rapid growth based on the acquisition of new brands and

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boutiques by the major fashion companies, today those same companies are focused on cost control and on improving internal efficiency. The drive toward the outsourcing and industrial delocalization has become significant, leading to a separation of the traditional phases of their supply chains (design, manufacturing, distribution, sales and post-sales services) among various actors, often located in low-cost economies, such as East Europe, the Far East and more recently North Africa, in order to take advantage of different local conditions [1]. This phenomenon has increased progressively in the luxury fashion industry, where a large part of the 'second line' is today produced prevalently by foreign contractors.

On these premises, the paper will develop a twofold objective. The first is to highlight and analyze what the main variables and factors to be monitored are in terms of information flows and control systems required by the implementation of the outsourcing and relocation strategies of various stages and activities (production, quality control and logistics) in fashion companies. The second is to see how fashion companies can solve the problems of sharing information and making improvements to the implementation and use of control systems through web-based solutions, as regards the principles of integration, supply-chain management and business intelligence. This type of solution is crucial to supporting companies in the containment of costs, monitoring of suppliers, in satisfying customer expectations and in the planning and coordination of strategies between different locations. The study will be based on Italian luxury fashion companies (i.e.: Prada, Armani, Ferragamo, Missoni, Gucci, Cavalli, Dolce and Gabbana).

In order to answer these questions, we developed a study made up of eight main steps. In the Sect. 2, we describe some of the distinctive features of fashion companies; in the Sect. 3 we analyze the background and the previous literature. In Sects. 4 and 5, we explain our hypothesis on the basis of our research study. In the following sections we the present our case study and discussion. Finally, we suggest the potential implications arising from integrating theoretical and empirical evidence.

2 Fashion Companies: Distinctive Features

The common opinion is that fashion is strongly linked to the various environmental and cultural needs of a country, to its history and its industrial development model, allowing for creativity to be transformed from an intangible asset to a marketable commodity [2]. At the same time, the particular nature of fashion is a powerful means of cultural homogenization on a global scale [3].

There are many factors that characterize the strategic business models of fashion companies; those particularly relevant to the interpretation of the diversity that they have assumed over time are: core business and segments, brand portfolio, degree of vertical integration and expertise, internationalization, design, ownership and growth [4]. It is also crucial to consider the type of product included, such as the production model adopted by companies: 'ready-to-wear' (Armani, for

example) or 'made-to-measure' have features that could either lead to or inhibit the outsourcing of production stages. These specific features enable us to understand and appreciate the competitive advantages that a fashion company can reach to varying degrees.

In the early 21st century, in the light of the combination of these factors, the Italian fashion industry scenario may be summarized as follows [4] (Table 1):

Especially multi-business and multi-brand fashion industries or those pursuing the internationalization process resort to vertical integration in manufacturing and retail (Fig. 1).

Surely, in the face of rapid environmental change, fashion companies make strategic choices aimed at flexibility. However, flexibility is also related to historical legacies and institutional constraints. For example, the French couture houses, companies traditionally characterized by the close integration of their manufacturing activities and the strong control on the part of the designer, outsourcing may come across as a threat to the brand. If anything, some companies (Christian Dior or Yven Saint Laurent) have opted for the outsourcing of some activities for the manufacturing of subsidiary products. Instead, Italian fashion companies have traditionally been bound to districts and this has allowed them to take advantage of small size and flexibility at the same time. Some have subcontracted large shares of their manufacturing activities, producing only a few key product lines; such a path of flexibility or modularity characterizes companies like Benetton, Armani, Gucci and Prada [5]. There is, of course, a strong focus on brand management, but this distinguishes the activity of control over the product and processes, as may be seen from Fig. 2.

Internationalization choices (sourcing of raw materials, manufacturing processes, finished goods, etc.), call for new management systems, also to be able to deal with some potential problems. Over recent decades in fact, the evolution of the market and competitive dynamics have led to the development of counterfeiting in the fashion industry (Gucci, Louis Vuitton, Prada, etc.) both on the demand and the supply side [6].

Known for its low production costs, China quickly became the premium destination for international fashion companies to produce their wares, with luxury brands like Armani and Ralph Lauren moving part or all of their production to this new region as well [7].

Over time, as we know the 'reasons' behind low production costs—above all environmental damage and the use of underaged and underpaid workers—have taken their toll, and as a result, some fashion brands are leaving China to produce their clothing in locations like Tunisia and Turkey, while some are deciding to take an internal approach and develop their luxury presence with Chinese talent and technology.

China is identified as the main area of the production and distribution of counterfeiting worldwide (2008: 60 %). Some recent studies identify the reasons for the growth of counterfeiting in factors such as: the relocation of production activities with the consequent difficulties in implementing traditional management

Table 1 Most important Italian groups

Brand Portfolio/Price Segments and Origin	Monobrand	Multi-brand (owned and or license)
Haute Couture, Prêt-à- porter/Ready to Wear, Diffusion, Designers	Armani, Dolce and Gabbana, Versace	Pure fashion houses: Valentino Fashion Group Industry-backed designers: Aeffe, MBFG (Moschino), Prada
Haute Couture, Prêt-à- porter/Ready to Wear, Diffusion, Premium	Ferragamo, Loro Piana, Zegna	Gucci, Diesel, IT Holding, Max Mara, Miroglio, Tod's
Bridge/Massa	Geox, Replay	Benetton, Calzedonia, Golden Lady, Sixty

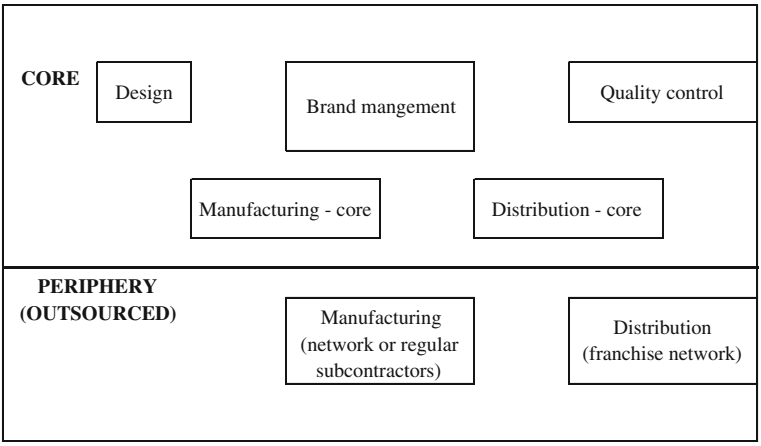

Fig. 1 Core and peripheral modules in the Italian trajectory

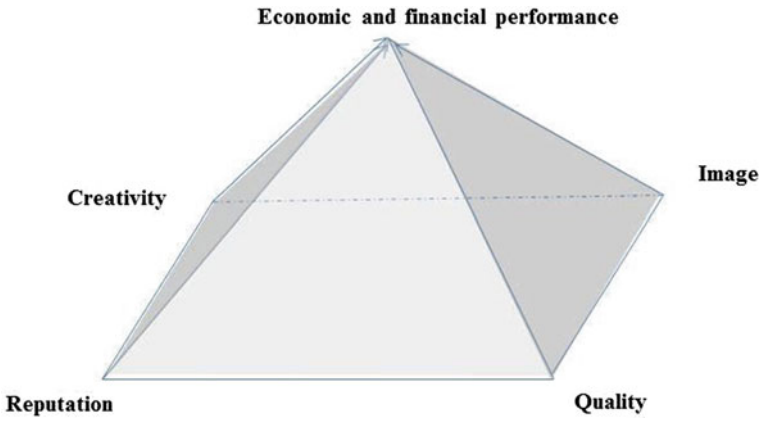

Fig. 2 The sources of competitive advantage in fashion industry

systems on the production process, the simplification of production processes, the increasing availability tools and technologies that make it possible to duplicate existing products and affirmed brands [6].

3 Theoretical Framework

The changes in strategy adopted by fashion companies have deeply modified the organizational models of such firms, which have moved from a classical one based on networks between firms in the same district [8–10] to a new one based on an increase in the number of partners involved in 'global networks' [11, 12]. Outsourcing implies a business relationship between two parties: the outsourcing subject (the client or principal) who makes the decision as to whether to outsource or not, and an external outsourcing firm (supplier or agent) [13]. Nowadays, as a consequence of outsourcing and globalization, suppliers change frequently over time, often for economic or technical reasons [14], and are mainly located in emerging countries. The objects of outsourcing are general business processes or the results of processes which might be outsourced [13, 15]. They may include core activities, production stricto sensu, as well as supporting processes [16] such as quality control and logistics [17, 18]. An increasing number of organizations are also considering outsourcing as a critical element of their organizational strategy [19] because they regard outsourcing as a powerful tool to reduce costs and improve performance [20]. As a consequence of the increasing complexity and continuous change in the supply chain, companies require significant changes both in the typology and in the quality and quantity of information processed.

The use of relational information systems becomes a critical issue for the efficient management of the relationship between a firm and its partners. Studies and research seem to show that nowadays, the best-performing Italian companies in the fashion industry, unlike in the past, no longer place the emphasis only on the traditional 'made in Italy' variable, but seem to concentrate on the full traceability of their whole supply chain. Such a change is due to the fact that the fashion companies today operate ever more in a global context where it has become critical to have certainty and full control both over the supply chain and over how and where the various production activities are carried out [21]. According to previous studies in the field of IS [22, 23], consideration of the broader organizational context within which innovation is applied has become central. Technological innovation and contexts may be considered as a 'heterogeneous network' of institutions and people within which ICTs are called to play a significant role [24]. This problem seems to be particularly important when IS innovations are applied to developing countries. In such countries, IS innovation involves the transfer both of technologies and organizational practices originally designed for different social and organizational contexts [24]. In all information systems, studying context variables has become central because such studies address the

issues of the implementation and use of technology within organizations themselves rather than in a laboratory setting [24].

Adopting an institutional view, in keeping with the perspective and language proposed by Swanson and Ramiller [25], the fashion industry's choice to adopt ICT innovations in the field of IS may be defined by the term "organizing vision". The organizing vision, defined as "a focal community idea for the application of information technology in organizations" [25], can be used to describe the situation in which the adoption of IT innovation is influenced by a general view of the value and the entailed risk of new technologies or business processes created by the formation of new networks of actors with whom the company operates. An ICT innovation is normally built upon several core technologies (such as relational database management—RDBMS—and XML language), considered "an important driver in the production of organizing vision" for its application [25].

One of the most important ICT innovations in the field of IS may be traced to Enterprise Resource Systems (ERP). ERP systems have had a very successful implementation, widely used to integrate legacy information systems across different areas of an organization [26, 27]. The growing trend to create new enterprises network and the emergence of new ICTs make it possible to develop and implement a large variety of supply chain options through ERP systems, creating significant cost and value advantages [28]. Implementation of ERP may bring significant benefits, making it easier to manage and integrate business processes among various organizations, minimizing information sharing time and streamlining the business processes [29, 30].

ERP systems can also support organization processes in order to minimize direct and indirect costs related to outsourcing and delocalization due to the consequent asymmetrical and incomplete distribution of information between actors [31, 32]. Every transaction is characterized by costs related to the phases of search, negotiation and enforcement. Studies and research show that ICTs play an important role in facilitating firms' decisions to outsource production and business services [33, 34]. The transaction costs concern the expense involved in setting up and monitoring the contract and contractor, as opposed to the costs of producing the goods or service in-house. When the decision is made to outsource one or more activities, the management's attention is focused on reducing transaction costs as much as possible. The transaction cost theory (TCT) perspective is useful for examining the contributions of IS to transaction cost reduction [35]. Information and communication technologies (ICTs) may be considered a powerful tool for supporting information needs, providing additional information and fostering the efficiency of the entire transactional process [36]. In the enforcement phase, ICTs may offer valid support in controlling the quality of goods, making the information exchange between the contractors more efficient and effective [37]. The need for forecasting, planning and sophisticated control systems becomes urgent for companies, meaning they need to be faster and based on a 'relational' logic [38] in order to ensure new information flows and more accurate input, process and output variable controls [39].

This is particularly true in luxury fashion industry, where the main source of competitive advantage could be traced to intangible factors, such as brand value, perceived quality levels, and the image or status symbol associated with the goods produced. For such firms, having an information system able to allow for an effective control of input factors (quality of materials), of processes (costs of production) and of output (quality of goods) thus becomes fundamental [40]. As we advance, many 'fashion players' show a strong need for a total integration between the different actors in their supply chain with a consequent need for the optimization of internal processes to achieve greater control of production, quality, distribution and logistics. This integration is achieved primarily through the sharing of cross-enterprise data at different levels of the supply chain; for example, relating to sales management, inventory management, production planning, timing and transport efficiency [41].

This is a critical aspect in a fast-moving industry such as fashion, where the traditional 'two-season collections' model (spring/summer and fall/winter) has been replaced by four or five collections per year. Consequently, today one of the most important competitive advantages in the fashion industry is the "time to market" [42]. The use of technology has become a crucial topic in enhancing the speed and flexibility of the industry and improving the quality of relationships along the whole supply chain. Fashion companies thus have to be constantly linked to their suppliers, distributors, logistics service providers and financial providers with whom they share up-to-date information [43].

Another critical related aspect in the fashion industry is information management. To improve the response time [44] and the ensuing coordination among all members of the supply chain requires a high level of information-sharing. Today, managing product-related information in the fashion industry is extremely difficult because of the increased variability in product typologies (model, color, size, etc.). It makes the integration of product information databases ever more complex [45].

A valid answer to these needs is offered by Enterprise Resources Planning Systems (ERP), which allow for the management of inter-company processes, providing a constant and prompt control of the various operations by re-engineering the whole supply chain [46–48]. A potential solution for the problems of item-related information management is to move towards a product-centric information system, namely centralizing the information around individual products and accessing the relevant information directly through them. From an operational point of view, the information technology solutions adopted by fashion industry are increasingly web-based in order to maintain centralized control and to allow access to entities all over the world.

4 Methodology

The paper performs a qualitative strategy of research. As suggested by several authors in the information system (IS) field, the use of idiographic rather than nomothetic research strategies attempts to understand a phenomenon in its context

by examining single entities or particular events [49, 50]. Case research is considered appropriate mostly for areas of research in which empirical studies and theories are at their early stages, or in practice-based problems where the experience of the actors involved and the particular context of action are critical [51, 52]. Case-based research is an empirical enquiry, which investigates a contemporary phenomenon within its real life context when the boundaries between phenomenon and context are not clearly understood [53]. A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information. In this strategy of research, the boundaries of the phenomenon are not clearly evident at the outset of the research, and no experimental control or manipulation is used [54, 55]. Consequently, there are three main reasons why case-study research is a viable information systems research strategy. First, the researcher can study information systems in their natural setting, learning about the state of the art and generating new theories. Secondly, the case-method supports the researcher in answering questions such as 'how' and 'why'. Thirdly, a case-study approach is an appropriate method for investigating an area characterized by new emerging issues, and in which few previous studies have been carried out [50].

The paper is based on a single case-study approach with an explanatory purpose. Hence, its aim is not the generalization of the results, but is to illustrate via a single case how the research questions formulated around information systems in the fashion industry are addressed. Since the aim of the paper is exploratory, a theoretical sample was preferred. The case was chosen on the basis of the 'observability' of the process/phenomenon to be studied.

The research object of this case study is one of the main Italian luxury fashion companies, referred to here fore the sake of privacy as the Alpha company.

Alpha is positioned as a luxury brand selling well-designed and expensive products. There are two reasons for choosing the Alpha company as the object of this case study. Firstly, Alpha is one of the largest luxury brand manufacturers in the world, representing a symbol of luxury goods and VIP style, which has recently outsourced part of its production (prêt-à-porter collection) and logistics to developing countries. After a series of major problems, the company invested in a sophisticated information system, developed and personalized by an Italian software house. Secondly, the Group has established a high-level and efficient supply chain management and control model, with an emphasis on supply chain integration in order to reduce direct and indirect costs related to outsourcing and maximizing benefits. For these reasons, it may be considered an ideal case study for academic research.

As for the data collection, multiple methods were used [50, 51, 54, 56]. Data were collected from January to June 2013 through semi-structured interviews. To provide a more comprehensive and accurate view of the issue investigated, converging measures were used [53, 57–59]. Key actors both of the Alpha company and the software house involved in the project were interviewed with the aim of better understanding why the company decided to outsource part of its production, as the problem occurred in terms of the needs of information flow and control

systems, in the wake of the technical solution adopted. The interviews were held with the production manager of Alpha and with the CEO and the project manager of the software house. Each interview took about 35 min and was audio recorded. Furthermore, secondary sources such as the company website, the AIDA database, newspapers, magazines articles and company press releases were analyzed.

5 Conceptual Framework and Propositions

The aim of the paper is to analyze the process of ICT implementation in a specific context (the fashion industry), underlining how information systems can support the luxury fashion industry by minimizing direct and indirect costs related to outsourcing strategies.

This means understanding the potential of information systems for the luxury fashion industry, and identifying critical variables in determining the success for businesses. The research approach used will be that of intensive research. It required the development conceptual insights, based on the theoretical framework exposed in the previous section, without any a priori hypotheses.

The model developed is based on the assumption that there are four main sources of competitive advantage in luxury fashion industry. They may be identified as: image, reputation the firm has on the market, quality of goods and creativity. While the image is mainly linked to the customer side, to the brand's perception, the reputation is associated with the social and economic dimension of the firm. Three of the main sources of competitive advantage (creativity, image and reputation) are intangible assets, while quality is linked to production and technical aspects. The different variables are linked to each other, and all influence the economic and financial dimension of the firm (Fig. 2).

Customers buy luxury goods, paying a substantial amount of money for it, because of the image of the brand, a fashion and style icon, and for the exclusivity of the brand and product. The exclusivity, from a consumer perspective, is linked to the concept of social status and to standing out among equals. There are two main risks that a company, which decides to outsource part of its production must prevent in order to avoid the loss of its competitive advantage. The main risks are connected both to the loss of trust and credibility between current and potential customers due to counterfeit or major damage to the company image linked to lower quality. Damages to image and reputation can also have a negative effect on creativity because of the lower attractivity of the brand in the eyes of famous and quoted stylists.

A valid solution to prevent or limit such problems may be found in information systems. To implement a sophisticated control system able to trace the process in all its phases became basic for fashion industry (Fig. 3).

One of the key aspects of monitoring the fashion industry can be traced in terms of quality. Quality in fact has a direct and indirect impact on other variables and aspects such as image, reputation, economic and financial performance.

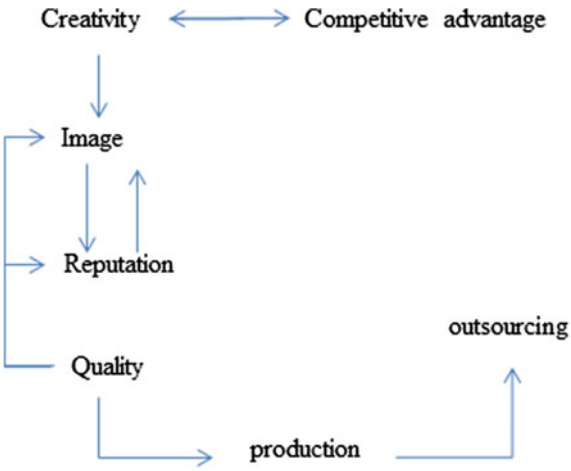

Fig. 3 The research model

Once formulated, the hypothesis may be summarized as:

1. Information and Communication Technologies (ICTs) and web-based solutions can facilitate control activities along global supply chains;
   - reducing the risk of indirect costs (reputational and image costs due to counterfeit) connected to outsourcing;
   - reducing agency costs between companies and suppliers.
2. Information systems and ICTS can improve business performance: (Fig. 4)

6 Case Description and Company Overview

The case developed is based on the study of one of the leading Italian fashion and luxury goods companies in the world.

The Alpha company was founded in the second part of the 20th century. Today it is part of a larger group with over 5,000 employees, 13 factories and 500 stores worldwide. It designs, manufactures, distributions and retail fashion and lifestyle products, including apparel, accessories, eyewear, watches, jewelry and home furnishings, fragrances and cosmetics under a range of brand names. After only one year of successful operations, the company expanded its presence in Europe and the next year in the United States by establishing a corporation. In the second half of the ‘80s, the company continued its overseas expansion in Japan through a joint venture with a Japanese corporation. In the ‘90s as part of a strategy to maintain control over product quality and distribution, the company performed a series of share investments on commercial and manufacturing companies. In 1999

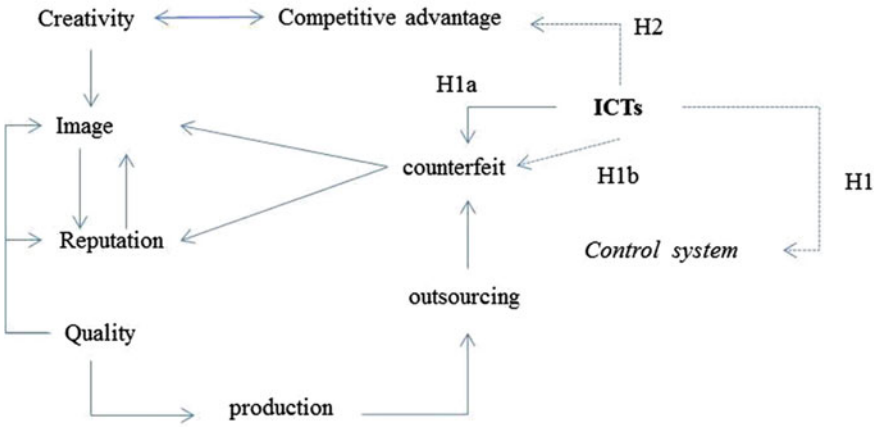

Fig. 4 The role of IS in the fashion industry—the framework

its first e-commerce presence was created in the United States. In 2008, US e-commerce services were also extended to Europe.

In Table 2 some economic and financial data concerning the Alpha company in the period 2006–2011 are given.

A few years ago, the company outsourced the production of its second line (prêt-à-porter) to China, maintaining quality control and logistics in Italy. Recently, for technical and economic reasons, the top managers also decided to outsource logistics and quality control to China. As a consequence of this strategy, several new problems emerged due to gaps in the safety and effectiveness of the quality control systems in place. Quality control, both in Italy and then in China, was based on sample analysis. This mechanism was used until some major problems arose. The first problem was related to the discovery of a flawed batch of 10,000 garments, already shipped to customers, with the neck hole too small for the passage of the head. Another problem was the discovery of the sale, on the black market, of garments eliminated from the Quality Control (QC) and resold at 25 % of the original price. This situation was considered extremely critical by the company because of the high risk of creating a situation of distrust in a well-known brand. There was also a clear necessity to keep all the garments monitored, whether saleable or not, provided by Chinese suppliers, as well as the costs connected to each supplier. The accurate monitoring of each supplier was made necessary by the risk that the high costs connected to lower quality and an elevated level of defects in the garments produced could reduce the economic advantage gained through the delocalization and outsourcing to China. An increase in the percentage of rejected items, in terms of input—raw materials—and output—finished garments—imply an increase in the quantity of goods acquired, thus undermining the profitability of certain contracts and/or suppliers.

Table 2 Financial statement

Variables	2011	2010	2008	2007	2006	2005
Sales	1.804.056	1.587.587.000	1.620.275.000	1.596.619.000	1.474.378.000	1.428.169.000
EBITDA	341.835	323.165.000	305.942.000	358.739.000	302.264.000	265.021.000
EBITDA/Sales (%)	19	20	19	22	20	18
Return on sales (ROS) (%)	15	14	14	18	17	13
Net Incame	180.824	160.092.000	127.700.000	219.012.000	131.887.000	165.354.000
Equity	1.546.130	1.250.522.000	1.040.698.000	927.048.000	756.212.000	925.252.000
Financial position	−451.985	−490.986.000	−206.113.000	−298.903.000	−192.052.000	−375.145.000
Return on Asset (ROA) (%)	12	13	13	19	19	14
Return on equity (ROE) (%)	12	13	12	24	17	18

An ensuing re-organization of information systems was thus a crucial step, and constituted the solution adopted by the company in order to avoid new and potentially dangerous problems in the production area.

A more sophisticated control system to evaluate the efficiency and integrity of the entire process was entrusted to an Italian software house. The new information system, based on an ERP platform, was successfully implemented. Today the software house manages the all the information flows between the company and its partners, having solved all the technical problems arising.

7 Case Discussion

Proposition 1 *Information and Communication Technologies* (*ICTs*) *and web-based solutions can facilitate control activities along global supply chains.*

ICTs have profoundly changed the way firms are managed. The fast and continuously changing nature of the business arena has led organizations to seek new means by which to improve efficiency and performance. Significant improvements have been achieved with the development of IT infrastructures to support business visions and goals. Nowadays, the global nature of businesses requires a more flexible and sophisticated supply chain, which implies cooperative planning, real-time information exchange and commitment between partners. Activities that were difficult to perform in the past are today made possible and easier by means of ICTs. Information and communication technologies can help firms to implement good control systems, minimizing direct and indirect costs due to outsourcing. In such a context, a critical aspect is that of having the rights tools, instruments and technologies to create efficient and effective processes.

Following Simons's approach, control mechanisms may be distinguished by the share of processes they are intended to monitor. Consequently they can be divided into three main categories: input control, process control and output controls [40]:

- The 'input control' is designed to monitor the material and human resources (workers and suppliers) involved in production processes [60–62];
- The 'process control' is aimed at ensuring that individuals (workers, partners, suppliers) carry out actions in a specific manner [63, 64];
- The 'output control' is focused on variables such as quality, costs, profit and customer satisfaction levels [40].

From a technical point of view, the fundamental role in supporting the information and control system architecture over networks is played today by new web-based technologies, tools that allow organizations to integrate their systems and processes in a more flexible way [57]. In this direction, the adoption of XML files may be considered an important element, making data storage, data sharing and data display/rendering useful. The XML file is an extensible markup language file used to create common information formats and share both formats and data in

every system based on the ASCII code (web, intranet, etc.). The XML is based on a syntactic mechanism that makes it possible to define and control the meaning of the elements contained in a document or text. XML is widely used today alongside HTML. It uses markers and named tags to assign semantics to the text. The tags may contain information in two ways: through the parameters or enclosing of the text, or via other types of information. Compared to HTML, XML has quite a different purpose: while the former defines a grammar for the describing and formatting of web pages (layout) and, in general, hypertext, the second is a meta-language used to create new languages, acts to describe structured documents. Today, XML is widely used to export and share data between different DBMS.

Another important technology for the improvement of supply chain processes, enlightening the information changes between different parties, minimizing related operating costs, is assigned to radio frequency technologies (RFID) [65–68]. RFID is an automatic identification system which allows to pick out and to gather data, thus enhancing forecasting and planning capabilities [69]. By means of RFID, it is possible to collect large amounts of accurate and real-time data and to share basic information in the decision-making process. From a technical perspective, an RFID system consists of a transceiver (reader) and one or more transponders able to communicate each other by means of a modulated radio frequency signal. The transponder sends the radio data in its memory by modulating the signal. In the case of a read-only transponder, these data represent a unique code, chosen from among billions of possible combinations, which is stored on the chip during its production. The data can be sent in both directions depending on the characteristics of the transponder (transmitter and receiver), which can incorporate both a chip with a ROM memory, written in the working phase of the chip and that can only be read, or an EEPROM memory that allows both the rereading and rewriting of various kinds of information about the object to be recognized.

It is easy to imagine the efficacy of such a system for identification, and the versatility obtainable with a data-collection system that uses it. The application possibilities of this new technology are vast and will become even more so in the near future. RFID systems are particularly useful when one wants to perform a reading without direct contact between the reader and object, when you want maximum safety in the transfer of information (the percentage of correct readings at the first attempt is higher than 99.5 %), when working in dirty environments or in particularly severe conditions where more traditional techniques fail, and when the presence of a control system needs to be hidden.

In the fashion industry, all three control typologies are fundamental, and ICTs can facilitate the implementation of the mechanisms necessary to deploy them. In such a context, a key activity in the overall control process is guaranteeing the full traceability of each item. This can be obtained by assigning a barcode to each item in order to mark it in a unique way.

In the case analyzed, a central role in the improvement of the different types of controls along the whole supply chain was played by the implementation of an ERP system. For the Alpha company, it was important to have complete monitoring of the various production activities and phases: input control on the

Fig. 5 A bulk swatch

materials used, process control on the various manufacturing phases outsourced, and an output control on the products created. Such controls require a constant flow of information between the various partners.

A central role in the passage between Italy and China of information and data concerning each single item was assigned to the File Transfer Protocol (FTP) of XML files. The File Transfer Protocol is a protocol for the transmission of files between two Internet systems. It allows users to download files or insert them into web pages through a system of authentication based on username and password. This enables two remote locations, in our case Italy and China, to have unique access and a secure file exchange.

Another very important tool used by the Alpha company in the control of items is the use of tablets for the control of the so-called 'bulk swatch' (a cloth made with the production yarn also containing references to the color bath). The use of tablets makes it possible to identify any discrepancies in the color bath or yarn used. The introduction of tablet technology in the process of quality control also meant simplifying the work of control, not requiring the use of highly specialized manpower, with a consequent cost-reduction (Fig. 5).

The various instruments and technologies described make it possible to facilitate the control process, although the real heart of the control system is entrusted to Enterprise Resource Planning (ERP) systems. The new ERP systems make it easy to manage and control data entry and are able to overcome the typical problems of fashion companies. While in the industrial sector, data are normally of two-dimensional, of an article-variant type, in the fashion industry it is necessary to resort to a matrix structure: article-variant-sizes. Information systems must be designed and developed to handle this type of data and allow for fast insertion (Fig. 6).

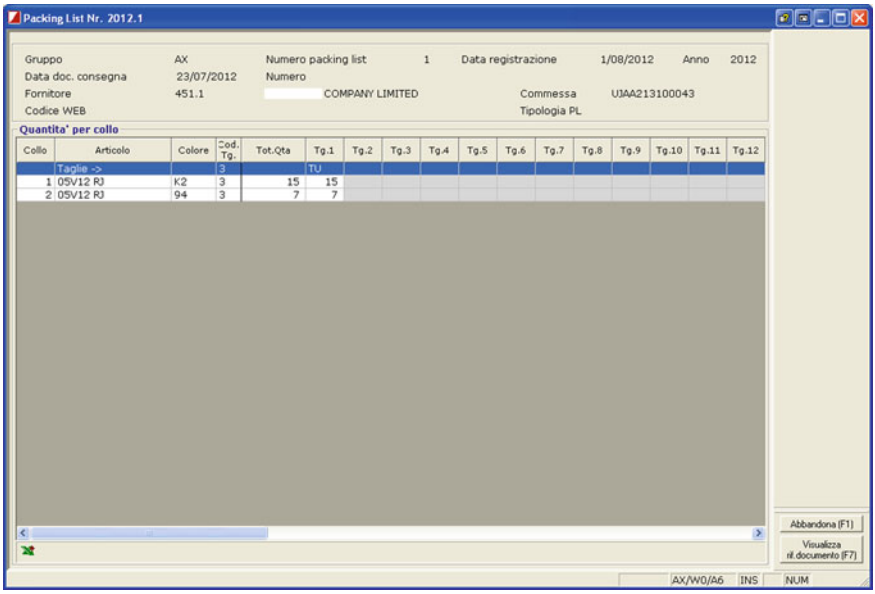

Fig. 6 The matrix approach

Proposition 1a *Information systems can help the fashion industry to reduce reputational and image costs due to counterfeiting.*

In the fashion industry the costs related to counterfeiting are high. Studies and research demonstrate that the effects of these illicit activities are quantified at around 6.9 billion Euros on the Italian market alone [70]. Likewise the OECD estimates that worldwide, the phenomenon concerns 8 % of all commercial traffic [71].

Counterfeiting activities are often carried out by companies from emerging countries. Consequently, the risk that the same contractors of part of the collection outsourced might replicate and sell it on the parallel black market is high. Data show that China remains the leading country for counterfeiting activities, followed by Hong Kong, India, Turkey and the United Arab Emirates (European Commission 2011).

The fashion companies that decide to outsource all or part of their collection have to invest in sophisticated control systems designed to guarantee the accurate monitoring of the entire process [39].

To reduce the costs of counterfeiting, Alpha implemented a system for the monitoring and counting of items. The system developed makes its possible to monitor all the items actually arrived in logistics, to carry out quality control on every item, to list the items and to manage the faulty. The garment labels are carefully counted and sent to suppliers in numbers equal to those of the items ordered. The counting and repacking phase is designed for quality control. All

garments that enter logistics must be controlled and equipped with a barcode to be made unique. The number of items entering and leaving must be identical. The counting stage is carried out as part of quality control. If the item passes the controls, it is read with the associated barcode and placed in a shipping crate. When the crate is full, a crate label is printed with another barcode which also shows the final destination market (Europe, Asia, etc.) and the means of transport (by plane or ship). If the item does not pass quality control, but the fault is repairable by tailors, it becomes a flawed item and is plotted as such. Once the fault has been corrected, the item returns to the counting phase and, after passing a new quality control, is 'repackaged' following the procedure described above. Conversely, if the item cannot be recouped, it will be treated as a return to vendor. In this case, it will increase the percentage of defects attributed to the supplier.

The process described allows for total control over the garments: no item without tracking may leave logistics. After the counting stage, for each group of items that arrive, the data are included in the packing list entry, and a report is sent to the Italian headquarters with an accurate indication of each typology of items: good, flawed and those returned to manufacturers. The number of items included in the report must be equal to the total number of items included in the input packing list.

Proposition 1b *Information systems can reduce agency costs between company and supplier.*

The agency problem, also called the free-rider problem, arises when an actor with superior information acts as an agent for a second one, allowing the first to exploit or expropriate resources that would otherwise provide returns to the second one. The problem stems from the information asymmetries between the parties and from their different objectives [72, 73]. Agency theory considers the different perspectives of risk that client and supplier have.

The case discussed shows how the Alpha company, in order to reduce agency costs due to information lacks and asymmetries between the company and its suppliers, has developed an information system able to monitor all the apparel as it arrives at the logistic department. The system includes a web-based sending from all the suppliers—via an FTP site—of an XML file (also known as a 'Preload document') containing all the data necessary to compile the packing list entries.

The data on the packing list are inserted directly by suppliers. Every supplier has an unique identification code to be included in the file. The purpose of these data is to respond to the need of Alpha to have an electronic document with the quantity and types of articles produced. Each item is then associated with a bar-code generated by the client. The data structure is fixed as XML files are used. Suppliers must build the file as follows:

- VariantTypes/VariantType
- SizeGrids/SizeGrid
- StyleItems/StyleItem
- Barcodes/Barcode

- Suppliers/Supplier
- AsnBD/Asn;
- Udses/Uds;
- Docs/Doc;
- Lines/Line;
- Sizes/Size;

The purpose of this file, in addition to managing the input of the items in logistics, is to perform an initial check on production. It allows the company to check whether the quantity ordered from the supplier is equal to the amount produced. All data are stored on the ERP system. The information system makes it possible to perform statistics on deliveries, on the deviation between order and production and, subsequently, between production and post-quality control.

In addition, the information system allows the procedure to be carried out by the supplier more quickly and easily. When items are shipped, a file is automatically created with the waybill.

Proposition 2 *Information systems and ICTS can improve business performance and competitive advantage.*

ICTs have changed the way companies operate and the processes by which products are created. Information technology has also had a profound impact on the business relationship between suppliers and buyers, two of the main actors in Porter's five strength model [74], affecting the firm's competitive advantage. ICTs can in fact alter the level of costs the company incurs in any part of the value chain [75] allowing for a precise control on costs related to different cost objects at different levels: processes, single phases, suppliers, product-service, etc. This is particularly true in such industries as that of fashion, characterized by potentially high information intensity both in the value chain and in the product. The fashion industry, by virtue of the large number of suppliers and customers it deals with around the world, requires an ever larger quantity of information along its entire value chain. Thanks to ICTs, companies can increase their ability to manage global networks, unlocking the power of broader geographic scope to create competitive advantage [75].

Through a special instrument called a 'monitor of orders', the information system developed in the Alpha company shows a list of the items which have passed controls in logistics, and creates an export file to insert in the reporting system of the Alpha company (Fig. 7).

The logic behind the whole system is as follows:

goods returned to vendors + good items + items recoverable but non-shipped = quantity of incoming items.

These data arrive in the information system of the Italian office so that it can print reports with the percentage of Quality Costs (QC) associated with each supplier. Currently, the company tolerates quality costs for each supplier as a percentage not exceeding 85 %.

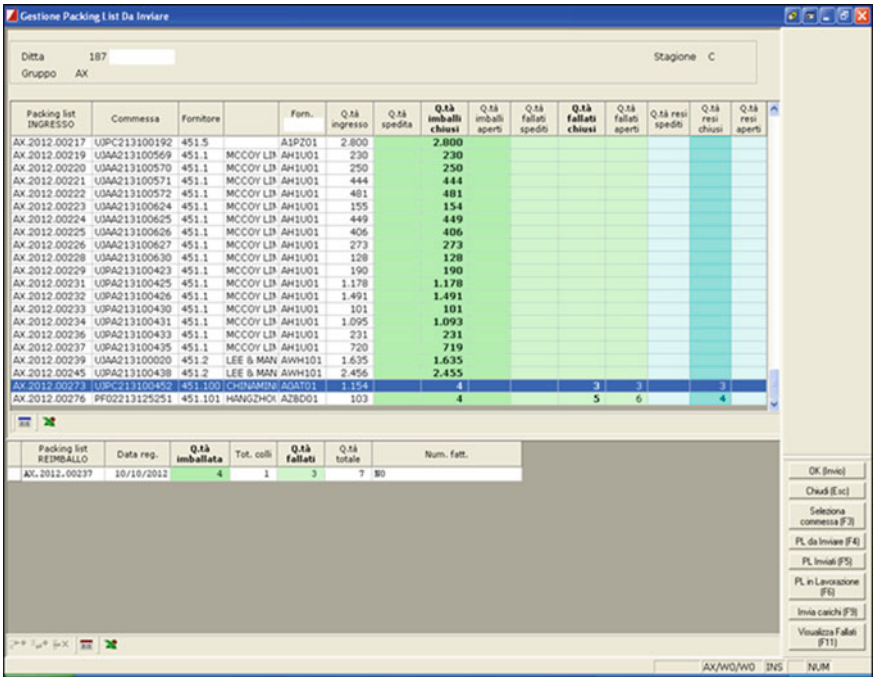

Fig. 7 The monitor of orders

8 Conclusions

In recent years, the expansion and evolution of the consumption of fashion products has been accompanied by a significant increase in counterfeiting (think of well-known brands such as Louis Vuitton, Burberry, Hermes, Chanel etc.).The simultaneous restructuring and decentralization of production processes has called for the implementation of strategies aimed at reducing the vulnerability of such companies. Surely the first action to be undertaken is the implementation and strengthening of the process of quality control of raw materials. Furthermore, as companies are subject to the risk that some of the contractors themselves of outsourced collections might replicate and sell them on the black market, parallel control action also goes in this direction. Control actions are therefore complex and involve costs that weigh on profitability. In fact, the 'cost of quality', constituting a particularly relevant voice, could erode the profitability of the order, thus requiring the replacement of the supplier.

The case discussed shows how the company has reduced agency costs due to lacks of information and asymmetries between the company and its suppliers, developing an information system able to monitor all the items that arrive at the logistic department.

The case seems to demonstrate how sophisticated information and communication technologies can facilitate control processes. ICTs can actually help companies in their strategy implementation by reducing the costs connected with them. By using information systems, luxury fashion companies can measure their activities more precisely and control processes, motivating suppliers to operate correctly.

The case also suggests that luxury apparel companies, who depend on technical superiority to achieve a brand image and product quality as key value drivers, have to focus on their manufacturer selection and process control. Furthermore, adopting a transaction cost perspective [31], the availability of more sophisticated technological requirements would reduce the cost economies of outsourcing, due to plausibly opportunistic behavior leading to the need to replace an outsourced manufacturer.

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Auditing of Information Technology Controls in Outsourcing

Tatiana Mazza, Stefano Azzali and Luca Fornaciari

Abstract The paper analyzes the level of Information Technology (IT) and the quality of IT Controls (ITC) in outsourcing. We collected data through a questionnaire sent to a sample of Italian listed companies and performed robustness tests. Our results show that in Italy: (1) IT in outsourcing is widespread; (2) ITC in outsourcing complies with USA frameworks. ITC mainly follow the Statement of Auditing Standard No. 70 (SAS 70) Report Types 1 and 2. Concerns about quality are related to the absence of a direct evaluation in outsourcer location and the absence of audit provisions.

Keywords Outsourcing · Information technology controls · Internal control over financial reporting

1 Introduction

Information technology (IT) in outsourcing has been defined as:—the "act of subcontracting a part, or all, of an organization's information system work to external vendor, to manage on its behalf" [1];—"managing a firm's IT infrastructure through … governance mechanisms with other firms" [2];—"the practice of transferring responsibility to third-party vendors for the management of IT assets and staff, and for delivery of IT services such as data entry, data center operations, applications development, applications maintenance, and network management" [3].

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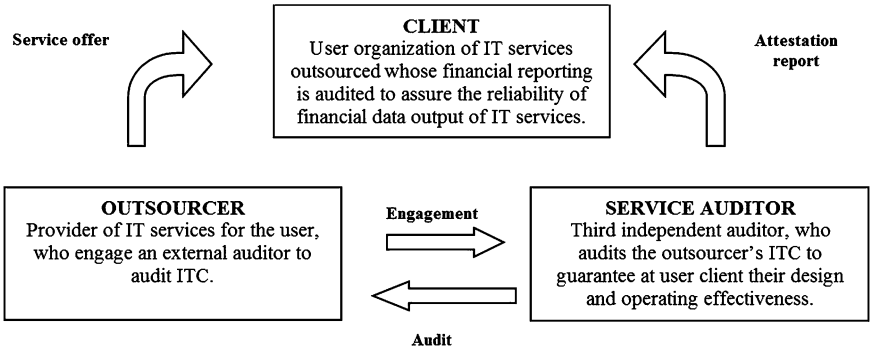

Fig. 1 Relationship between service auditor, outsourcer and client

Financial audits include IT Controls (ITC) because IT can increase the likelihood of material misstatement in the financial statement. IT in outsourcing is an element of client's information system which affects transactions, the financial reporting process and other events significant for financial statements. Both for IT outsourced or in house, ITC have to be audited.

ITC is today tightly regulated in the United States of America (USA) by the Sarbanes Oxley Act. Guidelines and frameworks on internal controls and the Statement on Auditing Standard No. 70 (SAS 70) also regulates the auditing in the presence of outsourcers.

This paper measures the level of IT in outsourcing and the quality of ITC in outsourcing in Italy, using the USA SAS 70 framework as a benchmark.

2 Literature and Background

Cannon and Growe [4] discuss the responsibility of management as laid down by Sarbanes Oxley Act in the USA. Also in Italy even where IT is outsourced, management responsibility cannot be transferred. The audit can be transferred to a Service Auditor, but the client company CFO or CEO retain responsibility. The client who outsources IT services needs to evaluate the ITC of the outsourcer, the provider of IT services, or alternatively use the attestation report signed by the Service Auditor. This is an independent auditor engaged by the outsourcer to guarantee design and operating effectiveness to clients (Fig. 1).

Authority guidelines and institutional frameworks in the USA lay down evaluation of ITC and evaluation of outsourcers. The evaluation of ITC covers the phases of scoping, planning, and risk assessment [5, 6]. The evaluation of outsourcers considers Service and Operating Levels Agreements, security, accuracy, integrity and availability of outsourcers (Principle 14 in [7]; Delivery and Support in [8]; Appendix C in [9]).

The Statement on Auditing Standard No. 70 [10] lays down scoping, planning and risk assessment procedures in its first section. Denyer [11] describes the roles of various participants (Client, Service Auditor, Outsourcer). Client internal auditors, in collaboration with the external auditor, carry out scoping: they identify all outsourced activities, especially IT and those that impact on financial reporting. In the phase of planning, they decide whether to audit these activities themselves, or to ask a Service Auditor to test the design and the operating effectiveness of the outsourcer's ITC which may impact on financial reporting. The Service Auditor should have experience of the industry and be in constant communication with the client, and is responsible for disclosing the procedures and framework used as well as completing the audit by the deadline. Denyer [11] calls attention to the fact that attestation reports should not be signed by non-Certified Public Accountant Service Auditors. Although the Sarbanes Oxley Act requires companies, in the phase of risk assessment, to scrutinize any business or IT processes and closely assess possible risks to financial reporting, many do not pay enough attention to the numerous new risks [12]. Clients need to make sure that the outsourcer meets conditions for the supply of services and has in place appropriate internal controls to cover the risks. The use of a Service Auditor becomes less widespread when client and outsourcer are strategic partners.

SAS 70 discusses Service Auditor attestation reports and Service Auditor responsibility in its second section. The outsourcer engages a Service Auditor to audit a part of its organization and to guarantee the reliability of controls to the client. The Service Auditor signs an attestation report Type 1 to attest only the design of the controls, or an attestation report Type 2 to attest the operating effectiveness of the outsourcer's Internal Control Over Financial Reporting as well as design of controls.

AICPA issued the SAS 70 in 1992, but it was not fully consistently or correctly applied until the Sarbanes Oxley Act in 2002. Misapplications included:

- Implementation for purposes outside its intended scope, e.g. for marketing [13–15];
- Preference for the less costly Type 1 report which excludes an evaluation of operating effectiveness [16];
- SAS 70 evaluations often equal to evaluations required by Sarbanes Oxley Act [17];
- Low quality of reports issued by inexperienced auditors or by Non-Certified Public Accountant Service Auditors [18].

In 2007, the Public Company Accounting Oversight Board published Audit Standard 5 which refers to SAS 70. SAS 70 is a USA standard. To solve the problem of application in different geographical areas, the International Federation of Accountants (IFAC) and the International Auditing and Assurance Standard Board (IAASB) developed the International Standard on Assurance Engagements—ISAE 3402 Assurance Reports on Controls at a Service Organization. In the USA, SAS 70 was replaced by the Statement on Standards for Attestation Engagements—SSAE 16 Reporting on Controls at a Service Organization, an

attestation standard (effective from 15 June 2011) and the new SAS Audit Considerations Relating to an Entity Using a Service Organization (effective from 15 December 2012).

The benefits of SAS 70 attestation reports are underlined by the following authors:

- Germano and Baker [19] find SAS 70 necessary because it requires the outsourcer to formalize processes and procedures and provides opportunities to improve planning of operations.
- Stanton [20] claims that over and above its stated aims, SAS 70 may also reduce the risk of costly errors, provide assistance to external and internal auditors, and reduce the length of time for responses to auditor inquires and requests.
- Nickell and Denyer [21] claim that SAS 70 plays a positive role thanks to the width of its scope, the large amount of information required for attestation reports and the requirement for the signature of a Certified Public Accountant. IT professionals have IT skills but are frequently lacking in accounting and auditing skills, and attestation reports require a higher level of professionalism.

3 Research Questions and Definition of Variables

Financial reporting is always supported by IT, which is often outsourced. Hall and Liedtka [3] show the large-scale IT outsourcing announcement by year. Rustagi et al. [22] and Barthelemy [23] present the distribution of contracts in terms of cost, the percentage of IT budget outsourced, type of IT activity outsourced, prior outsourcing and the duration of the outsourcing arrangement. Building on the contributions by these authors, we investigate IT in outsourcing in Italy.

RQ1: What is the extent of IT in outsourcing in Italy?

In order to assure reliability of financial reporting, a firm should: (a) evaluate the design and the effectiveness of outsourcer's ITC by way of Service Auditor reports or by way of direct evaluation in outsourcer location; (b) include audit provisions in the contract.

The different methodologies for ITC outsourcing evaluation are grouped and classified on a Likert scale (Table 1). At the top of the scale is the type of evaluation which is preferable according to the literature, authorities and professional institutions: the direct evaluation in the outsourcer location. Given the role of the Service Auditor in SAS 70, the use of Type 1 and Type 2 reports is included as a method. The two types of report are assigned different values on the Likert scale: consistent with the literature, Type 2 reports are considered a better evaluation than Type 1.

Audit provisions explicitly regulate and define responsibility, discretion in decision, key performance indicators, service level agreements and penalties

Table 1 Definition of variables

Variables	Definitions
ITC outsourcing evaluation:	1 = absence of evaluation
	2 = exclusive use of contract with outsourcer
	3 = evaluation of ITC design with SAS 70 Report Type1
	4 = evaluation of ITC design and effectiveness with SAS 70 Report Type2
	5 = direct evaluation in outsourcer location
	Likert scale based on frameworks (PCAOB, SEC, COSO, ITGI and AICPA)
Audit provision:	1 = contract between company and outsourcer includes audit provisions
	0 = otherwise

(Table 1). They benefit the client, in that the outsourcer audit must follow the standards, and the outsourcer, in that the audit is pre-defined and does not interfere with operations. The use of contract agreements is a first stage towards client control over the outsourcer, but is not always sufficient to assure reliability.

Based on prior literature and frameworks, we investigate the quality of ITC outsourcing in Italy.

RQ2: What is the quality of ITC in outsourcing in Italy?

Table 1 shows the definition of the main variables of interest. ITC outsourcing evaluation is an ordinal variable on a five-point Likert scale. Scores 1, 2 and 3 are evaluated negatively because the absence of evaluation or the exclusive use of contract does not assure reliability of ITC. ITC outsourcing scoring 4 is acceptable because it is compliant with SAS 70, Type 2 report which assures both ITC design and operating effectiveness. The highest score, 5, indicates the method of ITC outsourcing evaluation, which is the most preferable, especially where it is integrated with Service Auditor attested reports.

4 Questionnaire

Research was conducted by way of a questionnaire, drafted in collaboration with external auditors from one of the Big4. Instruments for each construct were based on the above-mentioned frameworks. External auditors made a key contribution in ensuring language would be comprehensible for the target companies. The questionnaire included multiple choices and yes/no questions about the procedures implemented for the evaluation process, with none of the questions requiring discretionary judgment.

The questionnaire was next tested on three firms: a bank, an insurance firm and a manufacturing firm from the target population. On the basis of their responses

Table 2 Sample selection

	Total	Manufacturing and service industry	Finance industry
Total number of companies listed on the Milan stock exchange in 2010	255	219	36
Less companies with no availability to attend the research	−133	−127	−6
Total companies to whom questionnaire sent	122	92	30
Less companies that did not respond (Response rate: 89 %; 43 % of the population)	−13	−8	−5
Total number of companies who responded	109	84	25
Less number of companies without an ITC evaluation process	−59	−53	−6
Total number of companies with an ITC evaluation process (about 20 % of the population)	50	31	19

and comments, the questionnaire, the study design and the measurement of some constructs were slightly adapted.

The questionnaires focused on evaluating the year 2010 and were distributed by email in 2011. Responses were received in a narrow time frame of 3 months. The distribution procedure involved sending a survey package containing the questionnaire and a covering email underlining the importance of the research and encouraging firms to reply. In order to increase the response rate, companies, which had not yet responded, were contacted by phone after 3 weeks.

To avoid the problem of self-selection, i.e. receiving responses only from companies with a good evaluation process and biased answers in evaluating their own evaluation process, we informed firms that external auditors would check the questionnaire responses. Because external auditors know their internal control system, this was an incentive for the firms to give true answers.

We opted to make the questionnaire confidential, i.e. although the names of respondent companies are known to us they are not disclosed here and results are shown only in aggregate form. In addition, it was emphasized that the research was under the auspices of a well-known university, widely recognized as trustworthy, so that firms could be confident that sensitive information would not be disclosed.

5 Sample

As shown in Table 2, the population is the 255 Italian companies listed on the Milan Stock Exchange.

We sent the questionnaire to 122 listed companies. We received 109 answers (89 % response rate—109 of 122; 43 % of the population—109 of 255). Among respondents, 50 firms operate an ITC evaluation process. This sample thus represents nearly 20 % of the population (50 of 255).

Table 3 Mean comparison

Variable	Sample mean	Control group mean	Two-groups mean comparison t test with unequal variances (two-tailed p-value)
Panel A—non-respondents or without an ITC evaluation process			
Size (total assets)	30173207	27845841	−0.1134 (0.9099)
Profitability (operative income/total assets)	0.0143167	0.0307055	1.1608 (0.2480)
n	50	72	
Panel B—other firms of the population			
Size (total assets)	30173207	11804580	−1.6044 (0.1124)
Profitability (operative income/total assets)	0.0143167	0.0074759	−0.6131 (0.5406)
n	50	25	

We performed tests for non-response bias and for the generalization of the results. We checked whether our results were affected by unknown factors that systematically distinguished respondents from non-respondents or companies without an ITC evaluation process (control group in panel A, Table 3) and respondents from the other firms of the population (control group in panel B, Table 3). We compared the sample mean of profitability and size with the control group mean. Control group data was collected from the financial reporting database DATASTREAM/WORLDSCOPE. The results in Table 3 show no sign of a non-response bias and no difference with other firms of the population in terms of either profitability or size.

6 Results

RQ1—Table 4 shows that 62 % of companies outsource IT. ITC in outsourcing are thus considered to be frequent, and need to be carefully evaluated in order to assess the reliability of financial reporting. There are no significant differences between industries: manufacturing and services and the finance industry show similar percentages of companies that outsource IT.

The majority of companies (mode in Table 5) outsource one service, and the maximum number of services is ten. The industry with the highest volatility (highest standard deviation) and the greatest number of IT services outsourced (greatest mean in Table 5), as well as the highest percentage of IT outsourced (Table 4) is the finance industry. The finance industry is not statistically different from other industries for the mean, but it is statistically different for variance (p-value).

Table 4 IT outsourcing decision

Industry	Yes		No		Total	
	n	%	n	%	n	%
Manufacture and services	19	61.3	12	38.7	31	100
Finance	12	63.2	7	36.8	19	100
Total	31	62	19	38	50	100

Table 5 Number of IT services outsourced

Industry	Mean	Mode	Standard deviation	Min	Max	Quartiles		
						25	50	75
Manufacture and services	2.4		1.7	1	8	1	2	3
Finance	3.5	1	3.4	1	10	1	2	6
Total	2.8	1	2.5	1	10	1	2	3
p-value for difference	0.29 t-test		0.008 F-test					

Cross section statistics for the subsample of companies that outsource IT services

Table 6 ITC outsourcing evaluation

	Mean	Mode	Standard deviation	Min	Max	Quartiles		
						25	50	75
ITC outsourcing evaluation (1–5)	3.41	5	1.6	1	5	2	4	5

Cross section statistics for the subsample of companies that outsource IT services

RQ2—We find that the quality of ITC in outsourcing in Italy complies with the USA frameworks, although there is room for improvement.

ITC OUTSOURCING EVALUATION: Our findings indicate that Italian companies are aware of the problem of evaluating outsourced ITC, and many have constructed a specific methodology based on USA frameworks. A mean of 3.41 (Table 6) could be interpreted as companies that follow SAS 70 with an evaluation of ITC design with report Type 1 (Level 3) or with an evaluation of ITC design and effectiveness with report Type 2 (Level 4). We confirm the use of attestation reports consistent with the literature [19–21]. However, even where attestation reports are used, if companies do not directly evaluate ITC in the outsourcer location, there are still risks related to the unreliability of financial reporting [11, 13–15, 17, 18].

AUDIT PROVISIONS: Most companies outsourcing IT include the audit provisions in the contract. This is a necessary but not sufficient condition to guarantee the quality of ITC. Our results however show a negative indicator: nearly half of outsourcing companies do not include audit provision (Table 7).

Table 7 Audit provisions

Audit provision	n	%
Yes	16	51.6
No	15	48.4
Total	31	100

Cross section statistics for the subsample of companies that outsource IT services

7 Conclusions

The paper studies the level of IT outsourcing and the quality of ITC outsourcing evaluation in a sample of Italian listed companies. Our results show that IT in outsourcing is a sizable phenomenon. In both manufacturing—services and the finance industries the majority of companies in our sample outsource IT and the related controls. Clearly, responsibility for reliability of financial information cannot be outsourced. The USA frameworks are the most widely used in Italy and in the absence of national Italian guidelines, can be used as a benchmark (RQ2). Consistent with the literature and with USA frameworks covering ITC in outsourcing our results confirm that:

- SAS 70 reports are more advantageous than the simple use of contracts [19–21];
- Simply evaluating design is not enough to ensure the reliability of accounting data [16];
- a direct evaluation of an outsourcer is preferable to the exclusive confidence in a SAS 70 report [11, 17, 18].

We found that most companies in our sample follow SAS 70 in issuing Type 1 and Type 2 Reports (Codes 3 and 4) but there is a lack of direct evaluation in the outsourcer location.

Audit provisions are an important prerequisite for quality of the contract with the outsourcer, but we found that they are required by only half the companies in the sample.

Our findings indicate possible methods of improvements for ITC, and given the impact of ITC on the reliability of financial reporting, these should be useful for companies, auditors and researchers.

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IT Auditing in Italian Banks: An Explanatory Study

Rita Lamboglia and Giuseppe D'Onza

Abstract This study analyses the characteristics of IT auditing in banks. Based upon two Italian case studies, the article provides a qualitative assessment of the objectives of the IT audit, the activities performed, the stakeholders served and the critical success factors that influence the capability of IT auditing to add value. The results show that the scope of the IT auditing function has extended; nowadays senior managers expect IT auditors to support them in the evaluation of the IT system and in the assessment of IT security controls. Regarding IT auditing activities, the most commonly performed are risk assessment and information security risk assessment. Considering stakeholders, the interviewees revealed that the main stakeholders are executive managers, while the critical success factors are the characteristics of the control environment, the capacity of the IT auditor to stay in touch with the business, and behavioural skills.

Keywords IT auditing · Banks · Case study

1 Introduction

In recent years, the importance of Information Technology (IT) auditing has grown with the increase of the demand for control mechanisms that can protect the value IT systems could deliver to enhance corporate business processes. A global study on internal auditing activities (entitled "Common Body of Knowledge in Internal Auditing"), carried out in 2010 [1], highlighted that the audit engagement on IT/ICT systems ranks sixth among the 25 activities considered in the study [2].

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The analysis of these results per industry shows that banks and insurance companies are the organizations where IT auditing engagements show the highest percentage and are performed by more than 80 % of 13,500 internal auditors who took part in that survey [3].

The most likely reason of these results is that financial companies show extensive adoption of IT to process their operations, and this has created a strong demand of assurance and consulting activities regarding the IT systems.

Another possible reason is that, since 2004, bank supervisory authorities have issued some regulations and exerted a certain pressure on financial companies to establish and periodically test the adequacy of internal controls over IT processes and resources.

Despite the importance recognized to IT auditing as an essential service to improve the effectiveness of the IS in the financial industry, there is still a very limited number of studies that investigated this topic in this industry.

Some studies analysed the problem of control over IT systems in relation to the decision of banks to outsource their IS function [4, 5], which highlighted that the need to maintain control over outsourced IS applications may increase their transaction costs. The presence of these costs could lead to the decision to manage IT services in house or through the parent company.

Other researchers [6] investigated the benefits internal auditors may obtain through a more intensive use of audit technology tools, due to the opportunity to process a large amount of data for auditing purposes in banks, as well as in other entities.

Therefore, the topic of IT auditing in banks remains quite unexplored in academics and professional studies.

This paper aims at contributing to the literature by analysing the characteristics of IT auditing in two large Italian banks. More specifically, the paper focuses on the following topics: the objectives of the IT audit department, the activities performed, the stakeholders served, and the critical success factors that influence the capability of IT auditing activities to add value.

The remainder of the paper is organized as follows: the second section reviews the relevant literature and formulates the research questions; the third section outlines the methodology used to carry out this study; the fourth section presents the results of the interviews; and the last section summaries and discusses the conclusions of this study.

2 Literature Review and Research Questions

IT auditing is part of the managerial control exercised over a company's IT system, which is designed and implemented in order to help a growing number of organizations monitor the effectiveness of their IT risk management system.

Despite its relatively short history, IT auditing has rapidly evolved over time as a result of the swift development featuring the use of information technology in business processes.

These changes concern many characteristics of IT auditing like the roles and objectives associated to that activity, the stakeholders it serves, the type of engagements performed, the skills and competencies IT auditors should possess to carry out their tasks effectively [7].

When considering the objectives of IT auditing, the definitions provided by academic and professional studies highlight different goals organizations could achieve by setting up this activity.

One of the most commonly adopted definitions identifies an IT audit as [8, 9] "a process of collecting and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity, achieves organizational goals effectively, consumes resources efficiently".

Other definitions highlighted the organizational perspective of IT auditing and defined this activity as a process for "discovering, monitoring and evaluating an organisation's information resources in order to implement, maintain, or improve the organisation's management of information" [10].

Another definition considers IT auditing as an independent and objective assurance and consulting activity performed with the aim of analysing whether the risks and controls related to the information systems are properly managed.

As an example, the assessment of IT risks and controls may be performed with the purpose of analysing if:

- the company's IT resources are effectively safeguarded;
- the integrity, confidentiality, and reliability of information are maintained;
- IT processes and resources assist the organization in achieving its business objectives (effectiveness);
- the IT strategy is aligned with the business strategy and allows the company to get a high return from the IT investment.

Taking all these definitions together, it clearly appears that the objectives of the IT audit department may vary between companies and encompass different features. Based on these considerations, we considered it interesting to analyse the objective of IT auditing in the banks under examination. So, our first research question is:

RQ1: Which are the main objectives of IT auditing in Italian banks?

The IT audit department performs a great number of activities because nowadays auditors serve a greater number of customers than in the past.

When considering the taxonomy of IT auditing, it is worth noting the variety of classifications existing in the literature.

A traditional and widespread classification distinguishes between auditing general IT controls and auditing IT application controls [11].

A growing number of authors have adopted the classification proposed by the CobiTframework to categorize IT auditing. These activities are often classified

considering two dimensions of the "CobiT cube": the type of IT processes analysed and the business requirements to be met by the audit [12]. Regarding IT processes, auditing activities are classified based on each phase of the IT system's life cycle by distinguishing, for example, the audit of the hardware procurement process from IT implementation and support.

When analysing business requirements, IT audits are classified into security, compliance, reliability, effectiveness, etc.

Other authors [13] combined these two dimensions and proposed the following classes: organizational IT audits; technical IT audits; application IT audit; development/implementation IT audits; compliance IT audits.

When we looked at the IT auditing activities proposed by the academic and professional literature, interestingly we noticed that there are many other activities, like the assessment of the disaster recovery plan, the review of software development documentation, and so on.

These considerations point out the difficulties one encounters when trying to develop a comprehensive list of IT auditing activities, as well as when seeking to define boundaries between those activities.

For the purpose of this study, researchers used the classification proposed by Moeller [14] on the hierarchy of control measures, integrated with the CobiT model [15]. Figure 1 shows the IT control hierarchy with, at the top of the model, IT governance controls; the second level refers toIT management controls, and IT technical controls are shown in the lower part of the figure.

A brief explanation of IT auditing, regarding each of the three control levels, is given below.

The importance of IT governance has grown over time, with increasing investments made by the organizations in their IT systems and with the greater significance these systems have acquired for the company's competitiveness and profitability.

There is a variety of definitions of IT governance. According to Moeller [14], "IT internal controls at governance level involve ensuring that effective IT management and security principles, policies, and processes with appropriate compliance measurement tools are in place".

The IT Governance Institute (ITGI) provides a broader definition of IT governance: "the leadership and organizational structures and processes that ensure that the organisation's IT sustains and extends the organisation's strategies and objectives" [16]. The ITGI recognized the importance of IT Governance with the issuance, in 2005, of the COBIT 4.0 framework regarding IT governance.

The CobiT model [15] identifies five areas of control, namely (Fig. 2):

1. Strategic Alignment
2. Value Delivery
3. Risk Management
4. Resource Management
5. Performance Measurement

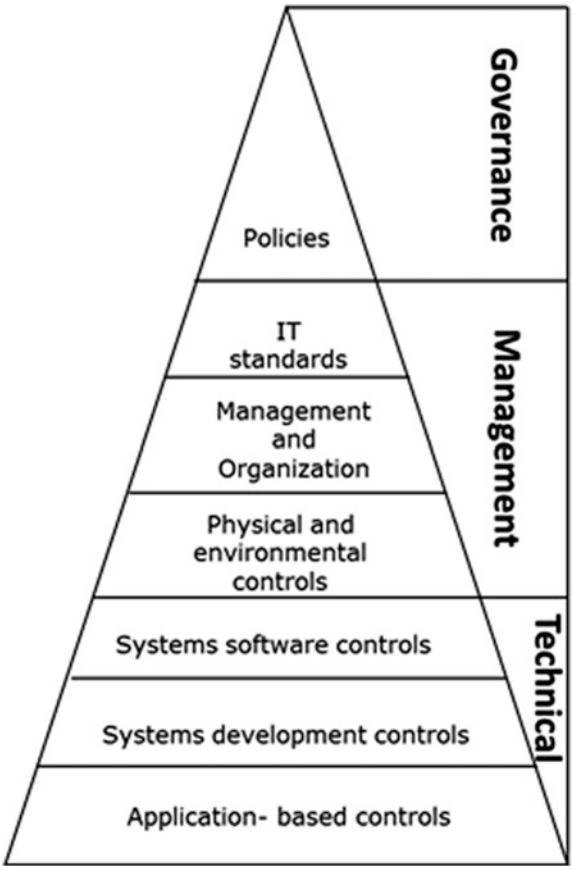

Fig. 1 IT general and application control hierarchy. *Source* Moeller 2010, p. 156

Fig. 2 COBIT IT governance focus. *Source* CobiT 4.0

Strategic Alignment regards the connection between the company's strategic plan and IT plans and its purpose is to ensure that strategic goals are supported by IT investments. Auditing strategic alignment means to analyse: (1) the strategic fit

of IT systems in terms of how IT supports the implementation of the business strategies of the company or creates new business opportunities; and (2) functional integration, which concerns how the choices made in the IT domains (architecture, process, people) impact the business domain and vice versa [17].

The assessment of Value Delivery aims at examining if IT systems deliver the promised benefits and if their output is in line with the defined business requirements. The achievement of this goal requires an adequate use of applications, information and technology solutions.

The analysis of Resource Management regards the optimization of the IT investment and a proper management of critical IT resources: processes, people, applications, infrastructure and information.

Risk Management is audited by referring to the policies the organization adopts to manage its IT risks effectively, in order to ensure that these risks are properly understood and effectively managed at all organizational levels.

Performance Measurement examines strategy implementation, project completion, the use of resources, process performance and service delivery. It includes setting and monitoring measurable objectives for IT process deliverables (process outcomes) and how they are delivered (process capability and performance).

As shown in Fig. 1, general IT management controls include: IT standards, management and organization, physical and environmental controls.

Regarding IT standards, IT auditors should identify and assess whether the processes, policies and procedures that allow IT systems to work effectively and deliver their services have been established, communicated to and followed by all the members of the IT organizations. These standards generally cover the phases of the IT system's life cycle and could regard many processes like IT service design, change and configuration management, operation and incident management, control procedure documentation.

The second level of general IT management controls regards the IT organization and management processes. IT auditors should review the organizational and managerial controls existing in the IT function. These auditing activities address different issues like there view the presence of an adequate, updated and documented disaster recovery plan, the existence of an IT business continuity management process, the asset management process of IT resources, etc.

The third component of IT management control concerns physical and environmental controls. In order to provide a broader view of these controls, researchers have renamed this level "IT security controls" to encompass all the actions taken to mitigate security risks and build up an effective IT security environment. Regarding this area, IT auditors could help the company improve its IT security strategy and security standards, mechanisms and procedures in place.

The last level of the IT control hierarchy describes IT technical controls, which include: system software controls, system development controls and application-based general controls.

The audit work on system software controls and system development controls consists in reviewing controls regarding the operating system (OS), the database

management system and other operating programs. The objective of this audit could involve different issues like the authorization rules for software installation, the maintenance and upgrading of programs.

Application-based controls refer to the review of IT applications, which are used by companies to support a variety of processes such as accounting, procurement, production, marketing. IT auditors are required to evaluate the adequacy and operation of the application systems and their capability to contribute to the effectiveness of the business processes.

Figure 3 shows the model researchers used to analyse the IT auditing activities performed by banks, with the integration of the control hierarchy proposed by Moeller with the COBIT 4.0 framework [15].

In order to analyse the activities carried out by the banks at issue, researchers formulated the following research question:

RQ2: Which the activities shown in Fig. 3 is/are performed in the companies analysed?

The studies conducted on IT auditing highlighted that the number of stakeholders served by this activity has increased during the years. While, at an early stage, EDP auditors worked mainly to support external auditors, their activity has expanded over time to meet the demand of assurance and consulting activities coming from other parties like the IT function, senior managers, the board of directors, the audit committee, etc. [18].

Regarding banks, the regulatory framework defined by the Supervisory Authorities considers IT auditors as part of the "third line of defence", which provide an independent assurance to the Board of Directors, business unit executives and the Audit Committee on the management of IT risks and on the status of the IT controls incorporated in the business processes ("first line of defence"). As a "third line of defence", IT auditors are also required to provide an independent assurance on those functions (like the risk management unit) that oversee IT risks and controls as a "second line of defence".

Significant differences are generally recognized in describing the relative power of these stakeholders [19]. In this context, it is worthwhile analysing the perception of the interviewees regarding the following research question:

RQ3: Who are the main stakeholders of IT auditors?

The literature on the value drivers of the auditing activity shows many factors that may affect the capacity of this activity to add value for the organization it serves [20–22].

These factors are: the characteristics of auditors (e.g. objectivity, credibility, leadership, skills, etc.); the way activities are performed and the tools used (e.g. risk-based audit plans, risk assessment methodology, etc.); the environment where auditors perform their engagements (e.g. characteristics of the control environment, support by the top management, etc.).

When considering the studies on the critical success factors of IT auditing, other variables could be identified, such as ethical standards for IT auditors, adequate

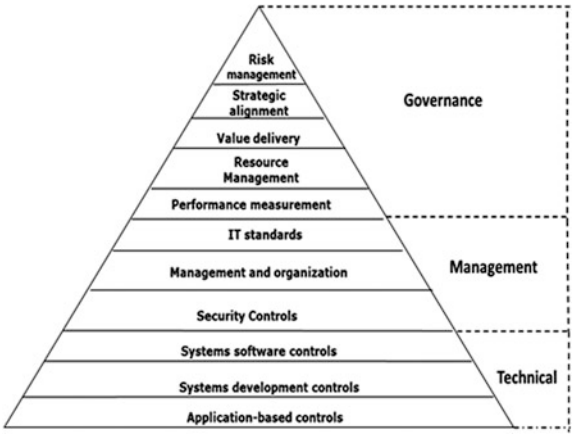

Fig. 3 IT auditing activities

planning of the IT engagement, and so on [23]. These mixed evidences highlight that a dominant model does not exist and that additional analysis is needed on this subject. All these considerations lead us to the following research question:

RQ4: What are the main critical success factors for IT auditing activities?

3 Research Methodology

Researchers decided to focus their investigation on the banking industry. The reasons behind this decision have been extensively described in the introduction.

This study concerned the two largest Italian banking groups. We selected the largest organizations based on the evidence of a previous research, which described a positive relationship between firm size and the creation of an IT audit function [24].

Furthermore, these groups operate on an international scale and their parent companies are both listed in the Milan Stock Exchange.

We used a holistic case study method to describe the IT auditing phenomenon in its real-life context.

To select the two case studies inspired by previous research on internal audit, we also took into account the age of the internal audit function [25], as well as the number of internal auditors. Concerning these parameters, we included a company with a mature internal audit function and with a large internal audit department.

Table 1 shows some characteristics of the case studies that have similarities. This will increase the comparability of results [26].

Researchers conducted semi-structured interviews with the head of the IT audit department.

An interview protocol was developed commencing with open-ended questions regarding general subjects, like the role of IT auditing in the banks, the professional background of IT auditors, the years of existence of the IT auditing function, etc.

Table 1 Characteristics of the banks analysed

Variables	Case study 1	Case study 2
Reporting line of IT audit manager	Chief audit executive	Chief audit executive
Number of employees in IT audit department	30	17
Employees in IT audit versus employees in IA unit	15 %	13 %
Years of existence of IT auditing department	More than 20 years	More than 20 years
IT auditing % outsourced	0 %	0 %

More specific questions relating to the objectives of IT auditing and the activities carried out were also examined. A sample of the questions posed is given below:

1. What are the objectives of your IT audit department?
2. What are the activities your IT audit department currently performs? What changes do you expect in the next 5 years for your auditing activities?
3. Who are your main stakeholders? What do you think they expect from your department?
4. What are the critical success factors of your activity?

The analysis of these qualitative data was based on the analytical protocol recommended by Miles and Huberman [27].

More specifically, the interviews were transcribed and read through several times to identify the themes. Since the interview questions were categorised under headings prior to the interview, this process itself helped align the themes drawn from the literature with the answers to the questions. The interviews lasted on average 1 h and they were completed in July 2013.

Documents like the IT audit charter, the IT audit manual, the organizational chart of the IT audit function were read through to gain a general understanding of the demographics and other significant contextual factors pertaining to that particular organization.

Next, the most important observations were summarised and sent back to the interviewees to obtain their confirmation.

4 Empirical Results

As discussed in the research method section, an analysis of the interview transcripts was undertaken to develop the themes. The themes extrapolated from the interviews pertained to issues raised from the literature review.

4.1 Objectives of the IT Audit Department

The findings suggest that the objectives of IT auditing have changed over the years. While, at an early stage, the creation of the EDP audit function was driven by the necessity to ensure the effectiveness of general and application controls over

the IT system, nowadays the scope of this activity has expanded to provide assurance on the governance and management processes regarding IT systems.

> The IT audit function has been set up during the eighties. Initially, it was a technical unit whose task was to evaluate and improve control over the IS infrastructure and applications. Today the scope of theIT auditing function has expanded. In summary, the current purpose is to assess the capacity of IT systems to help the business unit and company achieve their objectives. (Case study 1)

> The IT audit unit has existed for over 20 years and its development has gone hand in hand with the more pervasive use of IT resources in the business process. The role of the IT audit department has changed from a review of the technical aspects of the IT system to the monitoring of all IT processes and supervision of the management of IT-related risks. (Case study 2)

These changes reflect the fact that investment in IT systems has increased over time. IT is increasingly perceived as a critical asset for the competitiveness of a bank and financial regulators asked the banks to enhance their internal control systems concerning IT processes.

> The growth in IT investments has emphasised the need for the CEO and senior managers to understand the value delivered by these investments, ensure whether IT meets business requirements and assess users' satisfaction with IT resources. (Case study 1)

The evolution of the expectations of the main stakeholders determined the need to revise the objectives of the IT audit function. There has been an extension of the scope of this activity, that should continue to analyse risks and control at a technical level, to review IT security controls and be able to support the senior management in understanding the value created by IT systems.

> In particular, the objectives of IT auditing are: (1) to assess the effectiveness of the control of the design, development and management of IT systems in order to assess the reliability, integrity and availability of information and its capacity to support the business processes, (2) to monitor IT-related risks and the measures implemented to mitigate those risks; (3) to assure the adequacy and effectiveness of IT security strategies, policies and tools. (Case study 2)

> Senior managers expect IT auditors to support them in the assessment of the capacity of IT systems to improve the efficiency and effectiveness of the business process and ensure the integrity of the information used for processing operations. (Case study 1)

4.2 Activities Performed

The results regarding IT auditing activities are summarized in the following tables.

The list provided in Fig. 3 has been used to evaluate the IT activities carried out. The tables show the interviewees' evaluation of the fact that they are currently performing the activities proposed and their opinion on whether they expect the effort devoted to these activities will increase, stay the same or decrease in the next 5 years.

The findings show that today the involvement of the IA unit in IT governance is limited to risk assessment. Both the interviewees declared they are monitoring risk assessment and risk management processes in order to understand if the risks associated with IT processes and infrastructures have been identified and managed accurately. It is interesting to highlight that the goal of the analysis is to cover all the risks associated with IT systems (Table 2).

As highlighted by the interviewees, even though IT security risk is probably the main IT risk, it is also important to analyze those situations that may have a negative impact on the effectiveness of the IT processes. Regarding the other activities that are part of IT governance, most of them today do not fall into the domain of the IT auditing unit. However, the interviewees expect to play a more important role in the future in order to meet an increasing demand of consulting and assurance services from the senior management and the IT function.

Regarding IT management controls, the interviewees highlighted that the auditing of information security controls is vital in the current environment and they expect the time they spend on these activities to increase in the future. The massive use of e-banking and the need to protect the confidentiality, integrity and reliability of the data and information processed make the review of the control of IT security risks one of absolute priority for IT auditing. Security controls also play an important role to mitigate the reputational risk (Table 3).

When considering IT standards, Case Study 1 shows the need to improve the policies adopted by the company to regulate the development of its IT systems, the acquisition of hardware and software, and IT documentation. This activity is not performed in Case Study 2, and there is no expectation to see this engagement included in future audit plans.

Both interviewees declared they perform a regular assessment of the management of IT systems in their business group. This assessment mainly focuses on the disaster recovery plan and the business continuity plan (Table 4).

Considering technical controls, the respondents indicated that IT auditors regularly perform these activities.

Regarding system software controls, the interviewees highlighted that their audit programs envisage the review of the controls related to the management of the operating system, the database management system and other programs used by the bank to process transactions. They expect the importance of this activity to stay the same in the upcoming years.

Moreover, auditing involves the review of IT application controls, which are used to handle operations that include processes like payment, lending, accounting, etc. Even in this case, the interviewees believed that the importance would remain the same in the upcoming years.

Table 2 IT governance activities

		Case study 1		Case study 2	
		Today	Future perspectives	Today	Future perspectives
Governance	Strategic alignment	No	Increase	No	Stay the same
	Risk management	Yes	Increase	Yes	Increase
	Value delivery	No	Increase	No	Stay the same
	Resource management	No	Increase	Yes	Increase
	Performance measurement	No	Increase	No	Increase

Table 3 IT management activities

		Case study 1		Case study 2	
		Today	Future perspectives	Today	Future perspectives
Management	IT Standards	Yes	Stay the same	No	Stay the same
	Management and organization	Yes	Stay the same	Yes	Stay the same
	Security controls	Yes	Increase	Yes	Increase

Table 4 IT technical activities

		Case study 2		Case study 2	
		Today	Future perspectives	Today	Future perspectives
Technical	Systems software controls	Yes	Stay the same	Yes	Stay the same
	Systems development controls	Yes	Increase	Yes	Stay the same
	Application-based controls	Yes	Stay the same	Yes	Stay the same

4.3 Stakeholders of IT Auditing

When considering the stakeholders of IT auditing, the interviewee pointed out that they serve multiple stakeholders.

Interviewees were asked to indicate which are the most important stakeholders.

> To provide a ranking on our most important stakeholder, I have to indicate:
>
> 1. Chief Operating Officer
> 2. Chief Risk Officer
> 3. Chief Financial Officer
> 4. Head of IT department. (Case study 1)

When considering relationships with these stakeholders, the interviewees indicated that they submit a quarterly report to their stakeholders with a summary

of IT audit results and with an overall assessment of IT controls, the main IT risks that require further action and the remediation plan defined to reduce the risks down to an acceptable level.

Other recipients of the IT audit reports are the Chief Audit Executive and External Auditors.

Regarding the second interviewee, the answer was that

> the main stakeholders of the IT audit activities are:
> 1. Business line managers
> 2. The IT department
> 3. The IT security unit
> 4. Risk Management
> 5. The Internal Audit unit". (Case study 2)

Unlike Case Study 1, the IT audit department does not have a direct relationship with the Senior Management of the bank, but they interface with the head of the IA unit. The findings of IT audits are reported to the Chief Audit Executive (CAE), who, in his turn, includes the assessment made by the IT audit unit in an aggregate report on the internal control system, which is submitted to the appropriate member of the Senior Management and control governance.

When functional relationships with the Board of Director were considered, both interviewees indicated that they were managed by the CAE. The assessment of IT controls is part of the overall assessment of the internal control system, which is submitted by the CAE to the Board members.

The interviewee indicated that the more extensive use of IT made the assessment of the control over these system much more important in order to provide the CEO, the Board of Directors and the Audit Committee with an overall assessment of the adequacy of the whole internal control system.

IT controls are an important part of the actions taken to mitigate operational and reputational risks. These findings may help explain why the Chief Operating Officer and the Chief Risk Management are considered two important clients of IT auditing activities, as they provide these figures with the information they may use to monitor how these risks are managed.

The IT department is often considered the traditional auditee. Both interviewees highlighted they have a cooperative relationship with their IT department.

> During the last year, our IT audit unit provided the IT department with many consulting activities regarding, for example, the testing of the software developed internally by the IT function. (Case study 2)

The interviewees considered the CFO as an important stakeholder for activities focused on the control of financial reporting. For this activity, they also indicated that another recipient of the audit report is the external auditor. Since the introduction of the Italian SOX (Law 262/2005), which requires CFOs to publicly disclose the results of the assessment of their internal financial reporting control system, the IT audit plan includes the test that this unit carries out to support the CFO in performing that assessment.

4.4 Critical Success Factors of IT Auditing

The fourth theme analysed regards the critical success factors that influence the capability of the IT auditing activities to add value.

According to one interviewee, the critical success factors that add value are:

- *The Senior Management's support*
- *Leadership*
- *Communication skills*
- *The presence of a strong control environment in the organization*
- *The capacity to understand the company's IT risks and, based on this assessment, to set up the audit plan* (Case study 1)

As highlighted by the second interviewee, the capacity of IT auditors to generate value is affected by:

- *An expert and well trained audit staff*
- *Top managers' support*
- *The ability to understand problems (risks) related to the IT system and provide valuable recommendations*
- *The ability to build positive relationship with the IT department* (Case study 1)

It is worth noting that both IT auditors consider the support of the Senior Management and the ability to understand IT system-related risks to be a critical variable for adding value. Moreover, they both highlighted some behavioural skills—i.e. leadership, communication skills, capacity to build a positive relationship with the IT department.

5 Conclusions and Further Research

This article provides empirical evidence on the objectives of the IT audit department, the activities performed, the stakeholders served, and the critical success factors for the ability of IT audits to add value.

Regarding the objectives, we found that the scope of the IT auditing function has expanded during the year. While, in the past, the objective was mainly focused on the review of general and application controls, nowadays Senior Managers expect IT auditors to support them in the evaluation of the effectiveness of the IT system, as well as in the assessment of IT security controls.

Risk assessment and information security are two of the most performed IT auditing activities. Regarding IT risks, our interviewees highlighted that they are trying to adopt a holistic approach where all types of risks are considered in their assessments. IT security represents a priority to protect the banks against the cyber-attacks and ensure the integrity of the information processed. Therefore, the IT security audit is the primary activity performed.

Our interviewees said they expect the importance of both these activities to increase in the future.

When considering the stakeholders of IT auditors, the interviewees highlighted that the number of customers they serve has increased over time. The findings of our survey suggest that they consider executive managers as their main customers. They do not directly report to the Board of Directors and Audit Committee. However, their assessment is part of the overall evaluation report of the internal control system that is submitted by the Chief Audit Executive to the Board.

The interviewees highlighted that the capacity of IT audits to add value depends on three main factors. The first concerns the characteristics of the environment where IT auditors operate, because the support received by the IT audit unit from the CEO and the Senior Management is crucial for the success of the work performed by IT auditors. The second factor is the capacity of IT auditors to stay in touch with the organisation and understand the main risks posed by its IT system. The third factor is connected with behavioural skills, such as leadership and relationship building.

This study has two main limitations. First, we analysed only two case studies, a condition that does not offer sufficient ground for a generalization of the research findings. Secondly, our findings reflect the perspective of a single observer, even though we have tried to mitigate this limitation by analysing the company's documents during the project.

Our paper contributes to the literature on IT auditing and may suggest that IT auditing is a promising area for future research. Future researchers should undertake large-scale surveys to analyse the characteristics of IT auditing activities in banking or other sectors.

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The Influence of ERP Systems Implementation on Accounting, Organizational and Social Improvements: Evidence from Italy and the UK

Sara Trucco and Katia Corsi

Abstract The aim of this paper is to analyze the influence of Enterprise Resource Planning (ERP) systems implementation on accounting improvements and on organizational, social and governance benefits, and to extend the existing literature on this topic. Literature review highlights that the adoption of Information Technology (IT) can improve financial and non-financial performance ratios of a firm. Despite these considerations, it has not still been paid enough attention to the overall improvements that an ERP implementation can bring about on financial, organizational and social ratios. In particular, little is known about the influence of an ERP adoption on corporate governance and organizational aspects. In this paper, it is carried out an empirical study from a sample of the UK and Italian listed companies, using regression analysis and Chow test. Results show that the implementation of an ERP positively affects some relevant key performance indicators, as structural break analysis highlights.

Keywords ERP implementation · Financial ratios · Non-financial ratios · Organizational ratios

1 Introduction

ERP systems were introduced in the ‘90 s as response to a general requirement of large companies to have a single view of business management and a re-centralization of information sources. As time passed, the ERP facilitated the inter-

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enterprises relations in order to support "extended enterprise", based on the integration between firm and customers (customer relationship management), firm and vendors (supply chain management) and finally firm and sales network (sales force automation) [1, 2]. In the light of these considerations, the ERP system does not involve only informatics field, but the entire organization; ERP system is thus perceived as a strategic investment within the firm [3]. This is evident considering both benefits and critical perspectives associated to the implementation and the using of ERP.

The implementing ERP packages present several benefits on information system (such as more accurate, comprehensive, timely and available information) and on the decision process (such as greater speed and accuracy in identifying problems and opportunities and less time consumed in the decision making process) [4–7], as on the organization (such as reengineering processes, team work, vertical and horizontal integration, etc.) and on strategic aspects (such as the best response to market change and the enabling of e-commerce) [2, 8]. The relevance of these benefits has been confirmed by studies that show a positive reaction to ERP implementation announcements [9].

Most critical aspects for the success of the ERP systems regard organizational features as lack of sponsorship, skills, change management, an inter-functional vision and resistance to change [10, 11].

In a systemic perspective, all these issues are reflected in economic and financial dimensions, so many studies note that the ERP implementation contributes to: cost reduction, improved efficiency, reduced product cycle time, improved customer satisfaction [8, 12–16].

In our previous work [17] we analyzed the managerial, organizational and accounting impacts of the ERP systems and we proposed a three-dimensional model. This model focuses on leverages of the ERP advantages that are: 1. applications deployment, 2. process alignment, 3. people ownership. These leverages are reflected on motivation, consistency, operational excellence and even financial performance.

Aim of this paper is to analyze the influence of ERP systems implementation on accounting improvements, on organizational and managerial benefits and corporate governance aspects. We thus attempt to extend the existing literature on this topic, analysing not only financial performance, but even performance regarding organizational, social and corporate governance aspects.

Moreover, the analysis of the overall ERP adoptions' benefits is relevant, since costs and risks related to this strategic investment are very high and the consequent failure of the ERP implementation could lead to firms' bankruptcy [1, 15]. We conduct our analysis both for the whole sample of companies, in order to assess the general trend, and for each of them, in order to highlight some peculiar features.

Paper is organized as follows. Section 2 provides an analytical literature review; Sects. 3 and 4 define research design and sample; Sect. 5 proposes measurements of firms' performance; Sect. 6 defines the statistical model; Sects. 7, 8 and 9 propose results, final discussion and suggestions for future researches.

2 Literature Review

Literature review related to the ERP system adoption highlights some relevant streams synthesized as follows: the first analyses ERP implementation critical success factors, demonstrating the relevance of top management involvement, of human and organizational learning and aptitudes and of business process management [18–22]; the second studies the market reaction to ERP implementation announcements, finding that stakeholders perceive potential advantages of a new ERP system [9, 23] and the third investigates potential corporate performance benefits due to an ERP implementation, highlighting mixed results about it [6, 12, 24–27].

Some scholars of the third stream take into account financial ratios and other operational measures [12, 24–26] and others point out potential benefits in terms of information relevance and reliability [6] and in terms of increased quality of internal controls [28].

Most of academics agree that is important to have an holistic view of ERP implementation effects and to consider different impacts due to different features of firms [7, 15, 18].

In the following we examine the third literature stream, pointing out several contributions and discordant points of view of academics on this issue.

In the first decade of ERP use, literature focuses on IT and on managerial aspects, but no contributions point out the effects of ERP on the organizational performance. Since 2000, researchers begin to investigate this topic in order to find if benefits deriving from the ERP adoption exceed the costs (and risks) of its implementation. These studies take advantage of different methodologies [25], based on interviews (to analyze users' perception), case studies and surveys and they essentially use financial ratios.

Some of these studies, in order to emphasize the impact of ERP on financial performance, compare the performance of ERP adopting firms with a matching control group of non-adopting firms. The main studies of this type are conducted by Poston and Grabski [24], Hitt et al. [25], Hunton et al. [26], and Nicolaou [12]. Authors mainly focus on three financial performance indicators: Return on Assets (ROA), Return on Investment (ROI) and Return on Sales (ROS). In addition, Nicolaou and Poston and Grabski use Cost of Goods Sold over Sales (CGSS) and Employee to Sales (ES). Although they use a similar methodological approach and similar indicators, they have contradictory results.

Poston and Grabski, examining the effects of the ERP over a 3 years period, find no significant improvements in the main key financial performance indicators and a decrease in the following ratios: employee to revenue and cost of goods to revenue.

Nicolaou analyzes 4 years post ERP adoption and he concludes that IT benefits on the firms' performance become apparent only after a lag of approximately 2 years from the ERP adoption.

In the initial period, the ERP adopting firms do not show a better performance compared with the ERP non adopting firms. This partially confirms the IT productivity paradox, which claims little or no evidence in the relation between IT investment and firm performance

Hitt et al. state that an ERP installation takes between 1 and 3 years, and the first benefits appear after 31 months on average: this could be due to the pervasiveness of the changes related to a new ERP, the need to be multi-functional and to redesign the processes and, finally, to a high degree of managerial complexity. Authors highlight that in the first period of an ERP implementation, there is a discordant trend between internal and external performance indicators: a reduction in performance ratios and in productivity and an increase in stock market evaluation. This aspect could be explained considering market expectations about the significant and positive effects on firm performance: the market expects that ERP implementation may allow companies to improve their competitive advantage [29]. The benefits arising from the implementation of an ERP could increase along the time, especially if further modules are implemented. The authors highlight a decrease only in the ROE; however the results are consistent with increased use of equity financing before and during implementation rather than a decrease in performance.

Hunton et al. examine the effects of ERP on financial performance over a period of 3 years post ERP adoption and they confirm the productivity paradox: the performance for adopters does not change significantly from pre-to post adoption, but same performance indicators decline for non-adopters over the same time period. They also examine interaction between firm health and size and they find that large/unhealthy adopters can expect greater performance gains than large/healthy adopters, and the small/healthy adopters demonstrate better performance (ROA, ROI, and ROS) than small/unhealthy adopters.

Zaino comes to contradictory results, as he finds that 60 % of firms have benefits due to ERP implementation, whereas 40 % have a reduction in ROI [30]. Hendricks et al. argue that no or few financial benefits due to an IT adoption could be depended on high implementation costs [27].

Other researchers examine the immediate after-effects of ERP implementations, finding that these investments lead to productivity and profitability problems, especially due to the change of management during the implementations [1, 25, 26]. Authors thus confirm productivity paradox theory in their studies. This is especially true for the immediate period after the ERP system implementation.

Although scholars find different results about the ERP implementation effects, they all agree that ERP adoptions produce the full effects after a certain time-lag [24, 26, 31].

Taking into account the complex nature of an ERP system, recent studies explore the effects of the ERP adoption on both financial and non-financial performance indicators. Some scholars write about tangible and intangible benefits [12, 15, 32, 33].

We believe that this growing interest is also due to developing of performance measurement models, like the balanced scorecard, where the financial indicators

are lagging indicators (that reflect past performance) and not leading indicators (that reflect causal aspects of other nature).

Fang et al. propose the balanced scorecard to measure the effects of the ERP on firms' performance, analyzing the four classical perspectives (financial, internal process, customer and innovation and learning) [33]. In particular they explore whether different corporate objectives of ERP implementation (as reengineering processes, performing supply chain management, requiring for e-commerce, integrating ERP with other business information systems, reducing inventory costs, changing existing legacy system, requiring for multinational enterprise competitiveness, enhancing enterprise images, evoluting e-business) affect the post-ERP performance, highlighting that an ERP implementation performance, only focuses on financial results, could not be sufficient.

Uwizeyemungu and Raymond identify four possible models to assess the effects of an IT implementation (causal model, contingency model, process model and balanced scorecard model) [34]. They thus link the effects of an ERP adoption to the business process outcomes in the following way: automational effects are linked to efficiency; informational effects are linked to effectiveness and finally transformational effects are linked to flexibility. Finally they evaluate the ERP effects in a case study through the balanced scorecard model.

Gattiker and Goodhue propose a model in which they individuate some intermediate organizational benefits due to the ERP implementations that are: better information quality, more efficient internal business processes and better coordination among different unites of the firm [7].

Some researchers point out benefits of a new ERP in terms of customers' satisfaction and employees' productivity [13–16].

Qutaishat et al. through users' interviews, analyze the ERP impact on organizational and users' satisfaction in order to identify the effects on employees' productivity, service quality and innovation. Although the ERP positively influence these performances, the users' satisfaction doesn't affect the employees' productivity, because of the lack of suitable training. Cotteleer and Bendoly find a reduction in order cycle time and improvements in customer response times and delivery speeds and McAfee investigates operational benefits, such as faster transaction processing and customer response.

Other authors analyze the multidimensional effects of the ERP implementation. Florescu examines the impact of ERP implementation on firms' performance distinguishing three types of performance: the economic one, the organizational one and the human one [35].

Markus et al. in order to analyze the ERP implementation benefits, propose different dimensions including: economic, financial and strategic business ratios; business process aspects; organization's managers and employees aspects and finally organization's customers, suppliers and investors dimensions [15]. In particular they propose a measurement of organizational and human features and, through ERP adopters interviews, they find some interest benefits due to IT implementation, such as improved reporting and data access, cross-functional integration; increased management and satisfactions with IT system. Although

these perceived benefits, respondents also highlight some disadvantages, like a low user skill with new IT systems and a permanent loss of customers.

Consistent with this recent and growing interest in non-financial performance (without diminishing the relevance of the financial one) and behind the awareness of the ERP in the strategic management, we attempt to answer the following research question: does the ERP implementation affect firms' financial and non-financial performance?

Trying to fill the literature gap, we analyse the ways in which the ERP implementation could affect financial and non-financial ratios and their trends in the post implementation.

Finally we attempt to analyze the English and the Italian companies in order to highlight the different impacts of the ERP implementation attributable to different national culture. Most of the contributions, above mentioned, focus on an Anglo-Saxon context, even if some authors [36, 37] attempt to analyze the link between the ERP implementation and the cultural framework, mainly referring to the Hofstede's model [38, 39]. The scholar considers four main dimensions to define the national culture: the uncertainty avoidance, masculine/femininity, power distance and individualism/collectivism. Indeed, according to Hofstede's score (available at http://www.geert-hofstede.com/hofstede_dimensions.php) the main difference between the Italian and the English culture is the uncertainty avoidance (64 and 26, respectively), as the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity (apart from showing a little lower degree of power distance and a little higher level of masculinity[1]). The Italian culture has a greater uncertainty avoidance than the English one and this can indicate a lower propensity to introduce or fully implement changes, as an ERP system.

3 Research Design

According to literature review, the research hypotheses for our study are advanced as follows:

- Hp1: The ERP implementation is positively correlated with the main financial ratios.
- Hp2: the ERP implementation is positively correlated with organizational and social aspects.
- Hp3: the ERP implementation is positively correlated with governance aspects.

[1] The power distance has a score of 42 for Italy and 26 for the UK; the masculinity has a score of 72 for Italy and 68 for the UK; the individualism has a score of 82 for Italy and 98 for the UK. Data available in November 2013 from the Hofstede's model website.

In order to test our hypotheses, the study addresses the following research question:

- RQ: Does the ERP implementation affect firms' financial and non-financial performance?

4 Sample Selection

We conduct our study on a sample of Italian and the UK industrial listed companies that implemented a new ERP system between 2006 and 2010. The selection of firms in the two countries is justified by the aim to highlight the above mentioned differences among the two national cultures.

First, we extract all Italian and the UK industrial listed companies from ESG Asset4 (Thomson Reuters Datastream), as we are interesting in financial and non-financial ratios. At this stage we identify 166 UK listed firms and 25 Italian listed ones.

Second, we follow the selection procedure broadly used by scholars [12, 26, 40] and thus for each of them, we send an e-mail to the IT-manager in order to know if they implemented a new ERP system or had a new relevant IT upgrading between 2006 and 2010, and in the affirmative case, we ask them to point out the brand of the IT systems.

We obtain 11 e-mail answers (rate of response: 6 %) and 4 of these firms state that they adopted a new ERP or upgraded their IT systems in the sample period.

Due to few answers, we decide to download annual reports in the same time period, in which firms can announce the ERP implementation. In order to identify firms with ERP implementation, we conduct a manually content analysis, using a combination of the following terms: "implement", "IT system", "ERP", "software". This search has yielded a sample of 36 announcements of an ERP implementation and we notice that most of these disclosures are presented in the Management Discussion and Analysis (MDA), according to the literature [12]. All of the announcements regard initial implementation of the IT system or the implementation of a new and more advanced version than the previous software. Table 1 provides the distribution of ERP implementation by year in sample period, in the UK and in the Italian contexts, and it presents the final number of ERP-adopting firms used in our study (40 companies[2]). Table 2 presents a distribution of ERP vendors in the sample period for the 40 companies.

According to literature recommendation [12, 41] we build a match sample, composed of Italian and the UK listed industrial companies that did not implement a new ERP in the sample period. Each ERP-adopting firm is matched with a control one using Standard Industrial Classification code and total assets, if

[2] Final number of 40 firms is composed of 4 firms that answer by e-mail and 36 firms with announcements in their annual reports.

Table 1 Distribution of ERP implementations by year in sample period

Implementation year	Number of ERP implementation in Italy	Number of ERP implementation in the UK	Number of ERP implementation
2006	2	12	14
2007	3	5	8
2008	2	4	6
2009	4	3	7
2010	2	3	5
Total	13	27	40

Table 2 Distribution of ERP vendors in sample period

ERP vendors	Number of firms
SAP	12
Oracle	3
Proprietary software	3
Calinda software	1
Epos	1
Not specified	20
Total	40

Table 3 Descriptive statistics for adopters and non-adopters in pre-ERP adoption. (For non-adopters, we use the matching procedure described to conduct the Chow test)

	Net sales	Total assets
Adopters		
Mean	6334678.74	9807340.07
Standard deviation	11099745.10	19856616.81
Non-adopters		
Mean	5397813.32	7198842.99
Standard deviation	14620574.44	17128023.73

possible. If this matching procedure is not possible, we use a random selection. In this way, we create 40 pairs of companies. In order to assess the validity of the match sample, we send them an e-mail asking if they implemented an ERP system in the recent past and in the absence of the response we download their annual reports and we carry out the same content analysis conducted on ERP-adopting companies. We thus exclude firms with an ERP implementation in the recent past.

This match sample is created in order to exclude the external factors (such as financial crisis, institutional aspects, management turnover, etc.) that could affect the overall firms' performance. In this way, we can better underline the effects on firms' performance due to the ERP implementations or relevant IT upgrading.

The procedure results in 40 non ERP-adopting firms, composed of 5 Italian listed firms and 35 UK listed firms.

Table 3 shows useful descriptive information for adopters and non-adopters.

In order to compare the size of the two samples of companies (adopters and non-adopters) we conduct a t-test (Table 4) for net sales and total assets and results indicate that there are no statistically significant differences, at $\alpha < 0.05$, between the ERP firms and non-ERP firms in pre ERP-adoption.

Table 4 Statistically comparison between ERP firms and non-ERP firms

Ratios	T statistic	P-value
Net sales or revenues	0.890	0.423
Total assets	1.732	0.073

5 Measurement of Firms' Performance

According to our research hypotheses, firms should improve their global performance due to a new IT system.

In order to answer our research question, we use a set of financial and non-financial ratios extracted from Thomson Reuters Datastream and we measure firms' performance using three different aspects: accounting, organizational and social, and corporate governance.

Several streams of literature point out the strong link between the IT solution and the organizational environment, even if little few scholars focus on organizational impacts due to ERP implementation and most of the contributions deal the accounting ratios. As in our previous work [17], we argue that the ERP adoption strongly affects the social and the organizational contexts and, just second, it influences the accounting aspect. This may be confirmed by above mentioned studies which analyse the ERP implementation with the balanced scorecard model, demonstrating the multidimensionality of the firm's performance and the causal relationship between the financial and non-financial measures.

According to the literature, we deal the traditional accounting ratios, broadly used in similar approaches like the main indicators of the firm's financial performance. With reference to the organizational and social ratios and to the corporate governance score, the choice to select and collect them is conditioned by the availability in the database that we use (Thomson Reuters Datastream—ESG Asset 4).

The construction of these indicators would, indeed, require an overall knowledge of each firm and deep surveys to the employees in order to appreciate specific organizational impacts, such as climate or commitment inside a firm. The construction procedures in order to define the ratios are thus characterized by a high degree of discretion and subjectivity.

For these reasons we use the ratios described in the Sect. 5.1.

The size of the final sample is composed of 13 ratios for 80 industrial listed firms and for 13 years, resulting in 13,520 single entries.

5.1 Accounting Performance Ratios

Financial ratios used in the analysis are the following:

- *Return on Assets* (*ROA*) (Net Income before Preferred Dividends + ((Interest Expense on Debt − Interest Capitalized) * (1 − Tax Rate)))/Average of Last Year's and Current Year's Total Assets * 100.

- *Return on Investment Capital* (*ROI*) (Net Income before Preferred Dividends + ((Interest Expense on Debt − Interest Capitalized) * (1 − Tax Rate)))/ Average of Last Year's and Current Year's (Total Capital + Last Year's Short Term Debt and Current Portion of Long Term Debt) * 100.
- *Return on Equity* (*ROE*) (Net Income before Preferred Dividends − Preferred Dividend Requirement)/Average of Last Year's and Current Year's Common Equity * 100.
- *Return on Sales* (*ROS*) Ebit/Net Sales or Revenue * 100.
- *Cost of Good Sold divided by Sales* (*CGSS*) direct costs allocated by firms to productions, as material, labour and overhead, divided by net sales or revenues * 100.
- *Cash Flow/Sales* (*CFS*) Funds from Operations/Net Sales or Revenues * 100.
- *Working Capital/Total Assets* (*WCTA*) Working Capital represents the difference between current assets and current liabilities. It is a measure of liquidity and solvency. It is divided by total assets.[3]

5.2 Organizational and Social Performance Ratios

Organizational and social ratios used in the study are the following:

- *Assets per employee* (*APE*) Total Assets/Employees.
- *Score Client Loyalty Customer Satisfaction Transparency* (*SCLCST*) does the company report the percentage of customer satisfaction?
- *Score Community Implementation* (*SCI*) does the company describe the implementation of its community policy through a public commitment from a senior management or board member? And does the company describe the implementation of its community policy through the processes in place?
- *Employee Relations Improvement Tools* (*ERIT*) does the company have the appropriate internal communication tools (whistle blower, ombudsman, suggestion box, hotline, newsletter, website, etc.) to improve employee relations? It is a dummy variable.
- *Score Training and Development/Implementation* (*STDI*) does the company describe the implementation of its training and development policy?[4]

[3] Each financial variable and its measurement are extracted from Thomson Reuters Datastream.

[4] Each non-financial variable and its measurement are extracted from ESG Asset 4 (Thomson Reuters Datastream). Each ratio can take value from 1 to 100.

5.3 Corporate Governance Score

We use one synthetically ratio of corporate governance that is:

Corporate Governance Score (*CGS*) the corporate governance pillar measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long term shareholders. It reflects a company's capacity, through its use of best management practices, to direct and control its rights and responsibilities through the creation of incentives, as well as checks and balances in order to generate long term shareholder value.[5]

6 Statistical Models

We perform a regression analysis for each financial ratio and for each non-financial one. The statistical model applied on ERP-adopting and non ERP-adopting firms, is the following:

$Y = \beta 0 + \beta 1$ ERP Implementation Dummy $+ \beta 2$ Ebit $+ \beta 3$ Employees $+ \beta 4$ Total Assets $+ \beta 5$ Net Sales or Revenues $+ \beta 6$ Total Shareholders Equity $+ \beta 7$ Country $+ \varepsilon$ where:

- $Y =$ the dependent variable is represented by each financial and non-financial ratio, listed above. Each indicator measures the performance in ERP-adopting firms and in non ERP-adopting firms between 2000 and 2012.
- *ERP Implementation Dummy* a dummy variable, which takes value 1 for years after the ERP implementation for ERP-adopting firms and takes value 0 for years before the ERP implementation for ERP-adopting firms and for all the years for firms included in the match sample.

The year of ERP adoption is set to 0, as we assume that a new IT system has an average time to implement of around 1 year.[6] Thus, we assign the value 1 to the first post-implementation year.

- *Ebit* a control variable. It represents the earnings of a company before interest expense and income taxes. It is calculated by taking the pre-tax income and adding back interest expense on debt and subtracting interest capitalized.
- *Employees* a control variable. It represents the number of both full and part time employees of the company.

[5] Corporate governance variable and its measurement are extracted from ESG Asset 4 (Thomson Reuters Datastream). The ratio can take value from 1 to 100.

[6] Literature agrees that ERP implementation achieves first real benefits from 1 to 3 years, on average [14, 44].

- *Total Assets* a control variable. It represents the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets.
- *Net Sales or Revenues* a control variable. It represents gross sales and other operating revenue less discounts, returns and allowances.
- *Total Shareholders Equity* a control variable. It represents the sum of preferred stock and common shareholders' equity.
- *Country* a dummy and control variable, which takes value 1 for Italian firms and value 0 for the UK companies.

The control variables are ratios of size and financial health of a company, as literature agrees that a firm performance depends on these dimensional and financial aspects [26].

For the dependent dummy variable, ERIT, as it is not statistically correct to use the regression analysis, we calculate total frequencies of this variable pre and post ERP implementation, both for adopters and non-adopters. We, thus, match results for the two sample firms.

In order to validate and to strengthen our results, we perform a Chow test for each firm (both ERP-adopting firms and non ERP-adopting firms) and we test each financial and non-financial ratio that resulted statistically significant from regression analysis. The Chow test is used in time series analysis (2000–2012) to test for the presence of a structural break [42].

In order to conduct the Chow test, we calculate the differential performance in each ratio for each year (example: ROE: ((ROEt-2-ROEt-1)/ROEt-1)) and we perform the Chow test for each firm, depending on the year of the ERP implementation.

For non-adopters we use the matching procedure and we conduct the Chow test, considering the year of the ERP implementation for the correspondent ERP-adopting firm.

7 Results

7.1 Regression Analysis Results

The results of the regression analysis for accounting measures are reported in Table 5.

The results of the regression analysis for social and organizational measures are reported in Table 6.

The results of the regression analysis for corporate governance score are reported in Table 6.

Regression analysis allows us to test our research hypotheses.

As predicted in H1, the ERP implementation seems to partially improve few financial performance indicators of a firm.

Table 5 Results of the regression analysis for accounting measures

Dependent variable	β1	*p*	R^2
ROA	−0.158	0.807	0.155
ROI	2.274	0.074*	0.119
ROE	21.611	0.000***	0.056
ROS	−0.058	0.145	0.063
CGSS	0.058	0.001***	0.253
CFS	−3.518	0.007***	0.143
WCTA	−0.060	0.001***	0.075

*, **, *** indicate significant between 0.10 and 0.05; between 0.05 and 0.01; and between 0.01 and 0, respectively

Table 6 Results of the regression analysis for social and organizational measures

Dependent variable	β1	*p*	R^2
APE	−1280.873	0.002***	0.047
SCLCST	−1.396	0.398	0.047
SCI	4.434	0.116	0.055
STDI	11.041	0.000***	0.049

*, **, *** indicate significant between 0.10 and 0.05; between 0.05 and 0.01; and between 0.01 and 0, respectively

The results testing H1 (Table 5) demonstrate that the performance measures of ROE, ROI and CGSS are significantly higher for ERP-adopters than for the control firms, in the years after the IT implementation ($p < 0.001$, $p < 0.10$ and $p < 0.01$ respectively).

The performance measures of CFS and WCTA are significantly lower for ERP-adopters than for the control firms, in the years after the IT implementation (both at $p < 0.01$).

The second research hypothesis (H2) predicts that the ERP implementation also seems to partially improve organizational and social performance.

The results testing H2 (Table 6) show that the measure of APE is significantly lower for ERP-adopters than for the control firms, in the years after the IT implementation ($p < 0.01$), whereas the implementation of training and development policy (STDI) in a company is significantly higher for ERP-adopters than for the control firms, in the years after the IT implementation ($p < 0.001$).

Results for dummy variable, ERIT, show that the increase in the frequencies is 24 % for adopters and 30 % for non-adopters, so we can conclude that there are no relevant differences in the employees' relations, due to the ERP implementation.

The third research hypothesis (H3) predicts that ERP implementation improves corporate governance aspects.

The results testing H3 (Table 7) demonstrate that the corporate governance score is significantly higher for ERP-adopters than for the control firms, in the years after the IT implementation ($p < 0.001$).

Table 7 Results of the regression analysis for corporate governance score

Dependent variable	β1	*P*	R^2
CGS	9.496	0.000***	0.356

*, **, *** indicate significant between 0.10 and 0.05; between 0.05 and 0.01; and between 0.01 and 0, respectively

7.2 Chow Test Results

Results of Chow test for adopters and non-adopters (showed in Tables 8 and 9) confirm that the ERP adoption affects financial and non-financial measures of performance. In particular, 70 % of adopters have a positive structural break in, at least, one ratio (Chow test is statistically significant for 71 ratios).

Chow test results highlight that the positive effects, sometimes affect β_0 of our regression model, reflecting an one-off improvement (splitdum[7]), whereas other times they affect ratios' trend, reflecting an enduring improvement (sd_time[8]).

The remaining 30 % of adopters do not show a structural break in the sample period neither in an one-off improvement or in an enduring one.

In order to confirm previous results, we perform Chow test also for non-adopters, and tests show that 37 % of non-adopters have a structural break in the sample period (Chow test is statistically significant for 18 ratios). The remaining 63 % of non-adopters do not have a structural break in the sample period.

Results of Chow tests are relevant and consistent with our research hypotheses and with the more general results of the regression analysis, even if they require further interpretation.

From Chow test analysis, we besides attempt to describe the differences between the Italian context and the English one. In Italy, 70 % of adopters have a positive structural break in, at least, one ratio (9 firms out of 13) and also in the UK, around 70 % of adopters show a positive structural break in, at least, one ratio (19 firms out of 27), underlining an uniform general behaviour among firms. Further interpretation of each measure is conducted in order to emphasize the differences among the two countries.

In Italy, we observe a general one-off increase (splitdum) of ROE,[9] ROI,[10] CGSS,[11] CFS,[12] APE[13] and WCTA[14] in the first year after the ERP

[7] Splitdum is the β_0 of Chow test regression. T0 means the first year after the ERP implementation, t + 1 means the 2 years after the ERP implementation etc.

[8] Sd_time is the β_1 of Chow test regression.

[9] Structural break in ROE for 3 Italian firms.

[10] Structural break in ROI for 2 Italian firms.

[11] Structural break in CGSS for 2 Italian firms.

[12] Structural break in CFS for 2 Italian firms.

[13] Structural break in APE for 2 Italian firms.

[14] Structural break in WCTA for 4 Italian firms.

Table 8 Chow test results for adopters (Table only reports ERP adopter firms with a structural break in at least one ratio)

Adopters	Ratio	sd_time	Splitdum
1 (UK)	ROI	1.22827***	−13.3112***
		(t + 2)	(t + 2)
	STDI		6.61055*
			(t0)
	APE		1.83681*
			(t0)
	CFS	−0.927591*	6.36529*
		(t0)	(t0)
	CGSS	−0.09498***	0.984734***
		(t + 2)	(t + 2)
	WCTA	−0.115769*	1.17262*
		(t + 2)	(t + 2)
2 (UK)	ROE		0.738350**
			(t + 1)
	ROI	−2.46260***	18.6534***
		(t0)	(t0)
	WCTA	0.610490*	
		(t0)	
3 (UK)	CGSS	0.165937*	
		(t0)	
	WCTA	8.75868**	−83.3041**
		(t + 2)	(t + 2)
4 (UK)	ROI	0.222496*	
		(t + 2)	
5 (UK)	ROE	1.48918*	−16.4920*
		(t0)	(t0)
	ROI	1.59755*	−176.943
		(t0)	(t0)
	CGS	0.490850**	−4.78655**
		(t0)	(t0)
	CGSS		−0.820275*
			(t0)
6 (UK)	ROE	−0.30422*	2.59735*
		(t + 1)	(t + 1)
	ROI	−0.338046**	3.23802*
		(t + 2)	(t + 2)
	CGSS	−0.525341***	5.19007***
		(t + 2)	(t + 2)
	WCTA	−2.29897***	23.9945***
		(t + 1)	(t + 1)
7 (UK)	ROE	−2.3032***	24.5477***
		(t + 2)	(t + 2)
	CFS	−1.09879**	11.1714**
		(t + 2)	(t + 2)

(continued)

Table 8 (continued)

Adopters	Ratio	sd_time	Splitdum
	CGSS	−0.230776*	2.15715*
		(t + 1)	(t + 1)
	WCTA	2.53302**	−26.3601***
		(t + 2)	(t + 2)
10 (UK)	ROI	−3.92956**	47.2019**
		(t + 3)	(t + 3)
	CGS	0.229689*	−2.02896*
		(t + 1)	(t + 1)
	CFS	2.22577*	−22.6048*
		(t + 2)	(t + 2)
11 (UK)	ROE		0.493760*
			(t0)
	CGS	1.21498**	−7.43419**
		(t0)	(t0)
	STDI	2.51412***	−15.2132***
		(t0)	(t0)
	CGSS	−0.19186***	1.05727***
		(t0)	(t0)
12 (UK)	CGSS	−0.0460328*	0.491514*
		(t0)	(t0)
14 (UK)	ROE	0.83515**	−9.7107**
		(t + 2)	(t + 2)
	ROI	0.785501*	−9.41461*
		(t + 2)	(t + 2)
	STDI	−2.44404***	12.0509***
		(t0)	(t0)
	APE	−0.980996**	10.6669***
		(t + 2)	(t + 2)
	CGSS	−0.898578**	9.87827***
		(t + 2)	(t + 2)
15 (UK)	ROE	−0.864776**	10.1778**
		(t + 3)	(t + 3)
	ROI	−0.624511**	7.05326**
		(t + 3)	(t + 3)
	STDI	2.61337***	−18.2039***
		(t + 1)	(t + 1)
	CGSS	−0.329285**	3.62680**
		(t + 1)	(t + 1)
16 (UK)	STDI	2.61337***	−18.2039***
		(t0)	(t0)
	CFS	−1.32993***	15.2377***
		(t + 2)	(t + 2)
17 (UK)	CFS	0.358274***	−3.42680***
		(t + 1)	(t + 1)
	CGSS	0.393572***	−4.06022***

(continued)

Table 8 (continued)

Adopters	Ratio	sd_time	Splitdum
		(t + 2)	(t + 2)
	WCTA	−8.49852*	70.1364*
		(t0)	(t0)
18 (UK)	ROE	5.6548***	−39.9163***
		(t0)	(t0)
	ROI	5.54902***	−393.086
		(t0)	(t0)
19 (UK)	WCTA	0.987729**	
		(t0)	
20 (UK)	CGS	−0.231789**	1.24922**
		(t0)	(t0)
	STDI	0.0853988*	
		(t + 1)	
	CFS	2.91164***	−31.4610***
		(t + 2)	(t + 2)
	CGSS	−0.423876*	4.63176*
		(t + 2)	(t + 2)
25 (UK)	CFS	27.2485***	−271.070***
		(t0)	(t0)
27 (UK)	CGSS	0.0394700*	−0.331926*
		(t0)	(t0)
	WCTA	0.973514***	−8.66983***
		(t0)	(t0)
29 (Italy)	WCTA	−3.92055*	44.3419*
		(t + 2)	(t + 2)
30 (Italy)	CFS	−0.373351**	4.08520**
		(t + 3)	(t + 3)
31 (Italy)	ROE	−0.45342***	3.22372**
		(t0)	(t0)
	ROI	−2.46479***	28.8002***
		(t0)	(t0)
	CGSS		0.576942*
			(t0)
33 (Italy)	APE	−0.76895***	8.23499***
		(t0)	(t0)
34 (Italy)	CFS	0.216130*	−1.84766*
		(t + 1)	(t + 1)
	CGSS	−0.0776625*	0.626639**
		(t0)	(t0)
	WCTA	4.85248**	−48.8509**
		(t + 2)	(t + 2)
35 (Italy)	ROE	67.8365***	−700.998***
		(t0)	(t0)
	ROI	−1.92368***	20.2705***
		(t0)	(t0)

(continued)

Table 8 (continued)

Adopters	Ratio	sd_time	Splitdum
36 (Italy)	ROE	−20.1968***	243.925***
		(t + 1)	(t + 1)
37 (Italy)	APE	−0.289634**	3.09317**
		(t + 1)	(t + 1)
	WCTA	−1.09766*	10.8427*
		(t + 1)	(t + 1)
40 (Italy)	WCTA	−12.0618***	131.001***
		(t + 2)	(t + 2)

*, **, *** indicate significant between 0.10 and 0.05; between 0.05 and 0.01; and between 0.01 and 0, respectively

implementation, even if results show an enduring reduction (sd_time) of the same ratios after the post years implementation. Moreover CGS and STDI seem to not have any significance structural breaks in the 4 years post-implementation for Italian companies.

In the UK, we observe mixed results, since some firms show an enduring increase of ROI and ROE (5 firms and 3 firms respectively) after the first year of ERP systems adoption, while the remaining firms show an enduring reduction of ROI and ROE (4 firms and 3 firms respectively) in the same period and, together, an one-off increase of the two mentioned financial indicators especially after the 2 years of the ERP adoption.

For WCTA, APE, CGSS and CFS, we have similar results in the two countries. In particular, the UK firms demonstrate to have both an one-off and an enduring reduction of WCTA.[15] Most companies have an enduring reduction of CGSS[16] after the first year of the ERP adoption, demonstrating that this ratio tends to decrease along the time. All companies in our sample behave the same for APE[17]; results highlight a general enduring reduction and an one-off increase of this ratio in the post-implementation. For CFS, chow test shows mixed results in the UK, since 4 English firms have a positive structural break in the trend of this ratio and together an one-off reduction after the ERP adoption, while the results are inverse for other 3 firms.

Moreover in the UK, firms have a positive structural break also for CGS[18] and for STDI[19] that seem to have no impact for the Italian companies.

[15] Structural break in WCTA for 8 British firms.

[16] Structural break in CGSS for 12 British firms.

[17] Structural break in APE for 2 British firms.

[18] Structural break in CGS for 4 British firms.

[19] Structural break in STDI for 6 British firms.

Table 9 Chow test results for non-adopters (Table only reports non-ERP adopter firms with a structural break in at least one ratio)

Non-adopters	Ratio	sd_time	Splitdum
4 (UK)	ROE	1.27728***	−13.5095***
		(t0)	(t0)
	APE	−0.215502**	2.20671**
		(t0)	(t0)
	CGSS	0.068278***	0.691353***
		(t0)	(t0)
10 (UK)	CGSS	0.210205***	−2.29669***
		(t0)	(t0)
11 (UK)	ROI	−1.36333**	8.97337**
		(t0)	(t0)
13 (UK)	APE	−0.139410**	1.24240**
		(t0)	(t0)
14 (UK)	CGSS	−0.560357**	3.64248**
		(t0)	(t0)
20 (UK)	STDI	2.51412***	−15.2132***
		(t0)	(t0)
21 (UK)	WCTA	2.02992**	−10.0513**
		(t0)	(t0)
25 (UK)	WCTA	−1.37151**	14.7093**
		(t0)	(t0)
26 (UK)	ROI	-58.6984**	527.601**
		(t0)	(t0)
28 (UK)	WCTA	−6.20909***	66.1062***
		(t0)	(t0)
29 (UK)	APE	0.266596***	−2.34269***
		(t0)	(t0)
30 (UK)	ROI	3.46633**	−34.1343**
		(t0)	(t0)
36 (Italy)	STDI	−3.14046**	31.0328**
		(t0)	(t0)
	CFS	0.287147**	−2.30027**
		(t0)	(t0)
37 (Italy)	CFS	6.54290**	−70.2276**
		(t0)	(t0)
40 (Italy)	ROI	7.02940**	−79.2585**
		(t0)	(t0)

*, **, *** indicate significant between 0.10 and 0.05; between 0.05 and 0.01; and between 0.01 and 0, respectively

8 Discussion

According to the literature, the ERP adoption is a huge investment in a company, that produces interesting effects on the overall firm's performance.

Previous researches mostly analyse financial performance and few authors attempt to explore non-financial indicators.

Testing our research hypotheses, we answer our research question (*Does the ERP implementation affect firms' financial and non-financial performance?*).

Findings of the present study show some interesting effects in the financial, organizational, social and corporate governance measures of listed firms, that could be related to the ERP implementation.

In particular, through the regression analysis, a new IT system seems to improve the trend of some key performance indicators, traditionally based on earnings measurements, such as ROE and ROI, confirming some previous literature streams and our hypotheses. Although these considerations, other financial indicators, like ROA and ROS are not statistically significant in our regression analysis.

The regression analysis also shows a negative correlation between ERP adoption and WCTA and this result could be interpreted through the ERP effect on the inventory, that could produce a reduction in the working capital. Several studies [2, 8, 12, 43] show a reduction in the product cycle time and in the inventory due to the ERP adoption.

Surprisingly, we also find a positive correlation between ERP adoption and CGSS and a negative correlation between ERP adoption and CFS. CGSS result seems to be contradictory with the expected IT benefits, but it is consistent with some literature streams that highlight the "paradox productivity" [26]. The CFS result, instead, seems to be more difficult to interpret, even if this result is potentially consistent with the regression analysis result about CGSS.

In order to better understand these results, especially because some of them appear singular and innovative, we conduct the Chow test, that highlights the trend of ratios for each firm, in the sample period. The choice of use Chow test is due to our assumption that single-firm analysis could reveal some key issues of ERP adoption effects.

Other results from our regression model point out a negative correlation between APE and ERP adoption and this could be positively interpreted as an increase of the structural efficiency. This result is consistent with the previous result about WCTA, in terms of possible inventory's reduction.

Further, regression analysis shows that the ERP adoption seems to have a positive effect on just one social performance ratio: STDI. This measure summarizes if the company describe the implementation of its training and development policy. Although this consideration, nothing more can be stated, as other social and organizational ratios, used in this study (SCLCST and SCI), seem not to be affected by new IT systems.

Regression results also demonstrate a general benefit on corporate governance score, in terms of company's systems, processes and management practices. Considering the definition of corporate governance score taken from ESG Asset 4—Thomson Reuters Datastream, that recalls the internal control system concepts, this result could be associated to a general improvement in managerial processes, due to the ERP implementation.

As mentioned above, in order to deepen our regression results, we use Chow test to analyse the ratios' trend for each firm along the time.

For financial ratios, such as ROI and ROE, we find a diversified trend for ERP-adopting firms. In detail, results show that along the 3 years post adoption, some companies increase variation in the trend of ROI and ROE, while other firms have a great differential performance concentrated in 1 year (generally in the first year or in the second year post implementation). Adopters with an increase of these ratios' trend along the time, consistently with our regression analysis, also have a negative differential performance in the same year (probably due to the huge investment of a new IT system).

Similar considerations can be carried out on WCTA, as we notice a diversified trend for adopters. However, we find that most companies have a decrease in the working capital in the 3 years post-implementation, confirming regression analysis and previous researches about the reduction of the inventory.

Finally the remaining financial ratios (CGSS and CFS) require further explanations, through Chow test. In particular, we often observe an one-off increase in CGSS in the 2 years post-implementation, consistently with regression results. The trend for the same ratio, instead, is mostly negative, so we can conclude that in recent years post-adoption, firms are characterized by an increase in the cost of goods sold, even if this cost seems to decrease along the time, consistently with some literature streams.

For CFS indicator, we notice that each adopter has a differential trend. In general we can say, that if cash flow increase one-off in the 2 years post-implementation, the trend of this ratio along the time, decreases and vice versa. We argue that this result is particularly difficult to interpret as CFS has a non-homogeneous behaviour in our sample firms and the literature about it has a gap. We therefore assume that CFS depends on the short term liquidity policy within a firm.

Regarding social and organizational performance measures, Chow tests confirm the validity of the regression analysis, as adopters always show a negative trend in the assets per employees (APE) and a positive trend in training and development policy ratio (STDI) just for the UK companies.

Finally, regarding governance aspects, Chow test also confirms the regression analysis, as we find an increase in the trend of the CGS along the sample period for the UK firms.

Chow tests allow us to analyze the differences among the two countries, underlining that in the Italian sample we do not have any effects in STDI and CGS, whereas these measures show impacts in the UK companies. This result seems to be consistent with the different national cultures highlighted by the Hofstede's model. Indeed, the higher degree of uncertainty avoidance in the UK firms highlights a higher propensity to introduce new tools and instruments that could bring about radical changes within the UK firms. In this perspective, the UK firms are likely to support huge investments in training and development (this explains the different trend of STDI between Italy and the UK) and even to stimulate changes in the management philosophy and approach, until to improve the corporate governance score (CGS).

Considering our overall analysis, we point out a weakness of our study, as a little percentage of matching control firms too have a structural break in the sample period. The evidence that some non-ERP adopting firms have a variation of the ratios along the sample period could be due to external factors, not considered in this study, that affect the trend of ratios of each listed company.

Finally, we are aware that the stronger benefits from the ERP adoption could be introduced to the conclusive phase, as the financial and human efforts are very huge in the first years after the IT implementation. This could be partially explained by literature about the "paradox productivity" theory, that highlights the difficulties to identify IT benefits in the immediate post adoption period and the contrasting behaviours of several ratios with respect to positive expectations.

9 Suggestions for Future Researches

We identify two main future research streams on this topic: the first one is related to the operative method in order to correctly select adopters and non-adopters and the second one is related to analyze the ERP benefits along time, taking advantage from Chow test method.

In particular, we are aware that the effects of each IT system could vary considerably from firm to firm, and from country to country, thus future researches could explore the different effects of an ERP implementation due to different countries and to different industrial sectors. We also suggest to explore effects on firms' performance due to different types of ERP vendors or number of the implemented ERP modules.

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Part II
Organizational Change, Innovation Management and Impact of ICT

A Bibliometric Study of the Literature on Technological Innovation: An Analysis of 60 International Academic Journals

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Abstract This paper aims to contribute to the debate on technological innovation, organization and work. Although technological innovation remained a debated topic in the academic literature during the past years, its implications for organizational processes seem still not sufficiently theorized and empirically investigated. By using two complementary journals' rankings a search in the ISI Web of Science platform from 1985 through 2013 was performed. To analyze the 998 scientific retrieved contributions a bibliometric analysis has been conducted, adopting also Social Network Analysis tools. Our results reveal a significant growth of the technological innovation literature over the investigated period, the multidisciplinarity of the field and, particularly, the relevance of management and business and economics contributions. Overall, this study offers a broad overview of the literature on technological innovation and emphasizes the opportunity to investigate the role of technological innovation within the organizational life.

Keywords Technological innovation · Organization · Work · Literature review · Bibliometric analysis

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1 Introduction

Over the years theoretical perspectives and empirical research on technological innovation have developed together with theoretical and empirical studies on organization [1]. Moreover, significant changes have led both academics and practitioners to reconsider technology and organization's roles and functions. In response to these changes, scholars started to investigate the implications of technological innovation for the organization [2, 3].

'Innovation' can be defined as the production or adoption, assimilation and exploitation of an idea or behavior that is new for the organization. It can be a new product, a new service, a new process, a new business model, a new technology, or a new administrative practice [4, 5]. With specific reference to 'technological innovation', several authors define it as the development of new products and processes, or of substantial technological improvements in existing products and processes [6, 7]. Particularly, when the innovation is not exclusively related to products, but refers to processes, it implies changes in organizational structures, in the organization of work, but also variations in techniques and tools. The latters, in turn, lead to changes of the required skills and the professional roles [8, 9].

Given these premises and regardless of the extent and comprehensiveness of the adopted definition, the importance that technological innovation has for companies dealing with a constantly evolving environment seems undeniable. There appears to be consensus, both in the academic and in the business world, about whether the technological knowledge and the innovative capabilities are key resources for companies, as well as one of the main determinants of their performance [4, 6, 7, 10, 11]. Moreover, the relevance of technological innovation is due to its impact on the economic and social life, both at the macro and at the micro level [4, 12].

Nevertheless and as already noted by some authors [13–15], although the process of technological innovation [4, 16] and its results increasingly permeate the modern enterprise, the link between technological innovation, organization and work seems still not sufficiently theorized and empirically analyzed. Particularly, the need to investigate the connection between technological innovation, organization and work is emphasized by some recent literature reviews [14, 17]. The outcome of these reviews shows that, after a great deal of attention devoted to technology in organization studies in the 50 s of the last century, there has been a decline in the interest to this topic. This trend has become even more marked in the last two decades. Orlikowski and Scott [17], for instance, show that from January 1997 to December 2006 more than 95 % of the articles published by the so called top management journals does not take into account the role and impact of technology in the organizational life. Furthermore, the majority of the economic and managerial literature, by Schumpeter onwards [18, 19], appears to be mainly focused on the determinants of innovation [4, 6, 20] while neglecting the effects and the influences that innovation unavoidably exerts on organizational processes and people. This lack of attention turns out to be problematic especially if one considers that the use of new technologies: (a) changes both the structural and

social aspects within organizations; (b) mediates and influences the activities of firms, industries and economies [14].

This paper lies within a wider research aimed at understanding to what extent and how the technological innovation affects the production processes of organizations in different sectors changing their structures, roles, decision-making processes, systems and logics of human resources management. Particularly, the literature review presented here contributes to the debate aforementioned with a twofold purpose:

1. On the one hand, the aim is to offer an overview of the last 30 years' literature concerning technological innovation—both organizational literature and not—and to show how the meaning and importance of this concept evolved;
2. On the other hand, the goal is to identify and categorize—both in time and conceptually—areas of study and research—even future research—about technological innovation, organization and work.

2 Method and Data

The extensive analysis of the existing literature has been articulated in three main steps: (i) identification of the international journals on which carrying out the analysis; (ii) identification of the keywords to use for the scientific contributions' search on the set of journals selected; (iii) use of the social network analysis (SNA)'s tools to perform the bibliometric analysis of the publications retrieved according to the previous stated criteria.

Concerning the first step, we focused not only on top management (or business) journals—as previous literature reviews have done [14, 17]—but we identified 60 journals taking into account two different and complementary rankings:

- 45 journals of the 'Financial Times' ranking (FT45)[1]: this is a rating whose importance is widely recognized in the academic world and especially by management scholars [21];
- 15 journals of the 'Technology Innovation Management Journals' ranking (TIM): this is a ranking developed by Thongpapanl and published, in its last version, on the journal 'Technovation' [22]. This rating has attracted interest and attention, especially in the last two decades [23–25].

We chose the ISI (Institute for Scientific Information) Web of Science (ISI-WoS)[2] platform to search and retrieve publications, since we had checked the presence of all the 60 selected journals in its databases and following previous scientific works (for example see Knoben and Oerlemans [26]). Afterwards, we

[1] http://www.ft.com/intl/cms/s/2/3405a512-5cbb-11e1-8f1f-00144feabdc0.html#axzz2YYYxf4nd.

[2] http://apps.webofknowledge.com.

identified "technolog* innovation*" as the keyword to use in the "TOPIC" field of the query. On ISI-WoS, the words specified in the "TOPIC" field are searched in the title, abstract and keywords of each contribution published in one of the sixty journals. The asterisk in the keyword indicates zero or more characters (e.g. technology, technologies or technological). The search of the selected keyword in all the 60 journals from 1985 to now[3] returned 998 results.

Finally, a bibliometric analysis has been conducted on the 998 scientific retrieved contributions, adopting also Social Network Analysis (SNA) tools. As a matter of fact, the use of SNA tools for the literature review, especially within the social sciences [27, 28], allows to examine the behavior of a scientific community (or more than one community) based on the data of the related publications [29].

3 Analysis and Results

During the observed period, a total of 998 scientific contributions were published, consisting of 806 (81 %) articles, 43 (4 %) proceeding papers, 51 (5 %) book reviews, 69 (7 %) reviews and 26 (3 %) editorials, (the dataset also includes one note, one correction and one meeting abstract). All the document types were kept in the dataset since our purpose is to provide a broad overview of the literature on technological innovation and because all of them make a substantial contribution to the literature. Concerning the distribution of the 998 publications in the selected journals, 78 % of them have been published on journals belonging to the TIM ranking—particularly, 144 (14 %) appear on Research Policy, 121 (12 %) on Technovation, 101 (10 %) on International Journal of Technology Management—, whereas the remaining 22 % on the FT45 ranking's journals—for example, 29 (3 %) have been published on Organization Science, 26 (3 %) on Strategic Management Journal and 15 (1.5 %) on Management Science.

The examination of the 998 publications involves two steps: (i) the analysis of some descriptive indicators (e.g. the trend of the number of publications and citations per year), and (ii) the use of SNA tools with the aim to discover some interesting insight about the content of the selected contributions.

3.1 Descriptive Analysis

Figure 1a reports the number of publications per year from 1985 to 2013. As shown in this figure the number of publications increases through the years, especially during the period 2006–2012 (reaching 84 publications in 2012).

[3] 1985 was selected as the starting point because the chronological coverage of ISI dates from this year. The search has been conducted for the last time on August 7th, 2013 in order to have a sample updated as much as possible to the latest contributions available on the database ISI.

More in general, three distinct time periods could be identified:

- *emerging* stage (from 1985 to 1991): this first time period is characterized by a very moderate production (between 4 and 7 publications per year);
- *growing interest* stage (from 1992 to 2005): on average, the number of publications is higher than in the previous phase and fairly constant;
- *strengthening* stage (from 2006 to 2012): after 2005, a jump is evident in the number of publications. The consistent growth of scientific contributions during this phase shows that—in the last years—there is a strong and consolidated interest in the scientific community on this topic.

The data obtained for the current year (2013) are partial, since we conducted the search on August 7th, 2013.

The second descriptive indicator used in our analysis is the number of citations per year. As shown in Fig. 1b, the number of citations increases almost exponentially during the years. Also in this case we considered the data obtained for the current year (2013) as partial. The trend of the number of citations per year could be considered a proxy of the impact of these contributions on the whole research community.

Particularly, citation patterns are relevant to see which publications, and what type of research, has been influential on the literature (a sort of building blocks). On this regard, Table 1 indicates which publications are most often cited within our dataset. The table reports the publications that are cited at least 50 times by the contributions belonging to the dataset. We arbitrarily chose this cutoff point, resulting in this core set of 18 contributions, namely the most influential publications in the specific field of technological innovation.

The most cited contribution, with 147 citations, is the article of Cohen and Levinthal, published in 1990 in Administrative Science Quarterly; three additional publications (two articles and one book) have more than 100 citations. Moreover, two of the most cited articles (the grey rows in the table) belong to our dataset of 998 publications: the article of Teece (1986) with 141 citations and the work of Garcia and Catalone (2002) which obtained 50 citations. Referring to the sources of the most cited references, the table highlights that four articles are published in Research Policy (TIM ranking); three are published in Administrative Science Quarterly (FT45 ranking); two most cited publications belong to Organization Science (FT45 ranking) and other two papers are published in Strategic Management Journal (FT45 ranking). These results validate the value of combining the two rankings that we have chosen for our analysis.

Furthermore, on the basis of the three time periods identified before, it is possible to highlight the impact of each cited reference on one (or more) specific time interval. Particularly, the first three references listed in Table 1 are also the most cited references in the "strengthening" stage, and among them Nelson and Winter (1982) and Cohen and Levinthal (1990) are also the first and the third most cited ones in the "growing interest" stage. While the citations of all the references shown in the table are quite homogeneously distributed among the two more recent stages, only three of them result quite relevant for all the three time periods: Dosi (1982), Nelson and Winter (1982), and Schumpeter (1934).

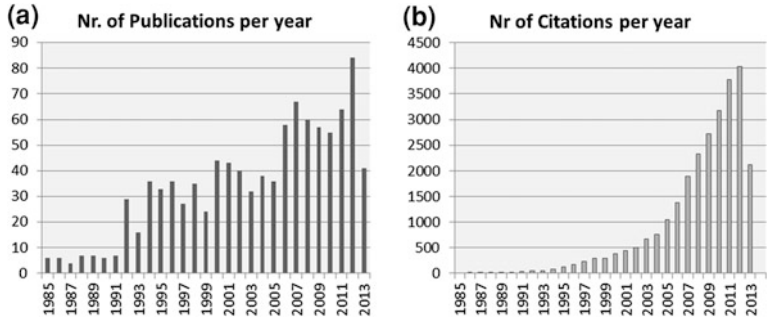

Fig. 1 Number of publications (**a**) and citations (**b**) per year

3.2 Investigation Based on SNA

Additional insights emerged from the Social Network Analysis of the publications' distribution by Web of Science categories (Fig. 2) and research areas (Fig. 3).

Overall, the sample under examination appears characterized by a balanced representativeness. Particularly, our resulting dataset of 998 publications could be classified into 14 Web of Science subject categories which reflect the way in which journals are grouped. These categories are assigned by the ISI staff on the basis of a number of criteria including the journal's title and its citation patterns. The three most common categories are 'management' (854 contributions; 85.6 % of the total), 'business' (431; 43.2 %) and 'engineering industrial' (293; 29.4 %), followed by 'planning development' (250; 25.1 %), 'operations research and management sciences' (245; 24.5 %). The size of the nodes represented in Fig. 2 reflects this information. As 'management' and 'business' subjects are at the top of this ranking, this implies a more managerial rather than technical tradition in technological innovation. This result supports the decision of combining the two selected journal rankings. Moreover, the figure shows the linkages among the categories and the thickness of the ties indicates how many publications are classified in both categories. We can observe that 308 contributions are assigned to both 'management' and 'business' categories; other two categories pairs are connected by more than 200 publications—'management' and 'engineering industrial' (293) and 'management' and 'operations research and management sciences' (245). The distribution of the publications by a variety of categories—including also 'Multidisciplinary Sciences', 'Ethics', 'Business Finance', 'Applied Psychology'—gives us an idea of the multidisciplinarity of the technological innovation field. This diversity of subject categories should suggest researchers, seeking information on technological innovation, to expand their search to different and even general purpose journals.

Whereas subject categories are assigned to each scientific contribution on the base of the journal of publication's characteristics, ISI-WoS attributes to each publication also one or more research areas, namely article-based parameters reflecting the specific field of the study.

Table 1 The most cited references

Author(s)	Year	Article/Book title	Source[a]	Cit.
Cohen W.M. and Levinthal D.A.	1990	Absorptive Capacity: A new perspective on learning and innovation	ASQ	147
Teece D.J.	1986	Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy	RP	141
Nelson R.R. and Winter S.G.	1982	An evolutionary theory of economic change	HUP	141
Henderson R.M. and Clark K.B.	1990	Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms	ASQ	101
Tushman M.L. and Anderson P.	1986	Technological discontinuities and organizational environments	ASQ	99
Teece D.J., Pisano G. and Shuen A.	1997	Dynamic capabilities and strategic management	SMJ	82
Dosi G.	1982	Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change	RP	77
Barney J.	1991	Firm resources and sustained competitive advantage	JoM	72
Von Hippel E.	1988	The sources of innovation	OUP	71
March J.G.	1991	Exploration and exploitation in organizational learning	OS	67
Pavitt K.	1984	Sectoral patterns of technical change: Towards a taxonomy and a theory	RP	63
Schumpeter J.	1934	The theory of economic development	HUP	53
Kogut B.	1992	Knowledge of the firm, combinative capabilities, and the replication of technology	OS	53
Wernerfelt B.	1984	A resource-based view of the firm	SMJ	53
Rogers E.M.	1995	Diffusion of innovation	FP	52
Damanpour F.	1991	Organizational innovation: a meta-analysis of effects of determinants and moderators	AoMJ	51
Garcia R. and Calantone R.	2002	A critical look at technological innovation typology and innovativeness terminology: a literature review	JPIM	50
Abernathy W.J. and Clark K.B.	1985	Innovation: Mapping the winds of creative destruction	RP	50

[a] *ASQ* Administrative Science Quarterly; *RP* Research Policy; *HUP* Harvard University Press; *SMJ* Strategic Management Journal; *JoM* Journal of Management; *OUP* Oxford University Press; *OS* Organization Science; *FP* The Free Press; *AoMJ* Academy of Management Journal; *JPIM* Journal of Product Innovation Management

Figure 3 shows the linkages among the nine research areas (the total number of the possible research areas is 151) in which the contributions of our sample have been classified. The most recurrent research areas are: 'business and economics' (998 publications; 100 % of the total), 'engineering' (394; 39.5 %), 'public administration' (250; 25.1 %). The figure also points out that 'business and

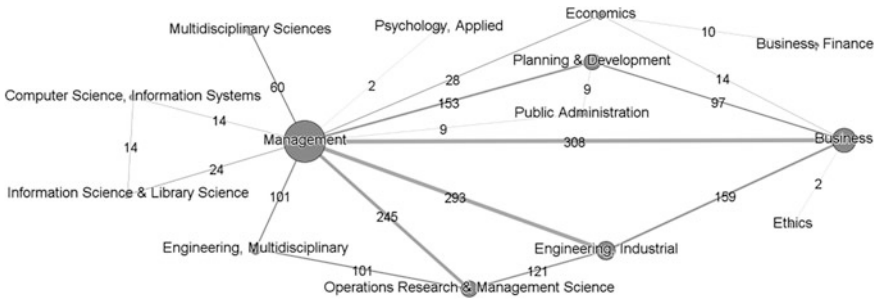

Fig. 2 ISI subject categories network

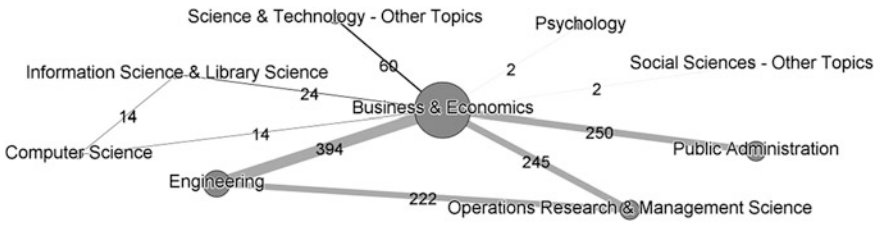

Fig. 3 Research Areas network

economics' presents a huge linkage with 'engineering' (394 publications are common to the two areas), 'public administration' (250) and 'operations research and management science' (245). There are very few common publications (only 2) between 'business and economics' and both 'psychology' and 'social science-other topics'.

On the basis of what emerges by Figs. 2 and 3, the multidisciplinary of the research on technological innovation is confirmed, avoiding the risk to mostly (or exclusively) consider the Information Technology (IT) perspective.

Since both subject categories and research areas are defined by ISI-WoS, we decided to perform a third analysis, similar to the previous ones, but based on the keywords defined for each contribution by the authors. The keywords analysis provided an overview of the research trends, since keywords reflect the focus of individual contributions. For this purpose we extracted the most popular keywords used in the dataset and we showed them in a graph (Fig. 4) in which they represent the nodes.

The tie between two of them indicates that they are mentioned in the same publication; whereas the thickness is related to the number of contributions in which the pair appears. In Fig. 4 we present the 32 most frequently used keywords. The size of each node (and its label) represents the occurrence of keywords within the dataset. It arises that 'performance' (139), 'technological innovation' (116), 'research and development' (119) are the three most recurrent keywords. Furthermore, there is also 'technological-innovation' keyword (87 occurrences) that can be viewed as synonym of 'technological innovation'. Considering the occurrences of

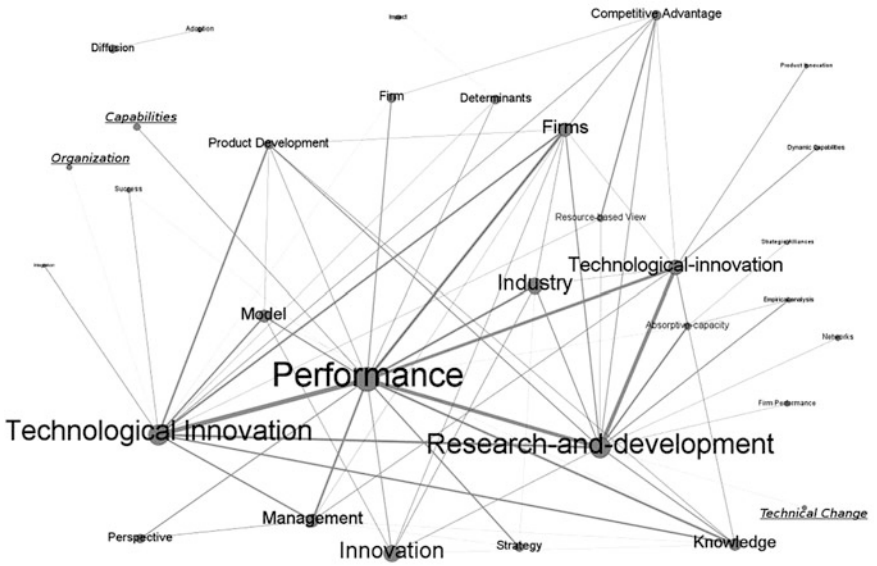

Fig. 4 Keywords occurrence network

both keywords (203), they reach the greatest value compared to the other ones. The most popular keywords pairs are 'performance/technological innovation' that recurs 37 times; both the pairs 'performance/research and development' and 'technological-innovation/research and development' recur 32 times. In particular, the keyword 'performance' is often matched with 'firms' (26 times); it recurs 23 times also with the keywords 'management', 'industry' and 'knowledge'. Topics related to 'technological innovation', instead, are: product development (the pair recurs 20 times), firms (22 times) and knowledge (21 times). Finally, the keyword 'research and development' is also linked to 'absorptive capacity' 21 times.

Overall, the results obtained by the keywords occurrence analysis show that some relevant issues about the research on technological innovation should be addressed. On the basis of our analysis, the linkages between technological innovation and 'organization', 'capabilities' and 'technical change', have hitherto received relatively little attention in the literature. It is surprising also to note the absence of some topics traditionally linked to technological innovation in organizational studies, such as design, employment, task or, more in general, job [30–32].

4 Conclusion and Next Steps

We started this article by highlighting that there is not much clarity about the actual level of progress that has been made in studying the link between technological innovation, organization and work. Our analysis was motivated by two

observations: first, technological innovation and its determinants have remained a debated topic in the academic literature during the past years and, second, the same literature has neglected the role and impact of technological innovation on the organizational processes. Accordingly, we approached our analysis with a twofold objective: to provide an overview of the existing literature on technological innovation and to identify extant or potential areas of study and research on technological innovation, organization and work.

Although earlier studies have already explored the technological innovation literature's state of the art, our analysis extends and complements these findings by using a more comprehensive set of journals, as well as bibliometric methods of analysis. Particularly, the descriptive and social network analysis conducted in this study show a significant growth of the technological innovation literature during the years, the multidisciplinarity of the field and, particularly, the relevance of management and business and economics contributions. The central point of the paper is to highlight the need for more theoretical and empirical exploration of technological innovation within the organizational life. This is highlighted by the analysis conducted on the dataset of 998 contributions selected from 60 international academic journals and particularly emphasized by the keywords occurrence analysis. Even if at this stage of the research, it is difficult to draw any strong conclusions concerning the possible developments in this field, we are pretty sure that the exploration of the relationship between technological innovation, organization and work will be an interesting and promising future area of research.

The next steps of analysis should include the refining of the keywords used for selecting the dataset. Furthermore, the use of additional Social Network Analysis tools both for recognizing clusters of articles in the sample depending on whether they have common references or not (co-reference analysis—[33, 34]), and for identifying the theoretical building blocks using the recurring quotes (co-citation analysis—[35]) also conducting a longitudinal study on the three different stages identified before. Moreover, the bibliometric analysis could be used to examine the evolution in time of the knowledge creation process within the sample of the selected articles (cross-citation analysis—[36, 37]). Future works could thus identify newly emerging topics and observe the temporal evolution of the already emerged insights. Finally, a qualitative-interpretative analysis of a limited subset of articles, identified during the phase of bibliometric analysis as core theories or cluster's representatives, should be conducted.

Overall, this paper offers a broad overview of the literature on technological innovation and highlights a lack of attention on the relationship between technological innovation, organization and work. It suggests promising future research paths which could have both theoretical and practical implications.

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DsNA: A Database for Strategic Network Analysis in Italy

Mario A. Bochicchio, Barbara Livieri, Antonella Longo and Pierluca Di Cagno

Abstract Cooperation among firms is universally seen as a catalyst of competitive advantages. However, 50 % of alliances fails, often due to the lack of tools and methods to quantitatively track the effects of alliances on firms and to link goals and KPIs outside of traditional organizational boundaries. Nonetheless, performance management and performance measurement have a key role in the assessment of alliance's goals achievements and of the impact of alliances on firms. This concept has been included in DsNA, a tool for the analysis of strategic partnerships, that we developed with the aim of providing firms, networks' managers, researchers and policy makers with a more structured and complete information. In particular, the innovative aspect consists of the creation of an online service which enables KPIs monitoring and benchmarking, thus simplifying a possible reconfiguration of network dynamics.

Keywords Strategic alliances · Database · Enterprise modelling · Performance measurement · Online database

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1 Introduction

Cooperation among firms is gaining ever more importance due to globalization, which has forced businesses to rearrange their organizational structures and to focus on flexible forms of aggregation, such as strategic alliances (SAs). Indeed, in some circumstances, SAs can contribute to an increase in performance [1, 2] and can lead to an increase in the economic capital of firms through cooperation and resource sharing.

However, it is known that globally 50 % of SAs fails, often due to the lack of a comprehensive analysis that combine strategic goals and KPIs [3]. In this context, firms could benefit from reliable data on performance of both firms and SAs. In other words, firms could benefit from a more structured and rich approach on what to monitor and on how to compare KPIs [4] in order to understand the drivers of SAs' success and, thus, to enhance their performance.

This analysis is relevant both in the pre-alliance phase, in which firms decide whether to create a partnership (strategy definition) and with whom (partner selection), and in the alliance phase, after the SA is built. Several Critical Success Factors (CSFs) on partnerships, relevant to both phases, have been identified in literature [5–9]. The analysis of such CSFs and of related KPIs can enable a first evaluation of the inter-organizational setting and can help to understand performance drivers, facilitating firms in strategic and organizational choices, such as whether cooperate with others or how to structure the SA (e.g., number of nodes, type of control). Moreover, it can bridge the gap of knowledge in inter-firms relationships, thus allowing a better understanding of the effects of SAs on firms. However, at the best of our knowledge, no tools or services are available online to perform this kind of assessment through monitoring and benchmarking. For this reason we decided to develop it and to make it available to all interested stakeholders, under the name of DsNA (Database for Strategic Network Analysis), as an online service which enables KPIs monitoring and benchmarking. In particular, in DsNA the benchmarking is performed through statistical analysis of similar firms or firms with certain characteristics, in order to protect privacy. Due to the presence in Italy of a legal obligation of firms to register network agreements we choose, as a first step, to apply our tool to Italian firms, in order to collect their data (e.g., firms' balance sheets, network agreements, networks' structures, financial ratios) in a database and to design a suitable user interface for online usage. In a future step, the fieldwork will be extended and spread out to other countries and forms of SA. At the moment, DsNA is designed and built to process data from all of the 3,681 Italian firms that, in the time interval 2010—March 2013, created 707 network agreements. The description of DsNA is focused on the database structure, on the system features and on the results obtained from the evaluation of a subset of such firms. Moreover, the system has been put through a two-phase validation, which allowed us to test technical and usability aspects.

This work is structured as follows. In Sect. 2 we discuss related works concerning control mechanisms and performance in strategic partnership and

goal-oriented requirements. Section 3 describes the scenario, the goal-stakeholder perspective, the requirement, the system architecture and the implementation aspects. Section 4 is for results discussion and conclusions.

2 Related Works

Several authors [10] studied the role of control mechanism, such as management accounting, in inter-organizational environments. Nonetheless, to our knowledge no one applied these results in order to quantitatively analyze the performance of SAs and of involved firms. In this scenario, we focus on current performance measurement systems and on how to define goal-oriented requirements useful to develop them.

2.1 Performance Measurement in Strategic Partnerships

Performance management and performance measurement have a key role in the assessment of SAs and of how the strategic partnership is affecting firms. In more details, performance monitoring in SAs can be focused on three aspects: (a) the firms; (b) the effects of the SA on the firms; (c) the SA. While there is a consolidate literature on sub-a), there are still few works on how to measure the effects of SAs on firms (sub-b), with no attention on quantitative aspects. For sub-c) researchers and practitioners propose several guidelines, performance management tools (e.g., modified Balanced Scorecard and scorecards) and enforcement methods (e.g., Open Book Accounting, henceforth OBA [11–16]). In particular, in [13] the authors highlight how OBA allows firms of a SA to share accounting information, which improve the decision process. However, many firms are reluctant to disclose these data, because OBA is sometimes seen as formal control mechanism that can damage trust [17].

2.2 Goal-Oriented Requirements

Requirements Engineering (RE) deals with the definition of properties of software systems [18]. In more detail, goal-oriented RE methodologies, such as KAOS and i*, have been successfully adopted to define the main properties of business-oriented software systems. In particular, KAOS stands for Knowledge Acquisition in automated Specification [19] or Keep All semi-formal Objects Satisfied [20]. It is a framework combining different levels of expression, semi-formal reasoning, semantic nets [21], agents, objects, and linear-time temporal logic to define goals and requirements of business-oriented software systems. I* [22] is an agent-oriented

modeling approach that can be used for RE, business process reengineering, organizational impact analysis, and software process modeling. Other goal-oriented approaches have been defined by several authors [18]. Due to the similarity of the basic assumptions of these approaches and to the scope of our analysis, we decided to use KAOS to define the requirements of DsNA.

3 DsNA System

The DsNA system has been designed through a structured approach based on KAOS, on W2000/IDM [4, 23] (for the hypermedia design) and on UML [24] (for all other modeling aspects). The approach starts with the definition of the motivation, of the scenario (Sect. 3.1), of four groups of stakeholders and of their goals (Sect. 3.2). Then, we define the main software elements of the system (Sect. 3.3). Finally, we describe the main implementation aspects and the early test phase.

3.1 Motivation and Scenario

The motivations of our work lie on some considerations based on the analysis of literature and reports on SAs. First, performance management has a high degree of complexity in inter-organizational settings, but it is not yet possible to analyze in detail which costs and which revenues of a firm are ascribable to the SA. Thus, presently it is not possible to know in detail the impact of a SA on its firms. However, firms' and SAs' managers could benefit from quali-quantitative information allowing them (a) to better understand if SAs are a good choice for them, (b) to comprehend what to expect from a SA and (c) to monitor how their firm is going in comparison with other firms (of the SA and external). Therefore, an acceptable solution is benchmarking, which allows the comparison of firms or SAs with similar ones. Still, a benchmarking system requires for many information, which are not accessible at a reasonable cost to firms.

The chance to develop such a benchmarking system was offered by the Small Business Act (SBA), which assigned a key role to SAs to improve the levels of innovation and internationalization of SMEs. This led the Italian parliament to introduce a specific legislation (Law n. 33/2009) for "network agreements" as a form of SA, providing a legal framework for relationships among enterprises. The legal obligation to register the contract enabled some associations to produce reports on this form of strategic partnerships, but these reports take into account only qualitative data (e.g., [25, 26]) with no regard for quantitative performance measurement aspects and for the possibility to access their primary data to assess their approaches.

In our opinion, the feasibility of the proposed approach lies on the existence of an automatic system able to process the large amount of data required for

benchmarking. For this reason, in this work we describe both the benchmarking approach and the technical aspects of the DsNA prototype. The system (http://dsna.unisalento.it) is based on a database that collects information on firms involved in SAs making them available online for all stakeholders and allowing users to create customized reports. At the moment the access is reserved to interested researchers whom can write to the authors for authorization.

3.2 Goal-Stakeholder Perspective and System Requirements

For the definition of the system requirements we take into account five stakeholders, who are potentially interested in DsNA, which can be subdivided in two groups: internal stakeholders (firms' and SAs' managers) and external stakeholders (researchers interested in SAs, network associations and policy makers). Indeed, a comprehensive system of analysis represents an opportunity to better understand SAs'. For all stakeholders we defined a complete set of goals and constraints ordered by priority. Then we transformed it in functional and non–functional requirements through a refinement procedure. In order to systematically model the system requirements, we followed the SA's lifecycle, distinguishing the requirements in the pre-alliance phase, operational life phase and conclusion of SAs life phase. For example, for firms we consider three main goals. In the pre-alliance phase [G.1], each firm is interested in evaluating the suitability of network agreements for the achievement of specific objectives (e.g., fiscal benefits, lower interest rate, growth in R&D). In the alliance-management phase [G.2], they are interested in a self assessment, through an analysis of their own balance sheet and financial ratios and of other firms' related data. In all phases [G.3], they are interested in benchmarking, performed by comparing their KPIs with those of firms with homogeneous characteristics under given criteria, e.g., sector, firm's or SA's age, size. In all phases, privacy is a good example of a non-functional requirement, because firms want to control what to show (nothing, just minimal data, financial ratios, etc.) to others users (SAs' partners, external observers, etc.) of the DsNA system.

In short, SAs' managers have the same goals of firms, in a SA perspective, and three more: they want to evaluate and compare the performance of firms in their SA, the distribution of benefits and the overall statistics (synthetic data). Finally, external stakeholders, although with a different perspective, are interested in all the previous goals, and also in the possibility of defining new ratios to apply to firms and SAs.

3.3 System Architecture and Implementation Aspects

DsNA is a Web System composed by two main application: (a) a subsystem to collect the financial statements of all firms involved in one or more SAs, loading it in a database and (b) a frontend, in charge of computing all relevant KPIs and to present

them to stakeholders according to their roles. Considering the problem size (less than 5000 firms and related financial statements for 5 years) and the estimated workload (less than 10 concurrent users), we decided to use the classic three-layer architecture. In particular, we used a LAMP (Linux, Apache, MySQL, PHP) architecture integrated with the jQuery v.2.0 library to support asynchronous page update.

For sake of simplicity, the main elements of the data model are represented in Fig. 1. The "Firm" entity type is used to store all relevant info about each involved firm. The SAs' data and the participation of firms into SAs are taken into account by the "Strategic alliance" entity type and by the "Includes" relation type.

This approach allowed us to evaluate firms' KPIs (i.e., ROI, ROE, EBITDA, NFP, ROS, ROA) and the benchmark values. The choice to use SQL views for KPIs, made them very fast to implement and very simple to test. Even if not efficient from the computational point of view, the adopted approach was very effective in terms of overall implementation costs, with less than five person-months for the first working prototype of the whole application.

The privacy requirements summarized in the previous subsection have been taken into account by defining a specific profile for each system user type. Moreover, the presentation aspects of DsNA have been modeled and implemented through a navigation tree and through a page template associated to each user type. An example page of the website for SAs' managers is reported in Fig. 2. In the central part of the page are indicated the relevant values for a given SA and the contribution of each composing firm. The parameters used to compose the page are shown in the left panel.

3.4 Validation Aspects

The validation of the prototype concerns four aspects: performance, usability, features (through an expert review) and coherence with existing literature. To test the 1st and 2nd aspects we populated the system with 192 firms and 75 networks: the dataset is not already complete because the agreement for the data provisioning is still under draft.

An ETL (Extraction, Transformation and Loading) tool has been used to import the balance sheets of firms on the MySQL DB. Specifically, we used the Kettle tool of Pentaho BI Community Edition suite. Kettle scripts processed the inputs with a speed of around 8 s/file (around 27 min for 192 files). Extending the dataset (3.681 firms) we estimate that around 9 h are required with the same machine already used for this test. The update operation, repeated every 4 months, is processed offline and doesn't impact on users' performance. For the load test, considering the order of magnitude of firms potentially involved in SAs, we estimate that the system will have no more than 1.000 unique visitors per day. Our tests show that even in the hypothesis of maximum load (i.e., simultaneous access of 20 users), the server (a standard quad-core Pentium with 32 GB of RAM) exhibits a response time lower than 3 s. To test the usability of the service we asked 10 graduate

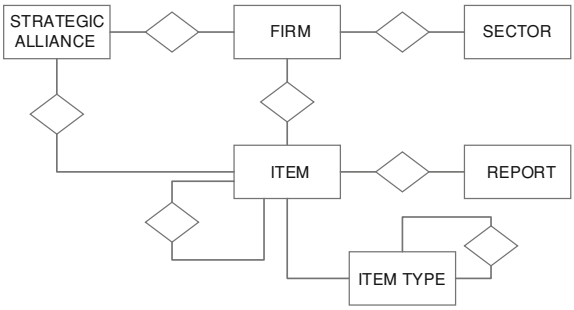

Fig. 1 DsNA information model

Fig. 2 Part of web site page for network managers

students of the course of Data Management (M.Sc. in Management Engineering—University of Salento) to execute some tasks, after an explanation of DsNA features. In particular, we asked them to work on a subset of 20 KPIs for a period of 2 months and to evaluate not only the usability but also the service continuity and the delivered quality. After the test, they answered a short survey about technical and usability aspects. The students pointed out a number of mistakes and errors in navigation, which allowed us to correct and improve the design of the Web Application and the structure of the service before the actual go-live.

Furthermore, we selected a recognized expert panel composed by two employee of the Commerce Chambers of Lecce, whom operate with SAs, and four business literacy and consultancy experts. We explained the problem and the scenario and asked them to test if the requirements make sense for firms and SAs, assigning to each requirement a degree of importance. It resulted that requirements meets firms and networks' needs, although some improvements can still be done.

At the current state of research it is not possible to complete a field evaluation of the service. We assume that prospective users cannot have a clear understanding of the possible applications of the system, until it is in a more advanced stage of

prototyping. Therefore, part of the validation is based on the existing literature and on coherence theory [27]. The proposed approach (based on benchmarking) and tool (online database) are well known and documented both in scientific literature and in industrial field, since performance benchmarking is well known to enhance competitiveness [28].

4 Discussion and Conclusions

In this work we propose a tool, named DsNA, for the analysis of Strategic Alliances (SAs) through monitoring and benchmarking techniques. The aim of the system is to provide all stakeholders with quali-quantitative structured and complete information. In particular, DsNA allows (a) to perform a benchmark analysis of firms and SAs with homogeneous characteristics, (b) to better understand the economic trends of SAs and (c) if, and in what measure, firms obtain benefits from a SA. In this way, SAs can become a suitable solution also for firms that lack of the economical and managerial resources required to enforce a complex and homogeneous performance measurement system in the whole ecosystem. In other words, DsNA can provide a support for the decision process of managers in an inter-organizational environment.

For the production and development of DsNA we used a systematic approach that enabled us to design and automate the evaluation and publication of KPIs. With the prototypical system, we achieved the following results: (a) acceptable evaluation and publication costs of benchmarking data; (b) the evaluation of firms in network agreements, with a detailed description of their characteristics (e.g., sector, place, employees); (c) the evaluation of a broad number of KPIs and related sector benchmarks.

Future works will include the extension of the system with more advanced anonimization techniques, the creation of a collaborative version of the platform to foster data exchange and Web 2.0 interaction among stakeholders in the perspective of e-participation and the use of taxonomies and ontologies to analyze the link between business goals and KPIs.

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Business Development Through Digital Transformation: The Evolution of Amazon.Com

Andrea Resca and Paolo Spagnoletti

Abstract Since 1995, when the first book was sold as an online bookstore, Amazon has continued to evolve turning to a provider of cloud computing services and a publisher. The aim of the present paper is to investigate this evolution focusing on the concept of platform and the concept of infrastructure as metaphors of the business/environment relationship and of the reframing of business sectors. In the case in question, an overlapping between the concept of platform proposed and the technological platform emerges so that it has become the backbone on which Amazon's businesses run. On the other hand, the concept of infrastructure outlines an environment in which customers can turn into suppliers and also into partners.

Keywords Platform · Infrastructure · Amazon · Strategy · Structure · Environment

1 Introduction

The enhancement of global competition and the processes of deregulation (or more regulation), internationalization, and accelerated technological change, constrain today's organizations to adapt to their complex environment and challenge traditional managerial practices and value creation processes. Nevertheless, complexity is not only a given characteristic of the organizational environments but also represent a manageable dimension of such environments [1]. In fact, socio-technical, economic, and political trends enable new trajectories for transformation and therefore organizational inertia is increasingly eroded [2].

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An important role in this context is played by information technology (IT) that has the potential to promote the emergence of novel organizational arrangements and to foster organizational innovation as entities with an inherent social constructed nature and a capability to be constantly adjusted and adapted [3–5]. In fact IT is supplanting hierarchy's role in coordinating and controlling activities and new forms of organizing are continually created though the affordances of IT artefacts [6–9].

Since the introduction of pioneering strategic information systems, such as American Airlines' SABRE, McKesson's Economist and American Hospital Supply's ASAP, at the end of the 1970s, the role of information systems as a means of strategic management has been investigated. In this respect, a dual perspective has emerged within the discipline of information systems: the business strategy perspective focused on the role of the organization itself, whereas the industrial economic perspective privileged the role of the competitive environment [10]. This duality derives directly from studies in strategic management. In fact, strategic management research can be subdivided into two main branches: content research and process research [11]. Contents research aims to detect factors that enhance firms' competitive advantage, whereas process research investigates how firms' strategies emerge over time. In other words, content research outlines the steps that should be followed in order to be successful, and process research focuses on how these steps should be actually put into practice.

Within content research, there are two main streams. The so-called Porterian school [12, 13], on the one hand, and, on the other, the firm-level resources and capabilities stream [14–16]. The former turns to studies of industrial organization and industrial economics, such as Bain's [17] and the Chandler's [18] works, maintaining that industry characteristics determine a firm's performance. However, this approach has been criticized. Namely, if industry characteristics are so influential, why do firms differentiate from each other considerably and why do some outperform others? This suggests that industry characteristics are not so relevant as it was believed. At this point, the focus of strategic management research moved from industry characteristics to firm-level resources and capabilities. The resource-based view of the firm [14, 15] and the concept of dynamic capabilities [16] are the main results of this approach, and they are a popular concept in IS research (e.g., [19]).

The strategic systems research mirrors the debate on strategic management and is still characterized by the dual perspective, and, similarly, industrial economics approaches clash with business strategy approaches.

The aim of this paper is to pave the road for a better understanding on the strategic role of IT in organizational transformation. In particular, our analysis is focused on the mechanisms through which new digital architectures enable organizational innovation. Here organizational innovation is intended as the process through which an organization is both re-aligned with its environment and contributes to shape the rules of the game by creating, acquiring, transforming, combining, linking, and deleting IT capabilities and organizational capabilities. The perspective proposed is an attempt to go beyond the Porterian school and the firm-level stream as such process embraces multiple levels spanning across

strategic, structural, and technological aspects which are intertwined and in a state of continuous evolution. Drawing upon an integrated framework for strategic and structural transformation [20], we introduce the case of Amazon.com, a leading company that has experienced a continuous process of organizational innovation by constantly rethinking its digital infrastructure. An historical view of innovation trajectories undergone by this company is provided, together with a roadmap for further investigation.

2 Research Strategy

In order to understand the role of IT capabilities into a strategic framework for building successful organizational innovations, we investigate the digital transformation processes of one of the most successful dotcom companies. In other words, the research question consists in the analysis of Amazon's evolution on the basis of the theoretical framework introduced below. The theoretical framework proposes the concept of platform and the concept of infrastructure as metaphors for investigating the relationships between organizational structure, business strategy, business environment and technology. The nearly 20 years history of the company is presented according to three main periods for the clarity of the analysis.

Developing an in depth case study [21] has the advantage of observing the combination of strategic moves and organizational innovation supported by IT within a single unit of analysis. In fact, unlike many other examples of organizational innovation in which IT capabilities are distributed among multiple players, in this case the control of the digital architecture is centralized in a single company that provides them to its partners and customers. Moreover, the global geographic span covered by the company and the timeframe of its activities instantiate the environmental complexity by also encompassing the more recent advancements in digital architectures.

This research study is essentially based on a document analysis and our primary source was the internet. Since its foundation, Amazon has been covered intensively by all media and a large amount of data and information is available. Specifically, three main sources have been used in evidence collection: Wikipedia, Amazon's press releases, and Amazon's balance sheets and related documents. All main Amazon's applications, solutions, partnerships, etc. have a an entry in Wikipedia allowing a cross-search. Being listed in the stock exchange, Amazon is bound to inform shareholders about the financial situation and press releases are continuously issued for updating on current activities. Finally, the "Wayback Machine" application (by the way, provided by an Amazon's company) has been used in order to compare Amazon's web pages in the course of the years.

A document analysis has limits. First hand data and information were not available even though the intention was to rely upon accredited sources such as Wikipedia and balance sheets. Another limit of this research study consists in the substantial overlapping between the platform metaphor and the technological

platform. Despite the importance of the latter, it does not emerge clearly what has been the role of the organizational structure and how the platform metaphor could represent it.

Before presenting the case through an historical view of the main trajectories of Amazon.com's organizational innovations, we introduce the interpretive framework used for conceptualizing the phenomenon under investigation.

3 Theoretical Framework

The theoretical framework considers three perspectives [20]. The first perspective outlines the importance of the technological architecture in the modalities through which firms organize for innovation [22]. The organization as a platform [23, 24] is the second perspective taken into consideration. Finally, dynamics of value creation are at the basis of the third perspective [25]. Technology and particularly IT are, here, seen as drivers and tools for a dematerialization process that allows to recombine the factors of production for achieving a competitive advantage. Each perspective provides conceptual tools for understanding the trajectories of organizational innovation undergone by the company.

The IT architecture perspective wants to analyze the characteristics of the technology at stake. It draws on the fact that digital products have a layered modular architecture that integrates modularity (components can be connected through standardized interfaces) and layering (components can be also physical items) [22, 26, 27]. These inherent properties pose several opportunities and constraints to the emergence of organizational arrangements. At first, the digitization of products blends the boundaries between products and between industries. Then, the layered modular architecture provides a range of possibilities to insert digital components into a physical product representing strategic choices to pursue digital innovation. A further challenge lies in the fact that digital products can be transformed into digital platforms and as such is fundamental to control or not the key components or specific combinations of components within certain layers. Technological tools such as APIs and SDKs, and factors such as incentives, the management of property rights and the array of forms of control provide a series of opportunities for a company to be attractive to companies that are heterogeneous and far from the business [28]. Traditionally, organization studies focus on the figuring out of organizational solutions for the reduction of coordination costs (i.e. [29, 30]), of transaction costs (i.e. [31–33]) or for achieving the alignment with the strategy and the environment (i.e. [18, 34]). Nowadays, the question is to deal with surprises and unexpected events that change completely the business scenario or with an innovative technological trend. Therefore, it is not sufficient to outline a specific configuration of roles and relationships or a further organizational form for governing transactions.

The concept of platform is introduced in this respect [24]. Obviously, this concept refers to the technological environment. The organization as a platform

represents, like in the computer firms, the basis on which products are developed. In other words, it designates a specific strategy and structure relationship, related suppliers and customers, and the organizational structure able to coordinate them. For instance, the shift from the PC/386 platform to the PC/486 platform represented an occasion for a new configuration of products, suppliers, customers and the related organizational structure. All of this becomes possible because the platform metaphor provides the possibility to outline a blueprint for dealing with primary tasks such as a competitor's move or a technology trajectory on the basis of a bet [24] or an option [35]. The bet or an option on a primary task (technological trajectory, environment change etc.) leads to specific alliances, acquisitions, mergers, vertical integration etc. and the organization as a platform allows to support this sort of betting. What is at hand, such as routines and pre-existent structures, is re-used for this new endeavor as in the case of the open source software adoption [4].

The main characteristics of the organization as a platform can be summarized as follows: (i) it provides an organizational architecture based on a multiplicity of structures; (ii) frames and routines can be easily transformed across diverse organizational settings; (iii) it provides a context in which available resources can be reinterpreted in innovative ways reallocating them in completely different frames; (iv) superficially it acquires a common configuration but actually manifests itself facing surprises and using resources in an unexpected way; (v) it achieves flexibility outlining structures that provide innovative answers to chaotic events [20].

The concept of platform was taken into consideration, among others, by Hanseth et al. [36]. In this case a platform is considered a sort of springboard: "oil platforms, platforms at bus and railroad stations, platforms for launching missiles, etc. as a basis to stand on, perform actions on top of, or be used to enter another "domain" (Hanseth et al. forthcoming). Organizational functions such as production, finance, marketing, sales etc. are conceived as the footing to deal with the business environment, the starting block that allows the figuring out of a strategy.

Hanseth et al. [36] discuss also the concept of infrastructure. The term infrastructure, normally, suggests the series of services that characterize modern society such as water and electricity supplies, public transportations, road networks etc. At a first look, a significant difference between the concept of platform and the concept of infrastructure does not emerge. However, a platform tends to support a specific endeavour (oil extraction, missile launching, train access etc.). In contrast, an infrastructure tends to support a large community or a society. It constitutes an underlying level for supporting human activities in a larger social order. Infrastructures can also work as a platform if they are "built on top of and by combining, or integrating existing infrastructures [36] ". In organizational terms, an infrastructure, differently from a platform that outlines the organizational functions/environment relationship, is conceived by the configuration of the entire system in which the organization operates.

Normann's work [25], contributes to analyse the concept of infrastructure introduced above. The notion of upframing is helpful in this respect as an endeavour to envisage a larger conception of value creation that bring "players

with desperate assets and competence together into forming a new, functioning value-creating system" [25]. The turbulence of competitive environments suggests that organizations themselves have difficulty following strategies so that it becomes decisive to take advantage of forms of co-production or crowdsourcing for example. In this context, also non-monetary exchange are valid for realizing new value systems. Normann [25] turns to the concept of infrastructure as well for emphasizing the importance to establish new rules of the games that go beyond traditional business sectors and business systems. Specifically, he introduces this concept as the metaphor for building a larger system able to influences strategies, actions and interactions of the players operating in it. Here, technology contributes to the creation of business scenarios to be realized. The infrastructure should also identify a two phases process in which, at first, interactions among players are supported and how, then, they can progressively evolve. The role of the infrastructure is also to recognize and mobilize dormant resources as parts of a comprehensive system establishing non-monetary resource of exchange (i.e. barter).

The strategic framework envisaged in the present paper is an attempt to combine the concept of platform and the concept of infrastructure for interpreting the evolution of the Amazon's business model. Specifically, the case in question sees a relevant role of technological platform and of the technological infrastructure. However, the intention is to use these two concepts as metaphors valid for any organization.

The platform as the footing to deal with the business environment is an organizational arrangement in which pre-existing routines, structures and processes are recombined to deal with a primary task (a market contingency, a technological innovation or a competitor's move) [24]. In this understanding, the efficiency of an organization structure is pushed into the background. What is crucial is the possibility to manage a primary task committing on organizational arrangements at hand and, eventually, on alliances, mergers and acquisitions. Differently, the infrastructure metaphor stresses the role of the business environment at large. The question is not to take advantage of a technological innovation or of a market imperfection. It is to pursue a larger conception of value creation [25]. To sum up, the strategic framework envisaged is constituted by two main levels defined by the platform metaphor and the infrastructure metaphor. The former focuses on the recombination of routines, structures and processes to achieve a primary task and the latter stresses the role of the business system at large in this proposal leading to a perspective where the strategy/structure alignment and the structure/environment alignment are reconsidered for dealing with primary tasks.

4 The Amazon Case

Amazon.com Inc. (Amazon) was established in 1994 and in 1995 the first book was sold, as an online bookstore. Now Amazon is not only an online bookstore but also something more. The intention is to describe the evolution of the e-commerce

website for selling books into a far more integrated system at the basis of different businesses. Three periods characterize Amazon's evolution. From 1994 to 2002, online retailing has constituted its core business. In 2002, the idea to provide to external developers and website owners the client-server environment available was realized and Amazon Web Services moved its first steps even though only in 2006 cloud computing services were launched. 2007 marks another period as the e-book reader Kindle series was inaugurated signing Amazon's entry into the electronic devise market. At a first look, online retailing, cloud computing services, and electronic devices seem three distinct businesses. Actually, the objective is also to demonstrate that these three businesses are strictly integrated. The development of technological components has led to this consideration and it constitutes the red thread for investigating these three periods.

4.1 1994–2001

These years have seen the continuous expansion of the e-commerce website due to both internal growth and acquisitions. As far as the internal growth has concerned, the Associate program and the "1-click shopping", started respectively in 1996 and 1997. With the Associate program anyone with a website can host links to Amazon.com and receive a commission up to 10 %. In 2 years more than 30,000 members joined the program, 500,000 in 2000, and 2,000,000 in 2008. The "1-click shopping" solution simplifies the purchase process once the customer is registered. From 1998, it is not only possible to shop books but also music and DVDs and at the end of 2001 also electronics, toys and games, and tools and hardware. In 1999, important innovations were introduced in the Amazon website. Amazon.com Auctions, a web auction service, and zShops, a fixed price marketplace business, contributed to enlarge business activities. However, Amazon.com Auctions solution was not successful due to eBay competition and later was abandoned and zShops was merged into Amazon Marketplace providing the possibility to any merchant to set up a "shop" to put on sale goods through the Amazon website. Amazon marketplace, offers to any Amazon's customer also the possibility to buy and sell used and collectible items from Amazon's website product detail pages. Among the several features that have been introduced in this period, it is worthwhile to mention the "Look Inside the Book" one. Since 2001, customers are allowed to flip through the inside pages of thousands of books.

In 1998, Junglee Corp., a provider of web-based virtual database technology, which allows visitors to assess a variety of products sold by other merchants, was acquired. This is considered the acquisition that has guided the transformation of Amazon from a retailer into a retail platform enabling third party retailers to sell on Amazon's website.

4.2 2002–2006

In 2002, Amazon decided to provide to developers and website owners the possibility to incorporate many of its e-commerce platform features into their websites free of charge. In other words, for instance, the Amazon.com Shopping Cart became available directly on these third party websites. This was considered an important step for the development of IT and specifically of the internet. However, it is only since 2006 that Amazon Web Services are not only related to retail but to the provision of cloud computing services such as storage (S3), computer power (EC2), and structured data or database (SimpleDB). The idea at the basis of these services is to provide a network infrastructure as a commodity similarly to water and electricity. Among Amazon Web Services, the Mechanical Turk needs to be mentioned. It is a crowdsourcing internet market place in which computer programmers post tasks to be performed. Workers can browse existing tasks and complete them for a monetary payment. At the basis of this feature, there was A9, an independent company founded in 2003 by Amazon for developing search and advertising technology. Specifically, in the period taken into consideration, A9 has provided a search engine that allows product search and advertising technology (technology for delivering sponsored link advertisements on the Amazon.com retail web site).

2005 is an important year in the Amazon's account due to three acquisitions: Booksurge (a publisher on demand), Mobipocket (a French company of e-book readers), and CustomFlix (a DVD on demand company). Both Booksurge and CustumFlix will be merged later into CreateSpace providing on-demand books, CDs, and video and Mobipocket was at the origin of Kindle series. In 2006, Askville.com was launched. It is operated by A9 and provides services such as Yahoo! Answer and Google Answer even though, like in a computer game, users can gain or lose "experience points" according to their activity.

During the same period, the e-commerce website has evolved as well. The list of categories on sale has increased significantly with apparel and accessories, sports and outdoors, jewelry, and Amazon Wedding. In 2003 the "Search inside the book", as an integration of the "Look inside the book" feature, was introduced. In August 2004, the Joyo.com Limited was acquired as the largest online retailer of books, music and videos in China. Amazon Prime and Amazon's ProductWiki were launched in 2005. Amazon Prime is a membership program so that, for a flat fee, members get unlimited express two-day shipping for free, with no minimum purchase requirement. With Amazon's ProductWiki, customers have the possibility to edit product information. Amazon Connect, a sort of blog dedicated to authors for exchanging ideas related to their books with readers, saw the light in 2006 as well as Amazon Unbox that later was renamed twice as Amazon Video on Demand and Amazon Instant Video. It's an internet video on demand service which offers television shows and films for rental and purchase.

4.3 2007–2013

The evolution of the Amazon e-commerce website has continued also in this period. Both product categories and local Amazon's websites have augmented. Now Amazon is directly present in 10 countries around the world. Customer satisfaction metrics that allow to monitor both customers' behaviors and sellers' behaviours (sellers that take advantage of the Amazon's website) have been improved and in 2009 the "Customers who bought related items also bought" feature was added. Amazon Prime membership program does not only offers to members shipping for free but also the access to instant streaming of movies and TV shows other than some titles of Kindle library e-books. The acquisition of Brilliance Audio (an audiobooks publisher) in 2007, and of Audible.com in 2008 (an internet provider of spoken audio entertainment, information and educational programming), have contributed to this service. The program Amazon Advantage differentiates from Amazon Marketplace due to the fact the latter allows to sell only items already entered in the Amazon system and without the possibility to change its description. With Amazon Advantage, this becomes possible other than item shipping directly form Amazon warehouses. The same service is provided also on large scale as Amazon operates retail websites for Sears Canada, Timex, Marks and Spencer, and Lacoste among others. With Amazon Webstore, a software as a service e-commerce platform, businesses have the possibility to build an e-commerce platform in a day. Amazon Selling can be integrated in Amazon Webstore offering the same items also in the Amazon Marketplace. Fulfillment by Amazon (FBA) is a third feature that can be integrated with Amazon Webstore and Amazon Selling. Amazon manages third-party products in its warehouses picking, packing, and shipping them to the seller's customers who can, eventually, take advantage of the Amazon Prime membership and in this way delivery costs will not be borne. Of course these services are provided also singularly. Amazon FPS (flexible payment service) is an Amazon web service that allows the transfer of money between two entities.

This period is also characterized by the continuous growth of e-commerce websites that operate independently but are controlled by Amazon due to acquisitions. Among them, it's worthwhile to mention Abebooks in 2008 (an online marketplace for books that controls BookFinder.com, a book price comparison website, FillZ, a book inventory and order management company, and Chrislands, a company that hosted websites for over 1000 booksellers); Zappos (an online shoe and apparel retailer), in 2009; Wook (an internet retailer of electronics and household goods), Quidsi or Diaspers.com (an online retailer for baby products), and BuyVip (an internet retailer that acts as broker between fashion brands and customers) in 2010; LoveFilm (a provider of home video and video game rental and streaming video on demand) and The Book Depository (an online book, e-book and public domain seller) in 2011.

Amazon Web Services growth is continued as well. Products related to storage (i.e. S3), computer power (i.e. EC2), and database (i.e. SimpleDB) have been

integrated with products related to networking (i.e. Amazon Route 53), content delivery (i.e. Amazon CloudFront), deployment (i.e. AWS Elastic Beanstalk), management (i.e. Amazon CloudWatch), and app services (i.e. Amazon CloudSearch). In this account, Amazon Marketplace Web Service, an integrated Web service API that helps Amazon sellers to programmatically exchange data on listings, orders, payments, and reports has been introduced. Specifically, the Fulfillment API provides to a seller the possibility to send order information to Amazon with instructions to fulfill customer orders on the seller's behalf.

As it was already mentioned, Kindle was launched in 2007. Kindle is a device for shopping for, downloading, browsing, and reading e-books, newspapers, magazines, blogs, and other digital media via wireless networking. In 2009, two new versions followed (Kindle 2 and Kindle DX) as well as apps for IPhone, IPod Touch and PCs to access Amazon's e-books also on these devices. Since 2010, also apps for BlackBerry, Mac, IPad, and Android became available and Kindle for the Web, later renamed Kindle Cloud Reader, provides the possibility to rent e-books and share them on social networks or by email. An Associate program allows website owners and bloggers to take advantage of this feature making available e-book samples. Kindle Touch (a touch screen device) and Kindle Fire, a so called tablet, arrived to the market in 2011. The latter is equipped with the SILK web browser based on Android that, due to a split architecture, performs some of the processing on Amazon's servers to improve webpage loading performance. The iPad tablet is considered device-centric (based on iPad apps, hardware performance and content download) while Kindle Fire is considered service-centric (based on the SILK web browser, content provision and content streaming). Contextually to the Kindle Fire presentation, the Amazon Appstore was launched (Kinder Fire relies only to this mobile application store even though it is dedicated to the Android operating system). At the basis of Kindle series, other than Mobipocket acquisition in 2005, there is the Amazon subsidiary Lab126. Acquisitions related to the development of these devices have followed with Lexcycle (e-book reading software company), Snaptell (an image matching start up), Touchco (a touch screen start up), Pushbotton (an interactive TV), and Yap (a speech recognition start up).

Publishing activities have grown considerably in this period. Since 2007, authors and publishers have in Kindle Direct Publishing a solution for publishing e-books for Kindle and Kindle apps worldwide in exclusive whereas printed versions can be sold independently. 2009 saw the Amazon entering in the imprint business with AmazonEncore publishing of out-of-print or self-published titles with sale potential. Then Amazon Crossing (books in translation), Montlake Romance (romance), Thomas and Mercer (mystery and thrillers), and 47North (science fiction) followed. Amazon Publishing provides also a self-publishing platform that allows the publication of books and e-books under any imprint name.

5 Amazon's Strategic Framework

The platform metaphor and the infrastructure metaphor are at the basis of the strategic framework envisaged and as such constitute the two main perspectives for investigating Amazon's evolution. The intention is to interpret the three periods of time taken into examination according to this strategic framework. Specifically, the question is whether it succeeds to give a reason for the several steps that have led the transformation of an online bookstore into a provider of a large range of online but also offline services. Does the platform metaphor account for Amazon's business/environment relationship? Does the infrastructure metaphor account for the configuration of the entire business sector in which Amazon operate?

5.1 1994–2001

This period is characterized by the crucial role played by the e-commerce website for selling books, at first, and then also DVDs, electronics, toys and games. Amazon is a typical dot com company and among the most famous. Founded in 1994, it realized that the development of the internet could be a new opportunity for envisaging new business models such as the possibility to sell books according to novel modes. Therefore, the e-commerce website represents the platform of the strategic framework envisaged. It is the basis on which organizational functions were arranged in order to deal with the environment. The environment, at first, was represented mainly by internet users as potential customers and then also by merchants (see ZShops), by customers (see Amazon Marketplace for selling used and collectible items), and by partners (members of the Amazon Associate program). It is the website that constitutes the link between Amazon and the external world and the result of the bet on the possibility to figure out innovative ways to reach customers selling commodities. Main mergers and acquisitions of this period can be seen in line with the website as a platform.

The infrastructure metaphor suggests the importance to support a large community or a society. Due to Amazon's website, customers are not only the addressees of final products but also sellers of used and collectible items; traditional book sellers are not only Amazon's competitors but also contribute to offer a larger selection of titles to readers; website owners are not only clouded by Amazon but also have the possibility to act as a mediator with internet users (members of Amazon Associate). Amazon website can be considered an infrastructure for the mobilization of a large number of actors. Actors have different roles according to the situation. An Amazon's customer can transform into a supplier and a competitor into a partner. To sum up, at least in this period, the strategic framework envisaged in this paper suggests that Amazon main purpose has consisted in aggregating a large number of internet users who can take advantage of the e-commerce website according to different roles such as customers, sellers, and mediators.

5.2 2002–2006

The e-commerce website has continued to represent the platform metaphor also in this period. However, it has evolved considerably due to new categories of products on sale (apparel and accessories, sports and outdoors, jewelry, etc.) and new features. The "Look inside the book" feature advanced to the "Search inside the book" one, Amazon Prime membership program was introduced as well as Amazon ProductWiki and Amazon Connect to scratch shipping-costs for a flat fee and involve internet users in the evaluation of products on sale. The "Look inside the book" and then the "Search inside the book" have inaugurated the digital content creation and with Amazon Unbox digital contents such as music and videos are available on the e-commerce website.

Two main factors suggest that new ways to deal with the environment have emerged: mergers and acquisitions of companies in the on-demand content (books, videos, and CDs) business and the making available of Amazon e-commerce applications to developers and website owners. Two new bets can be considered at that point. The opportunity provided to customers not only to buy and sell contents but also to produce them directly and to provide cloud computing services as a commodity. On the basis of these two bets, what actually is represented by the platform metaphor is changed. The e-commerce website has been integrated with a range of applications for offering new modes for the storage, elaboration and management of data and for the production of contents. Due to the new traits of the platform, the reference environment has changed too. Companies in search of novel solutions in the IT management domain and internet users interested in the production of contents also represent Amazon's environment of this period.

The infrastructure metaphor suggests that the construction of communities has carried on. Amazon Product Wiki and Amazon Connect have contributed to involve customers commenting items on sale and promote forums between authors and readers. However, the decision to allow developers and website owners to access Amazon's web applications has attracted a new type of partners such as the IT expert community that has played an important role for approaching customers of cloud computing services. The same role has been played by the Mechanical Turk service. The combination of the platform metaphor and of the infrastructure metaphor hints that Amazon has continued to pursue the strategy to aggregate internet users as customers, sellers, and mediators due to the development of the e-commerce website. This aggregation process has been also characterized by the provision of web applications and the possibility to realize contents on demand to be put on sale, eventually, on the Amazon's e-commerce website.

5.3 2007–2013

In the period considered, the Amazon/environment relationship has continued to evolve according to the perspective provided by the platform metaphor. This is due, mainly, to the full operation of retail websites, to the provision of e-commerce and logistics solutions, to the launch of the Kindle series, and to the entry into the publishing sector. Operating retail websites means that the Amazon e-commerce website and related logistics have been replicated for companies such as Sears Canada and Marks and Spencer. Now Amazon does not only provide a marketplace but also a customized e-commerce site and warehousing and shipping management. The creation of digital contents has been integrated with the production of electronic devices for accessing them and the entry in the publishing sector is linked to this strategy too. Three bets can be considered at the basis of these moves. To become a provider of e-commerce websites taking charge of the logistic side at different levels; to become a provider of electronic devices; to become a publisher both of online contents and paper-based contents. Consequently, the platform as a metaphor is represented by Amazon's e-commerce website integrated with web applications both for cloud computing services and business services, the production of contents, electronic devices and the publisher. Considering Amazon's reference environment, also consumers of electronic devices and authors are part of it.

The community building has continued also in this period even though it has characterized mainly actors already present within Amazon borders. Specifically, the series of acquisitions can be conceived to be led by the reconfiguration of the content business. Amazon is acquiring a relevant position in this market sector being a publisher, a book seller, a provider of services for contents on-demand, and a manufacturer of devices for accessing contents. To sum up, the aggregation process established by Amazon is carrying on redesigning the provision of business services, of purchasing ways, of content production and content access.

6 Conclusions

At the beginning of the previous section, two main questions were posed and specifically whether the platform metaphor accounts for Amazon's business/environment relationship and whether the infrastructure metaphor accounts for the reframing of the business sectors in which Amazon operates. Actually, the platform metaphor represents an attempt to throw light on its business environment. The evolution of the technological platform in this case plays an important role. It is the means through which the connection with the environment is established. From the supply of commodities to internet users, to the provision of e-services and digital devices, the platform constitutes the backbone on which Amazon's business runs. In some sense, to the evolution of the platform corresponds to a

coupling with the environment. In this respect, the infrastructure metaphor outlines the characteristics of the environment. An environment populated by customers that can turn into suppliers and also into partners. Here, to the typical consumers of commodities have been added IT experts and customers of cloud computing services ending with the reframing of the content business. To sum up, since 1995 when the first book was sold on as an online bookstore, Amazon has continued to reconfigure businesses not only innovative (i.e. e-commerce) but also traditional (i.e. logistics).

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All that Glitters is not Gold: Alleged Innovations in Human Computer Interaction

Leonardo Caporarello, Massimo Magni and Ferdinando Pennarola

Abstract Multinationals and hi-tech firms often advertise and claim for their newest innovations, presenting all kinds of improvements as authentic revolution for the industry. Regarding interfaces between users and machines, in particular, software developers announce repetitively their new versions, emphasizing their novelty and disruptiveness in order to attract more customers. Apparently, all competitors seem to play against everyone else. This study instead, demonstrates that when looking at the evolution over time of mobile phone interfaces—as an example of a widely adopted technology by millions of customers –variance and genuine innovation is very limited, and competitors prefer to follow their enemies instead of taking the risk of being disruptive into the marketplace. The study investigates why it is such and it explores the reasons why competitors get stuck with pre-existing user interfaces.

Keywords Human computer interaction · Mobile interfaces · Competition · Cooperation · User interface

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1 Introduction

One of the most fascinating interplay regarding users' behaviors and technology interfaces is by far the case of the mobile phone address book. Before the advent of mobile lines, the telecommunication industry outlined a clear set of dialing procedures, indeed evolved over the years, but substantially anchored to a simple rule: you must know your calling party's number to reach his home or office and establish a phone conversation. With the introduction of personal mobile communication services, all the handheld device software offered the possibility of storing personal contacts and combining them with numbers, either mobile or landline. Consequently a shift in the behavioral pattern occurred: users started calling people and no more numbers! To the extent that today, after more than two decades of telecommunication services in major countries, we can acknowledge that some numbers are forgotten and users do call their parties only by name. This is an exemplary achievement of how innovation in product and technology interfaces permanently impacts on a behavioral change on the users/customers.

But it's not all gold what it shines, as our title says. Although the introduction of the address book in mobile phone interfaces revolutionized the relationship people have with mobile technologies, what followed was a quite opaque interaction: on the surface, every launch of new technology was advertised as trend setting, breakthrough innovation, but in reality competitors preferred to play in more tranquil waters, with little upgrades applied to the user's interface.

In this study we have amassed data of 788 different types of mobile phones launched in the market from 1995 to 2013. All the data collected is consistent, clear and univocally determined. No room is left for assumption, intuition and supposition. To be more clear, we've identified a mobile phone as mainstream literature does: "a device able to make and receive voice calls over a radio link using a network provided by a mobile phone operator". In addition, the activity of making and receiving calls must be the core function of the device. Because of these characteristics, cordless phones are not part of our sample, since they use a private network under a short range, and neither the tablets fall into the category; some of latest tablet models do make and receive calls, but this activity clearly does not represent the core one. The first mobile phone in the world, according the previous definition, was the Motorola DynaTAC [1]. The first model of DynaTAC, the 8000x was commercialized for the first time in the 1983. The battery gave autonomy for 30 min of conversation or 8 h of standby; the interface was represented by a LED display that allowed dialing or recalling one of the 30 phone numbers stored in memory. The first-launch price was of $3,995 for the US market. We choose 1995 as the cut-off year to start collecting data for another reason: it was the year when major mobile operators in Europe, started their operations.

Competition and cooperation among industry players is subject of ongoing research and investigation, since many years. The mobile phone—and today smartphone—industry is an attractive global segment of today economies: it has a huge impact on citizens and it offers a remarkable research platform to investigate

the relationship between people, technology and technology adoption processes. Moreover, this industry is at the intersection of innovation, technology adoption and rate of change.

2 Theory Background: Models Cultivating Innovation and Designing User Interfaces

The speed and the dynamics of innovation have not been the same during the centuries: according to Mokyr [2], while before the industrial revolution innovation can be better identified as a byproduct of daily human routines, with some discontinuities in the process, after the eighteenth century both the inventions and the diffusion of innovative ideas radically changed; the way of doing innovation evolved and became more structured and institutionalized in R&D lab later on. For example, according to Fagerberg [3], invention is "the first occurrence of an idea for a new process or product" instead innovation is "the first attempt to carry the idea out into practice". This definition is not generally accepted. Another proposal come from Li [4], who classifies invention as novel and valuable, while innovation is a profitable invention. According to this criterion, only when an invention gets profitable it can really be considered innovation. According to Fagerberg [3], a very basic differentiation between the sources of innovation could be done dividing them into R&D based and learning by doing. The idea of creating big R&D labs started from the necessity to have a well-established and schematic way to do product and process innovation. The research and development activity is defined as a set of creative work done in a schematic way for the sake of increasing the amount of knowledge that can or cannot have as ultimate purpose the creation of a new profitable process/product. On the other hand, learning by doing is a concept used also in economics and it is associated to the ability of employees to raise the productivity up by pursuing systematically the same tasks or routines. One of the possible sources of higher efficiency can be founded in minor innovation [5]. Regarding the different types of innovation, again there are different proposal of categorizations. Henderson and Clark [6], propose what became a widely accepted typology: innovation can be Incremental, Radical, Modular and Architectural. Incremental and Radical innovation are differentiated according to the criterion of the level of newness and diversity while an innovation can be Modular or Architectural depending on whether it acts on components or on the links among components [7]. Incremental innovation is characterized by the introduction of small changes to a certain product, and it refers more to exploitation of existing knowledge or capabilities [8]. Radical innovation, on the other hand, has the roots into a new scientific paradigm and it may create totally new market opportunities. Then, there is Modular innovation in case of a core component replacement without any modification to the architecture [6]. According to Gawer [9], an innovation is Modular if there is a change on the components side without affecting the linkages: in addition it reinforces the

architecture and it is competence-enhancing rather than competence-destroying (like Radical innovation). Finally, an innovation is called Architectural when it affects and drastically changes the architectural knowledge of a given business.

According to the distinction proposed by Fagerberg [3] there are two different models of innovation: the Linear Model and the Chain Linked model. The Linear model, with some variants, consists in a four stages process: the first step is represented by the research phase followed subsequently by the development stage. When the innovation is ready, firms can concentrate on producing first and then diffuse the innovative product. On the other hand the Chain Linked model [10] is more recent and representative of several innovations in the high-tech industry. This model, in contrast with the linear one, assumes that the working flow starts from an unsatisfied market need. After having successfully identified it, the next step is occupied by research and design activities, then redesign and production till the marketing stage. All the process is characterized by complex feedback loops among all the different phases, which allow solving most of weaknesses highlighted in the previous model. This model is also called "Kline model" and, although designed mainly for commercial industries, the empirical evidence showed us a large use also in different sectors, like the defense and aerospace ones.

Other models not only do allow to be more innovative, but also drastically cut off costs, that means lowering final price for customers and being more competitive on the market. An important source of innovation is the Lead used method: Lead users are particular kind of customers which face needs long time before than the other normal consumers. They often innovate for themselves, to fill up their need, and they usually are not interested in commercializing or gaining profits from their products/solutions [11]. Usually innovations developed through the Lead user method are highly valuable and very appreciated by the market [12]; commercial value of innovations largely increases as "Lead user" characteristics of innovators intensify. This method is time consuming and it requires the disclosure of some information; both of these disadvantages make the model not suitable for industries, which have really short term innovation cycles and secretive ones.

Another relatively new way of doing innovation is the Community-based development. Innovative communities are composed by individuals who improve existing products or develop a new one or even simpler sharing knowledge among themselves. There is a cooperative spirit and they are often willing to share all the phases of the activity, from the idea generation to the final outcome. Communities can rise spontaneously or they can be Firm-hosted ones [11]. Innovativeness is important in information systems research [13] and digital environments facilitating the innovativeness of groups of people are a vivid branch of research [14, 15]. Thanks to Internet and the telecommunications revolution, communities are no longer boundaries-constrained and they can "assembly" their innovative contribution together with people living also on the other planet face. People are willing to contribute with their innovativeness also for free mostly due to enjoyment based and learning based reasons. These forces are called also the "invisible wage" for community members. Broadcast search is another interesting way to look for innovation and it consists in a voluntary disclosure on specific platforms of a problem that the

firm has; after that, a self-selection takes place which leads to the coming up of the most innovative people. The ones who find a successful solution are rewarded by the company [16]. Empirical results suggest that the greatest solution came from innovators involved in distant field of expertize from the focal one of the problem [17]. Finally, Pyramiding Search is a process based on the assumption that individuals who have a deep passion for a topic are more likely to know people, which have a higher expertize level in the same field [18]. Doing Pyramiding search means to reach, step by step, the top of the expertize pyramid, where the most skilled people lay, using the complex network and relational capital that people have. Empirical studies have showed that Pyramiding, if compared to Mass screening, allows to have a sensible increase in efficiency of doing innovation, cutting cost and improving results [19].

The existing literature on designing mobile interfaces is broad and it offers different interesting point of views [20]. The discussion starts identifying the key role of Patterns as "guidelines" for implementing interaction design on the mobile phones. The concept of Pattern Language was developed for the first time in Architecture; it is referred to a structured way of detailing good design practices referred to an expertise field [21]. A pattern language is composed by: the vocabulary (i.e. operating system (OS), battery, screen, menu, toolbar, digit, phonebook, SMS, EMS, MMS); the syntax; the grammar.

The term Anti-pattern, on the other hand, is used to describe a pattern which is counterproductive, representing sometimes also a worst practice, contrasted by the more widely cited best practice [22]. A pattern variation is defined as a change, a deviation from the original pattern that gives birth to a new pattern, whose novelty grade can never be equal to 100 %. A series of basic principles are also highlighted in order to guarantee and an effective pattern, and they encompass principles like respecting user-entered data, allowing the device to act in a smart way, giving priority to user tasks.[1] Other authors identify principles of mobile interface design, reflecting each one a different area of designing interfaces [21]. For example, navigation models: designers can concentrate in one screen all the relevant information, or they can implement a tab bar which allows to change the different screens or, finally, they can adopt the drill down solution presenting the information in a hierarchical way. According to a previous studies when too much data are displayed at once, users preferred scrolling type and vertical browsing.

3 User Interfaces Study: The Method and the Research Questions

The main aim of this study is to discover and extrapolate the real rate of change of mobile phones interfaces. Disruptive changes can be also called technology inflection points defined as an event or a discovery, which turns into a big change,

[1] For example, if the battery level is low it would be annoying to repetitively report this information interrupting the editing of a SMS.

which creates a huge gap between the before-steady point and the after-steady point. Our research questions can be summarized as follows:

(i) Do mobile phone user interfaces changed significantly over the years?
(ii) Do mobile phone user interfaces show any significant variance across models and brands?
(iii) What type of innovation models best represents the evolution of this typology of information systems?
(iv) Did the major technological inflection points (like voice commands, predictive/intuitive text editor technology, touch screen input systems) contributed in the change of the user interface?

The integral database is composed by 788 entries, i.e. mobile phones of the top major brands of the world: Nokia, Motorola, Apple, Samsung. Their devices score in the list of the top 20 world phones most sold ever, since 1995, our cut-off date, up to date. Models available only for a specific market, and models that differ from the original one only for aesthetical features were not part of the sample. We extrapolated interface features by reading the instructor's manual of the 788 entries, by using evidence from the human-computer interaction and design interface literature [5, 23–26]. Features were logically grouped into two categories: (A) click depth and (B) other features. The Click Depth is defined as the minimum number of clicks required to perform a specified task with the standard configuration of a mobile phone. According to the dominant literature about click depth, an excessive click depth can results to be annoying and time consuming for users, who are more and more busy and exigent [27]. More precisely we considered the following tasks: compose a text message, perform a voice call, redial a recent called number, scroll the phonebook, add a new contact to the phonebook, set the alarm clock, regulate the display brightness, switch to an offline mode, switch to a silent profile, activate wireless connection, open calculator.[2] The other features considered were computed as Boolean variables: vibration, touch screen, voice commands, shortcuts, predictive text, and they helped us tracking the major technology inflection points.

4 Results and Implications

We divide our results analysis into four different steps to answer our four research questions: (1) change rate of mobile interfaces, (2) change rate across time, (3) change across the brands, (4) technology inflection points.

[2] Legend: Compose a text message = A1, Perform a voice call = A2, Redial a recent called number = A3, Scroll the phonebook = A4, Add a new contact to the phonebook = A5, Set the alarm clock = A6, Regulate the display brightness = A7, Switch to an Offline mode = A8, Switch to a Silent profile = A9, Activate Wireless connection = A10, Activate Bluetooth = A11, Activate Infrared port = A12, Activate GPS receiver = A13, Open Calculator = A14, Vibration = B1, Touch Screen = B2, Vocal commands = B3, Shortcuts = B4, T9 technology = B5.

(1) Change rate of mobile interfaces

For every single variable we computed all the descriptive statistics where little variance emerges for every single data. We then propose a Change Rate index, that takes into account the variance, the difference between mode and mean and the range of each case.

The Change Rate index (CR) can be so structured:

$$CR = \frac{\left(\frac{V_1 * N_1 * R_1 * (Me_1 - Mo_1)^2}{MeR}\right) + \left(\frac{V_2 * N_2 * R_2 * (Me_2 - Mo_2)^2}{MeR}\right) + \cdots \left(\frac{V_n * N_n * R_n * (Me_n - Mo_n)^2}{MeR}\right)}{N}$$

where:

- V is the variance value of each feature.
- N_n is the number of observation that contribute to the statistics related to each feature.
- R is the range value of each feature.
- Me_n is the mean value of each feature.
- Mo_n is the mode value of each feature.
- MeR is the mean of all ranges of the feature.
- N is the sum of all the number of observation that contribute to the statistics related to each feature.

The overall CR is equal to 0.3098 while the weighted average of variances is 0.6705. This latter result can let us to conclude that the change rate of mobile phones interfaces is pretty low. The simplified formula can be so expressed:

$$CR = \left(\frac{V_n * R_n * (Me_n - Mo_n)^2}{MeR}\right)$$

These are the results in terms of CR:

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A11	A13	A14
Mean	3.267	0.217	2.159	1.388	3.643	3.675	4.066	3.429	2.117	4.514	3.575	2.882
Mode	3	0	2	1	4	4	4	2	1	5	4	3
Range	5	4	4	4	4	6	6	5	4	7	6	4
Var	0.773	0.427	0.248	0.365	0.529	0.589	0.491	1.391	1.187	1.619	1.608	0.291
N	778	787	788	785	784	770	471	310	776	473	139	686
CR	0.056	0.016	0.005	0.045	0.055	0.076	0.003	2.889	1.205	0.544	0.354	0.003

Considering the CR index, it is possible conclude that the click depth levels of Redialing a previously called phone number, Regulating the display brightness and Opening the calculator are the most stable ones, among the sample. The core concept here is that if the core activity for a mobile phone is to call, click depth for call must be equal to zero, if it switches to be something else, the interface may change.

(2) Change rate across time

For this purpose, we decided to use a Multivariate Analysis [23]. In this particular case, Principal Component Analysis was helpful to summarize data without losing too much information (variance) of them. The first principal component has, by definition, the largest possible variance (that implies having the strongest explanatory power), [28].

The table of eigenvalues of the correlation matrix is shown below. When the p-value of the Mahalanobis distance observed is lower than the significance level equal to 0.02, the mobile model has been flagged as outlier.

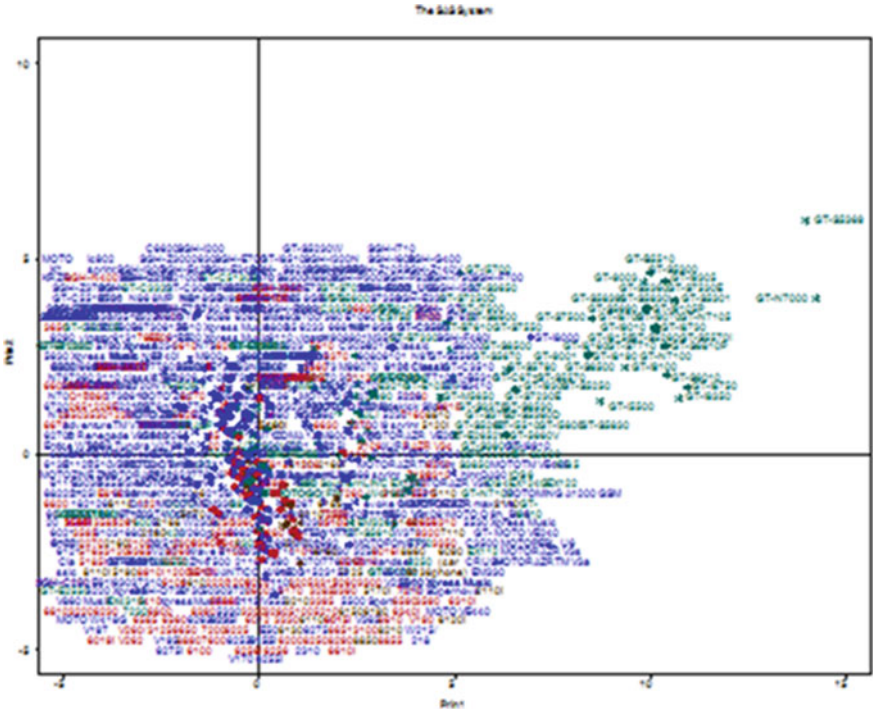
Eigenvalues of the correlation matrix

	Eigenvalue	Difference	Proportion	Cumulative
1	1.93679885	0.46938848	0.2421	0.2421
2	1.46741036	0.35907281	0.1834	0.4255
3	1.10833755	0.18013147	0.1385	0.5641
4	0.92820609	0.05614693	0.1160	0.6801
5	0.87205915	0.10668587	0.1090	0.7891
6	0.76537328	0.16031115	0.0957	0.8848
7	0.60506213	0.28830955	0.0756	0.9604
8	0.31675259		0.0396	1.0000

In accordance with the standard rule, we should consider 3 PC's, since only the first three exceed the unitary value; taking into account the first three eigenvalues we would explain the 56.4 % of the total variance. To test the Principal Components' capacity to explain the variances of each considered feature, we generated the correlations between the PCs and the column variables, the squared correlations that illustrate the explained variance percentage and the cumulated ones. The table below reports the cumulated percentages of variance explained for each variable, up to the number of considered PCs of six.

Obs	_NAME_	PROP_1_1	PROP_1_2	PROP_1_3	PROP_1_4	PROP_1_5	PROP_1_6
1	A1	0.06	0.34	0.55	0.62	0.64	0.96
2	A2	0.7	0.79	0.79	0.8	0.82	0.83
3	A3	0.6	0.62	0.68	0.68	0.71	0.71
4	A4	0.06	0.17	0.51	0.76	0.89	0.93
5	A5	0.01	0.51	0.57	0.63	0.67	0.95
6	A6	0.06	0.23	0.44	0.7	0.89	0.94
7	A9	0.02	0.32	0.32	0.54	0.96	0.96
8	A14	0.42	0.43	0.67	0.71	0.73	0.78

As it can be easily read from the table, all the variables exceed the value of 0.5 in terms of variance explained, which can be considered satisfactory for the sake of our aim. Moreover, it is possible to note that considering also the fifth PC would increase dramatically the explanative quality of the A9 feature. This makes sense since, as underlined previously, A9 refers to the click depth to switch the device to a silent profile; this task might be considered very relevant to be executed quickly for some manufacturers or designer while others did not consider the idea of inserting a shortcut by default. We then plotted data according two dimensional maps and the PCs. Each point plotted represents a mobile phone model. Our analysis is confirmed by looking at data over time. The following map shows the tendency along the two first principal components. It is useful to remember that these two PCs are mostly dedicated to explain the features A2 A3 A5 A14, partially A1 and A9.



The results here shows that the groups are pretty mixed, therefore we cannot report a significant difference in terms of mobile interface structure, according to devices' release date. The only exception can be detected for the 4 year group, colored on the map in green: this group refers to the newest mobile phones, the one released from 2010 to 2013. Since most of these devices are also touch screen, a

possible explanation could be that with the introduction of touch screen, the interfaces changed. To conclude, we can reject the hypothesis that mobile phones interface present significant differences among the years.

(3) Change rate across brands

The same Principal Component Analysis can be very useful to grasp if there are any meaningful differences in terms of interface among the considered brands, i.e. Apple, Motorola, Nokia and Samsung. Similar plotting of data along the PCs shows that, with the exception of touch based interfaces, meaningful differences across the brands do not exist.

(4) Technology inflection points

As discussed previously in this study, it might be interesting to discover what happened to mobile phones interfaces in correspondence of main technology inflection points, summarized in the application of predictive/intuitive text editor technology, voice commands and the blooming of touch screen mobiles. We used Boolean variables as discriminant element to grasp the change rate of interfaces in correspondence of main inflection points. The results show that only the touch screen technology marked a meaningful inflection point in the user interface, by looking at the results of the PCA. This may let us think that interfaces experienced rather an evolution more than a complete renewal when devices started to be equipped with touch screen.

5 Discussion

At this point it seems that manufacturers try to show a degree of change much higher than how their device interface actually change. The reason why firms want to show that their new products are very innovative and different from the previous existing ones, is pretty obvious: since in the developed world often consumers change their products not because these last ones are not working anymore, multinationals have to give them a reason to do that. Presenting a new model similar to the previous one, would not probably push a potential customer to finalize the purchase. On the other hand, investigating the reason behind the fact that manufacturers did not change the interfaces of the mobile phones, which they produce, can turn into a less immediate conclusion. A first explanation could be done using the notion of economies of scale: as quantity of production increases, the average cost of each unit decreases, thanks to the higher level of distribution of fixed costs among the single pieces. A second and maybe more determinant aspect is that customers are sometimes assaulted by a fear for change; in other words, people are amused by and resistant to the change at the same time. Customers are often prone to resist innovations also when these ones can be very beneficial and

desirable to increase the customer value. They remark the fact that a major cause of market failure for a new product is exactly the resistance encountered by the potential customers. Firms advertise their product interfaces as being innovative, because this is what customers want to hear. On the opposite side, these interfaces are not truly innovative, because this is not what customers really want after having purchased a new device. This sort of dualism can explain the empirical gap between what being advertised and what being in reality. If the flexibility of an interface gets higher, its usability grade goes down. This is due to the fact that a more complex or different interface requires more learning efforts form the users, that can also cause at a first usage a sense of disorientation. This aspect is particularly crucial due to the fact that the customer's first impression is often the one which leads and determines the product's judgment and evaluation. At this stage the reason behind what evidenced by the analysis becomes more clear; mobile manufacturers firms do not have any incentive to strongly modify their product's interfaces, both for cost effectiveness reasons and for customer satisfaction ones.

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The Psychological Contract as an Integrative Governance Instrument of the Legal Outsourcing Contract

Franca Cantoni, Alessandro Zardini and Cecilia Rossignoli

Abstract Outsourcing is a managerial procedure whose success needs clarification regarding the long-term relationship between customer and supplier. The authors' aim is to examine simultaneously the client's and supplier's perspectives through the psychological contract that, by assimilating the contents of the legal contract, focuses on (1) the implicit (not formalized) and reciprocal (mutual) duties between the two parties, (2) the equivalence of psychological obligations and contractual values and (3) the importance of the individual commitment level. While the legal contract is managed and based on an organizational level, the psychological contract is individual and perceived as such: from the authors' point of view, all workers, regardless of whether they work inside or outside the company, are part of the psychological contract. The authors employ a case study represented by an outsourcing center belonging to a group of Italian banks, using the "qualitative and quantitative" mixed method. In the first phase, a series of interviews will help identify the key variables to develop a questionnaire for both customers and suppliers. The second phase will comprise the interviews and questionnaire formalization. The two themes, the psychological contract on the one hand and the outsourcing governance on the other hand, represent a highly relevant matter that has received scant attention in the literature.

Keywords Outsourcing · Psychological contract · Case study

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1 Introduction

The idea of an outsourcing relationship based on the mere formalization of cogent contractual mechanisms, refined at an inter-business level and mainly intended to reduce opportunistic behavior, presumes an unbalanced relationship between the client and the services supplier. Instead, the authors propose the idea of creating and reinforcing strategic partnerships through the development of a governance integrative instrument (with the legal document)—namely, the psychological contract. This paper is structured in five paragraphs. In the first paragraph, the authors analyze the conflict in the legal contract between the protection of the relationship, which can be generated between outsourcer and outsourcee, and its integration, which can be provided by the psychological contract. The second paragraph presents the themes of outsourcing and the psychological contract. In the third paragraph, the authors present the context, the research questions and the adopted methodology, and in the fourth paragraph, they discuss the main elements arising from the current investigation. In the fifth paragraph, the authors propose the importance of the psychological contract as an integrative instrument complementing the legal contract. The work ends with conclusions and some reflections on the research in progress.

2 The Outsourcing Contract: The Incompleteness of the Legal Aspect

Several authors have provided definitions of the concept of outsourcing as a preliminary discussion for their own research:

- Some authors consider outsourcing a "*business practice*" [1] that materializes with the purchase or external transfer of some services [2–6].
- Other authors consider outsourcing an appeal to external sources to carry out activities that have traditionally been performed by internal resources [7] and others see this as a sub contractual process for some functions [8, 9].
- Still other authors [10, 11] treat outsourcing as an instrument to realize companies' reorganization, in which they focus their resources on activities that constitute their *core competencies.*

Literature on these aspects is prolific and rich; nevertheless, some undeniable limits in definitions exist.

Contractual aspects. Only a few authors have referred to the contractual aspects of outsourcing [12, 13]. The most typical schemes adopted to contextualize and regulate the outsourcing contract have included the tender contract (one party accepts, at its own risk, the necessary means and management of the work or service in return for money), the supply contract (one party agrees to work or provide a service in return for money, mainly independent of and without

obligation of subordination to the client), and even the under-procurement contract (a customer company commits, in part or completely, its production of works or services to another company, reserving only a commercial role). The choice of one scheme or another depends on the agreed-on responsibility and its corresponding consequences, as the entire regulation of the chosen scheme must be applied.

Nevertheless, all the outsourcing contracts have a common characteristic: the relationship between client and supplier, with more or less intense co-operation, involves a services' performance that can be either short or long term, depending on the kind of role or the externalized activity.

Temporary aspects. Another factor that authors have examined but should be considered a key factor in the outsourcing relationships is time [14]. Outsourcing contracts must be configured according to a medium or long-term relationship (depending mainly on the achievement of prefixed results) that emerges between two parties with the same aim to achieve success in the project. That is, both parties must gain some economic advantages derived from the relationship itself [15].

To overcome the main limits of the contract itself and its temporary nature, the authors define "outsourcing" as an external organizational modality of services, activities or function, in which it is necessary to refine a set of associative and/or trade contracts of a medium or long period between the company that externalizes (outsources or client) and the company that operates in the specific market area (outsourcer or supplier).

Thus, the main purpose of this research is to examine the concept of contract duration.

Together with the need to form a legal contract that satisfies a client's recommendations and needs, this research shows that most contracts are insufficient and unsuitable because of the difficulty in planning a normative long-term project due to:

- rapid changes in technology and in the need to transfer innovative content to the client and
- environment tumultuousness (structural changes in a client's organization and fierce competition).

To satisfy client's recommendations and needs, it is insufficient to establish the outsourcer—outsourcee relationship simply by honoring the specifications contained in a cogent and constraining legal contract.

As affirmed previously, this research abandon's the idea of an outsourcing relationship based solely on the mere formalization of a cogent contractual mechanism—which mainly attempts to reduce opportunistic behavior presumed from the unbalanced relationship between client and services supplier—in favor of creating and reinforcing strategic partnerships based on the equality of the relationship.

When acknowledging the value of the psychological contract as part of the legal contract, many concepts will change accordingly, as will their analysis and monitoring. For example:

- The research will address not only the "customer" but also "supplier satisfaction" and the integration of these two concepts [16];
- Important changes will occur even at the obligation level: that is, the research will address not only "do utes, faciout faces" (obligation for obligation) but also a "bundle" (set or obligation system).

This study views the mutual respect of the psychological contract from all the involved actors as the foundation for success in the outsourcing relationship. The vision of outsourcing as a mere legal contract unbalanced toward the supplier will be abandoned in favor of the combined management of the relationship. The idea of outsourcing as a managerial procedure that aims solely to remove the client from the management of non-core activities therefore becomes obsolete and unacceptable.

To comprehend the concept of the psychological contract and its integrative nature with respect to the legal contract, the authors next define the psychological contract and illustrate how it can be unified with the outsourcing legal contract.

3 Outsourcing and Psychological Contract

Several authors have examined the psychological contract, and Table 1 provides the principle definitions in chronological order.

The mapping of the examined literature shows that these different definitions are in most part limited and partial and omit aspects that are sometimes essential to understand the real nature of psychological contracts. For the present work, the authors posit that the psychological contract is an unwritten contract, comprising a set of expectations and obligations between client and supplier, in parallel with the obligation included in the legal contract, that formally constitutes the outsourcing relationship. In summarizing the main data from Figs. 1 and 2, a primary consideration arises.

This comparison shows that the literature on these two themes indicates a strong match point between 1991 and 2005. The authors thus attempt to unify the two themes by illustrating the context and research method adopted to demonstrate how the psychological contract can efficiently be considered a governance integrative instrument in relation to the legal outsourcing contract.

4 The Context, the Hypothesis and the Research Method

Regarding the context of analysis development, the authors found complete cooperation of SEC Services, a consortium established among several banking houses with the aim to provide banking and technological practicality services to their members [17] and clients [40].

Table 1 Definitions of psychological contract

Author	Definition
Argyris (1964)	Implicit contract assumes mutual obligations, expectations and values, which are not included in the legal contract [23]
Gouldner (1960)	Bases his theory on the legal standard of the reciprocity of individual and company, in terms of respect and mutual duties derived from the rules of equity and justice [17]
Levinson et al. (1962)	Set of mutual expectations accepted by both the company and the worker. Nevertheless, it must be clear that it can be difficult to identify the implicit expectations of the two parties [24]
Schein (1965)	What the worker expects from the company, not only in terms of salary but also from a psychological point of view. At the same time, the psychological contract includes the company's "expectations" of the worker [25]
Kotter (1973)	Implicit contract between individual and company that presumes what both parts expect to receive through the establishment of the work relationship [26]
Rousseau (1989)	Personal trust in the mutual obligation generated through the relationship between individual and company [27]
Rousseau, Greller (1994)	Set of actions developed by the company to make the worker stay with the organization, in an effort to foresee his or her possible actions [28]
Heriot, Pemberton (1997)	Process that specifies obligations and expectations that develop from the work activities, from the point of view of both worker and company [29]
Meyer, Allen (1997)	Consists of opinions and expectations of both parties, conditioned on a relationship that generates mutual obligation [30]
Morrison, Robinson (1997)	Mutual expectations and duties that occur between company and worker. These obligations arise from perceived promises from the company's agents [31]
Guest, Conway (1998)	This kind of contract must be analyzed on the basis of the relationship that occurs between worker and company. It is important to analyze both the point of view of the company and the worker about expectations and obligations [32]
Auteri (1998)	Set of ideas, convictions and expectations generated from the work and more specifically from the implicit agreement among individual, community and companies [33]
Weizmann, Weizmann (2001)	New concept that substitutes the security of job for the security of career advancement. Workers are informed about politics, procedures and opportunities created inside the company. Therefore, workers can obtain concrete expectations and become more responsible of their needs [34]
Tosi, Pilati (2002)	Opens a chapter on performances and legitimacy of work authority. They posit that the company's requests included in the contract limitations bring about worker satisfaction—that is, legitimate authority. Conversely, when the company goes beyond its authority, workers who accept requests beyond those limitations enter a zone of potential non-acceptance [35]

(continued)

Table 1 (continued)

Author	Definition
Conway, Briner (2005)	Relationship that occurs between the company and the worker. This is a commercial relationship in which people offer their knowledge of something and expect to receive what the company has to offer in return [36]
Costa, Gianecchini (2005)	Interior disposition of a legal obligation or technique (bound to the spirit of sacrifice and co-operation)and trust in a strong commitment to gain expectations (implicit and explicit, formal and informal) are the basis of the relationship, to find a mutual adequate solution for both parties [37]

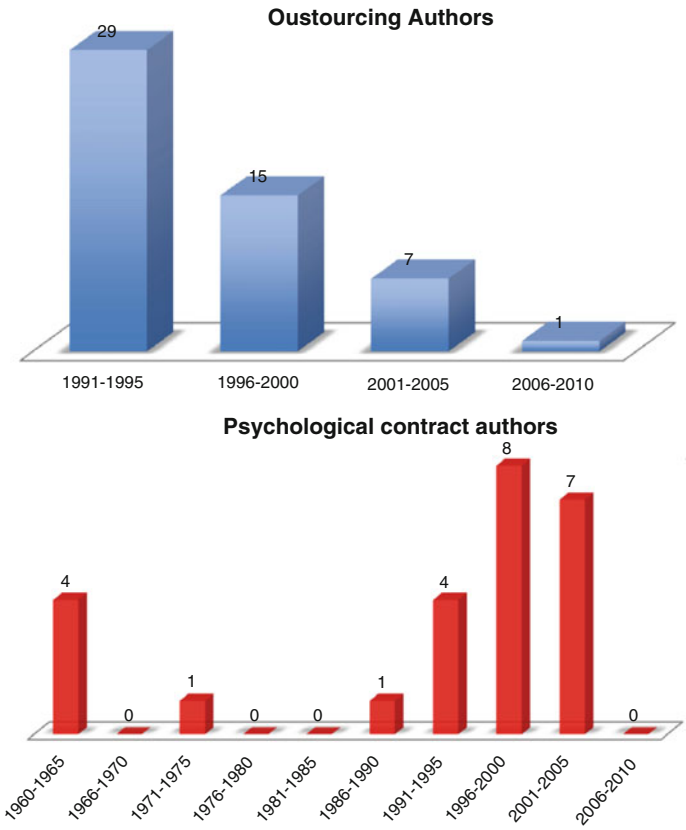

Fig. 1 Temporary evolution of the authors who have defined the concept of outsourcing and psychological contract

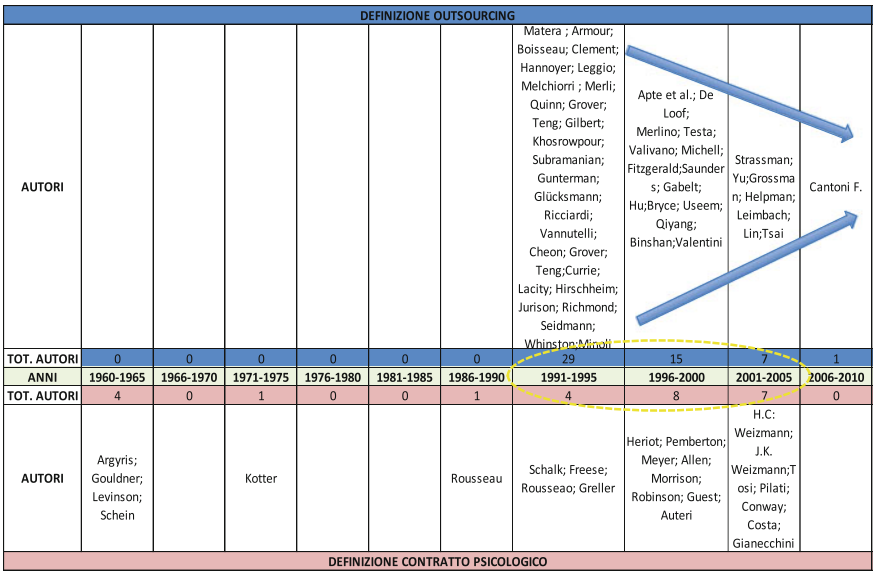

Fig. 2 Chronological comparison between the academic interest in the outsourcing themes and the psychological contract

The goal of SEC is to be a transparent, efficient and reliable partner, able to qualify clients' businesses, achieve cost reductions and improve managerial and functional systems over time.

With the aim of the company and client to reduce cost and improve contemporary managerial and functional systems, along with the pledge to provide complete support to the associated banks and their clients, the development of a strategic long-term relationship is crucial.

To realize its own mission, SEC treats the creation of a strategic development path for the relationship with its own members and clients as an instrument to provide constant and increasing improvement in quality management and performance for both its members and itself.

A relationship based on mutual trust, the reinforcement of the relationship based on the equality of the contracting party and the building of mutual trust are all fundamental elements for reciprocal growth.

Because the aim of SEC is to improve its relationship with the client, this research investigates the key elements, or levers, that can help it enhance the quality of a trustworthy relationship.

This need is reinforced through SEC's primary objective to anticipate the client's needs before they become evident and to improve innovation transfer to the client.

On the basis of the levers needed for a bilateral and balanced improvement of the relationship, the authors establish the construction and reinforcement of the psychological contract concept.

Therefore, the research questions are as follows:

(1) Which mutual obligations (client and supplier) constitute the psychological contract in an outsourcing relationship?
(2) What are the impacts of these obligations on the success and, therefore, the improvement of the relationship with the client?

The authors adopt a progressive, qualitative and quantitative research method to develop and test a model that focuses on improving the relationship between outsourcer and outsourcee.

At this time, the research is still in progress, and the authors are engaged in the qualitative study, which involves identifying the nature of the obligations that constitute the customer–supplier relationship and adopting the interviews methodology.

The quantitative study, which will take place in the second phase, will investigate the impact of the mutual obligations on the success of the outsourcing relationship and the effects of violations over time.

4.1 Mixed Method: Research Hypothesis, Development and Questionnaire Submission

In the following, the authors explain the research method initially based on interviews (Table 2). The track for the interviews management derives from the limited literature that characterizes this field of research. From the emergent indications, the authors develop the research hypotheses (11 in total). Section 3.1.2 provides a summary of these hypotheses.

4.1.1 The Research Hypothesis

The research hypotheses that are likely to be tested through the submission of the questionnaire are presented in Table 3:

In the following step (Sect. 3.1.2), the authors elaborate on both the research model and the definition of related variables.

4.1.2 The Research Model and Its Variables

The adopted model consists of two variables (x,y), where y is the dependent variable that measures the level of improvement in SEC services and x is the

Table 2 Excerpt of the interview

Questions	Biographical references
What is your role inside the bank? What are your functions?	
What do you think about the actual condition of outsourcing in the bank context? Is it developed or is it just at the beginning? What is the role of CIO in relation to outsourcing?	
What kind of relationship do you have with your suppliers? Is this true for all of them, or do you manage different relationships in relation to different suppliers? [38]	Kern, Willcocks 2000
What are, in your opinion, the mutual obligations that client and supplier have to respect in a post-contractual phase? What are, in your opinion, the key points for a successful relationship between client and supplier? [39]	Koh, Ang, Straub 2004
How much are you involved in the choice of outsourcer in relation to the outsourcing project? What are your contributions? [39]	Koh, Ang, Straub 2004
What is the role of relationship factors as communication, control, information sharing, integration between client and supplier in the outsourcing? [39]	Koh, Ang, Straub 2004
Which is the role of trust between client and supplier? [38]	Kern, Willcocks 2000
How do you manage the role division? [39]	Koh, Ang, Straub 2004
In your opinion, what are the key factors that make easier (or that enable) the strategic development of the relationship with the supplier?	
Can you tell us about circumstances in which you have taken part or that you have witnessed where the client-supplier relationship has had success as a strategic factor for business? What is your opinion about this experience? In your opinion, what have been the determinant factors for success? Can you tell us about circumstances in which you have taken part or that you have witnessed where the client–supplier relationship has failed as a strategic factor for business? What is your opinion about this experience? In your opinion, what have been the determinant factors for failure? [39]	Koh, Ang, Straub 2004
What have been the emerged problems (it there have been) in the management of this kind of relationship? [39]	Koh, Ang, Straub 2004
Has the relationship between client and supplier evolved during the passing of years? If it has, can you tell why and how? [38]	Kern, Willcocks 2000
Which perspectives can you see in the future regarding the relationship you already have with your supplier? And why?	

independent variable that measures the lever on which the company must act to increase the quality of a trustworthy relationship. Table 4 presents examples of levers that account for the measurement of Y—that is, affirmations related to the degree of satisfaction with the economic results of the bank:

Conversely, the variable X is independent and, as mentioned, measures the lever on which the company must act to increase the quality of a trustworthy relationship. In this case, the aim is to investigate which relationship behaviors help improve the partner relationship and therefore enhance the psychological

Table 3 Research hypothesis to be tested

H1	The sharing of information facilitates the improvement of the services offered by SEC to its own client SEC
H2	The co-operation between bank users and SEC workers has a positive impact on the level of service offered by SEC
H3	The high involvement of users in the various phases of the project has a positive effect on the services offered by SEC
H4	Training bank users in terms of knowledge about the new products/services provided by SEC has a positive effect on the services offered by SEC
H5	The willingness to offer e-learning services about current product/services has a positive effect in the quality improvement of the relationship between SEC and users
H6	The trust between client and supplier is of vital importance for the quality improvement of the relationship (in this case, trust indicates the reliability of the partners and, therefore, the respect of the legal contract)
H7	Having in-depth knowledge of the client's business and also understanding and anticipating its needs have a positive effect on the outsourcing relationship
H8	The monitoring of the services provided by SEC facilitates the improvement in the quality service
H9	The clarity of the client's requests enhances the success of the outsourcing relationship
H10	A formalized communication system among users, the bank and SEC increases the success of the outsourcing relationship
H11	Excellent relationships among partners facilitate innovation in terms of new products/ services provided by SEC

Table 4 Lever for the measurement of the variable Y

Assertion 1	In the past 3 years, the informatics system provided by SEC to the banks has been considered fundamental for the improvement of the relationships between the banks themselves and their clients
Assertion 2	In the past 3 years, the informatics system provided by SEC to the banks has been considered fundamental for the improvement of the degree of satisfaction between SEC and other bank clients
Assertion 3	In the past 3 years, the informatics system provided by SEC to the banks has been considered fundamental or significant for the improvement of competitive banks strategies (e.g., from the opening of web sites or new mobile services)
Assertion 4	In the past 3 years, the informatics system provided by SEC to the banks has been considered fundamental or significant for the improvement in banks reputation or image
Assertion 5	In the past 3 years, the informatics system provided by SEC to the banks has been considered particularly significant for the improvement in coordination modalities and co-operation inside the associated or client banks

contract between SEC and the banks and between SEC and the suppliers. Examples of levers to measure X appear in Table 5:

Some assertions are intentionally repeated using different words or stated in a negative sense (i.e., they assert the opposite of what was asserted previously): these are control questions that serve to verify the goodness and truthfulness of the answers provided by the interviewees.

Table 5 Some levers for the measurement of the variable X

Assertion 1	The sharing of information between SEC workers and the associated banks and clients helps improve the psychological contract (Rif. H1)
Assertion 2	SEC and the banks maintain good interpersonal relationships to facilitate the sharing of information and resources (Rif. H1)
Assertion 3	The sharing of information is facilitated by the strategic alliances among the involved parties (Rif. H2)
Assertion 4	The partnership among the parties facilitates the sharing of knowledge (Rif. H2)
Assertion 5	The organizational set observed in the relationship between SEC and the associated bank and clientshelps foster a high degree of co-operation among all the parties (Rif. H2)

5 Some Preliminary Results

The interviews clearly show that some themes are particularly pertinent for both *customer* and *supplier*. Themes about trust [18, 19], co-operation and information sharing [20] are central and frequently considered. With regard to trust, which is an important element in the psychological contract, the interviewees reported both different and complementary points of view. They perceived trust not only as the ability to respect the assumed obligations, even if not formalized, but also as an attitude that results from a positive evaluation of facts, circumstances, and skills of the other parties involved. In turn, these factors generally produce feelings of self-confidence and serenity toward the counterpart that has a long experience in the field. Trust not only involves the relationship between supplier and client but also the relationship with the situations that, in a long run, will become mutually lucrative and successful.

Other important cornerstones of the psychological contract in an outsourcing context are knowledge cooperation and sharing. These aspects have been carefully analyzed, and thus it has been possible to define the different research hypotheses. Nevertheless, what clearly emerges is the importance of the relationships between supplier and client through a partner vision. It is necessary to dedicate great attention to the inter-/intra-organizational relationships [21] to clearly specify the people who help realize the outsourcing relationship. Defining the particular interactions is essential but not sufficient. That is, it is also necessary to define clearly the roles, responsibilities and authorities of the interlocutors. These are the main elements that must be considered to achieve success in an outsourcing relationship [22].

The research project is now in its preliminary phase, and the authors are engaged in the transcription of the interviews that, for a correct and detailed analysis of the transcribed text, will be elaborated with Atlasti 7, a powerful workbench for the qualitative analysis of large bodies of textual, graphical, audio and video data.

6 Conclusions

This paper's contribution lies in the unified discussion of two research themes that the literature has presented singularly, leading to limitations in their development. Therefore, the aim of this paper is to define a new model to formalize the relationships between psychological contract aspects and outsourcing contracts. Moreover, *Banca d'Italia* (which recognizes EU laws) has recently discussed a new normative. That is, among several innovations, it has also introduced some themes connected with externalization modalities and governance. Because the normative is still in an early phase, the aim in this context is simply to highlight the relevance and actuality of this matter not only in Italy but also at the level of EU laws. This is a work in progress; during the next months, we will proceed with analysis of the interviews for the qualitative research. After this preliminary study, we will obtain information to develop the survey for the quantitative analysis.

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Processes of Technological Change in Healthcare Organisations: An Analysis of Coordination and Effectiveness

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Abstract The main goal of the paper is to explore the importance of the complementarities between ICT and organizational change in order to plan new organizational forms. In particular, the paper analyzes whether and how technology can be an important instrument of coordination for healthcare organizations. Results from our empirical research indicate that ICT solutions and initiatives play a significant role in improved information management and therefore re-engineering of business processes. We show how traditional organizational models and coordination are no longer consistent and sufficient in turbulent environments such as that of the Italian health. ICT provides new ways of coordination and control. So the traditional coordination mechanisms are scaled or enhanced with the use of ICT.

Keywords Organizational change · ICT · Healthcare organizations

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1 Introduction

Recent literature on the productivity gains attributable to the adoption of information and communication technology (ICT) has stressed the importance of the complementarities between ICT and organisational change. ICT enables a large amount of information to be processed and disseminated and reduces information costs, facilitating a higher level of coordination. There are two prerequisites to the implementation of ICT in organisations: the codification of organisational processes and the standardisation necessary to allow for full information exchange among the various processes [1]. The introduction of ICT is less costly and more effective in internal and external corporate activities that are already formalised before an organisational change process. ICT diffusion is therefore faster in large firms and in the supply chains that they dominate. The impact of new technologies on organisational change is still moderate and appears to be strongly related to firm size. Today, challenges to organisational effectiveness arise from activities related to not only products/services but also, and more important, coordination. Most entities that collaborate need to coordinate the flow of information. Specifically, ICT can be used to facilitate not only production but also coordination in organisations to reduce transaction costs and information-related coordination costs that affect organisational effectiveness [2]. Therefore, in this study, we examine whether traditional organisational models are sufficient to promote coordination in turbulent environments such as that of the Italian health sector. ICT provides new ways of coordination and control, and thus, traditional coordination mechanisms can be scaled or enhanced through the use of ICT. The main goal of this paper is to analyse the use of ICT to plan and organise organisations with new structures, which require to organisational variables and management styles [3].

ICT is considered a strategic resource that is necessary and important for the success of healthcare organisations in the current economic climate. However, there is little empirical research on ICT in the public healthcare sector. Identifying the characteristics of the processes and the services offered by.

ICT in the health sector could help to increase the effectiveness of healthcare organisations. Accordingly, this research aims to provide an understanding of the use of ICT in the public health sector to facilitate not only production but also coordination.

2 ICT and Organisational Change

The introduction of new technologies requires the development of processes of organisational change; however, often, new ICT systems are simply used to change an existing organisational structure.

A unique relationship exists between the design of organisational structures and the role of ICT; particular organisational structures require specific information

systems to support the structure, while the availability of certain technologies or conditions favours some organisational structures over others [4]. Much discussion in the international literature has focused on the impact of ICT on organisational structures and identified four ways in which ICT affects organisational structures.

ICT significantly affects the roles, power structures, and hierarchy within organisations; ICT is used in designing new organisational structures to facilitate coordination; ICT influences organisational boundaries producing new organisational models and organisational structures based on market needs rather than internal hierarchy; and, finally, the organisational change facilitated by ICT promotes the integration of systems within organisations [5]. Technology is dynamic and influenced by the context and strategies of decision makers and users [6]. Another stream of research has studied technology as a trigger of structural change. This perspective considers technology to be a social rather than a physical object, while the organisational structure is conceptualised at a process level [7].

The introduction of ICT changes the power structure of centralised and decentralised organisational structures while modifying the existing organisational structure [8]. Technology creates new rules for coordination and control that replace traditional mechanisms of coordination based on human resource availability and capacity. In facilitate coordination [9], ICT should be used with an integrative approach [10] to manage organisations' structured processes with a high interdependence on information [11].

3 ICT and Organisational Change in Healthcare Organisations

The implementation of ICT requires an organisational change that, particularly in the healthcare sector, is complex and long lasting [12].

The introduction of information systems in any industry requires a reconfiguration of an organisation's business model, particularly the strategic planning, mission, strategic goals, and options that create value for stakeholders. The structure of the Italian healthcare system resembles "concentric rings" around citizens, the main subject of the healthcare service. Healthcare services, which are spread along a health-illness-health continuum and differentiated in terms of complexity and intensity [13] within a wider range of organisational structures, involve complex interactions between financial backers, "regulator" subjects, companies, and many other organisations. The on-going impact of the business/organisational paradigm has changed healthcare organisations from simple systems in simple environments to complex systems in complex environments.

Different levels of complexity can be detected from the degree of agreement (between the different actors involved) and the degree of uncertainty [14]. A complex healthcare system uses ICT in an evolutionary logic as a response to change and as a tool to promote the universality and equality of healthcare.

The use of ICT in healthcare organisations is based on the principle that human health is in a relationship with all other environmental realities, both natural and manmade. This approach emerged by considering the role and effectiveness of medicine and aims to address global health-related problems and both the production and the delivery of effective healthcare services.

It is important to move the centre of gravity of the change to allow citizens to become active actors who are able to take care of themselves and choose the organisation that will allow them to receive the clinical care and benefits that they perceived to be most attractive. Based on this logic, ICT has the capability to store and manipulate knowledge as well as to implement effective internal and external communication systems. The use of ICT is spreading in all healthcare sectors (form hospitals to pharmacies), affecting all existing relationships and creating new relationships among the actors. The increasing access to information inside and outside the health system allows citizens to demand more information on the state of their health, the patient path they can follow, and the supply of and available alternatives to health services that the can receive; moreover, access to such information provides healthcare managers with data on the clinical courses of patients. Information systems facilitate the development of an organisational network, ensuring that knowledge and skills can be transferred effectively.

Integrating technology into organisations requires an increase in synergies through the focused development of the existing information flows between healthcare organisations and between healthcare organisations and patients to achieve a higher level of patient satisfaction, thus increasing the relational system of organisations. Thus, an ICT framework must be implemented to handle data from several healthcare information subsystems in order to provide a social healthcare network that can generate and deliver electronic data at the right time and in the right place for anyone involved in the patient care process. Interoperability is thus essential for developing a reticular organisation, as well as a higher level of organisational analysis requested for a single healthcare organisation. ICT is the most effective catalyst with which to provide answers to the demands required by such change, as ICT can provide models and tools to coordinate the flow of information and introduce innovative elements into organisations (related to the structures of organisations, characteristics of work, and nature of the environment) [15].

4 Methodology and Research Context

ICT is a strategic resource and is essential to the success of healthcare organisations in turbulent, dynamic, and complex environments. This empirical analysis is a qualitative investigation conducted based on grounded theory. In the case of healthcare work, much can be learned about the mediating functions of physical artefacts in articulating individual activities. The grounded theory approach is a qualitative research methodology that emphasises the iterative nature of discovery, especially in studying complex human activities in a rich social context. The

essence of the grounded theory approach is generative as opposed to confirmative. Because of its nature, the theory is applicable to studies on phenomena that are not yet well defined. The grounded theory approach provides procedural guidance to qualitative analytic methodologies [16]. Our research context for the empirical investigation is the pharmaceutical sector, which is very attractive research context because of the use of new ICT devices in the sector.

The support from and use of technology in pharmaceutical facilities appear to be crucial in facilitating the drug management process. An international study has reported high rates of error in the drug supply chain [17]: 4 % error in distribution and 18 % error in the preparation phase. The same study analysed the causes of such errors, attributing 20 % of errors to working routines, 18 % to inadequate controls, 12 % to packaging, and 17 % to poor communication. Reducing the risk of errors is closely linked to policy restricting governmental expenditures on the pharmaceutical industry. Within this context, the use of technology may reduce both drug production errors and clinical risk arising from reduced pharmaceutical spending. ICT applied to the drug management process of aim to:

- overcome repetitive manual tasks, which are more prone to human error;
- ensure the traceability of the prescription, dissemination, and administration of drugs;
- distinguish between the responsibilities of the various actors involved in the process (e.g., doctors, pharmacists, nurses), allowing all actors to take ownership of their specific expertise;
- optimise the use of capital (inventories).

The study analyses a detailed and explorative case study. Pharmacies, as the object of study, were identified in accordance with So.re.sa[1] and the ASL of Caserta. In applying the methodology of a case study analysis, we gathered, coded, and analysed data from the primary and secondary sources (see Table 1) mentioned above. We used unstructured interviews with the main actors involved in the change process.

The analysis is based on the identification of key processes related to the management of pharmacies. The analysis was performed through a focus group with the management of So.re.sa and the ASL of Caserta to elucidate on the challenge of establishing coordination tools and mechanisms that are specifically geared towards bolstering ICT at both the product and the process level.

The interviews explored the following variables:

- logistics and supply processes;
- roles, structures, and workforce;
- skills and professionals involved in logistics and storage management;
- ICT for processes.

In the last phase, the cases were reviewed through discussion with and observation of participants within the pharmacies to reduce interpretative distortions.

[1] Società Regionale per la Sanità S.p.a., or So.re.sa, is a company located in the Campania region of Italy with the mission of realising strategic actions to reduce regional health expenditures.

Table 1 Data sources

	ASL Caserta
Document (*secondary sources*)	Internal reports 2009–2010–2011 Budgets Planning documents Control check-list
	Yearly reports for region and General Administrative Office of asl
Non-structured interviews (*primary sources*)	General director, administration manager, health manager of ASL Caserta interview
	CEO of So.Re.sa interview
	Managers of pharmacies interview
Direct observation (*primary sources*)	Observation of work processes analysis of interdependencies between activities analysis of interdependencies between actors (General Administrative Office of asl Caserta/pharmacies of ASL Caserta/Soresa)

5 Empirical Analysis

5.1 The Survey

Assessments were made after having visited the pharmacies and interviewing the management and heads of the local health authorities (the general director of the ASL of Caserta and So.re.sa, the administration manager of the ASL of Caserta, and the health manager of pharmacies belonging to the ASL).

The study also involved an analysis of the relevant processes, and the parameters represented a methodological framework that was used for the empirical survey.

The case study included in a field survey of 13 pharmacies of the ASL of Caserta, which have 15 warehouses.

The complexity of the Caserta area led the ASL to choose a double supply and distribution channel: one part is internalised in the pharmacy system, and the other is outsourcing (Table 2).

As shown in Table 3 and from the steady increase in the cost of drugs, outsourcing is the only organisational alternative to the operative management of the warehouse.

The constant trend of increasing orders led to an exponential effect on the overall costs of the ASL, resulting in negative overall efficiency (Fig. 1).

The annual statements and economic results were also analysed together with the governance mechanisms and the regulation of major processes: procedures, manuals, regulations, certifications, information systems, accounting systems, governance (statute and corporate agreement), management reports, service menus, organisational models/standards, and so forth.

The analysis focuses on two levels:

Table 2 Pharmaceutical logistics in figures

Movement	326.322
User	79.840
Hospital beds	782 (di cui 154 Day Hospital)
Cost of the drug for inpatient	218.479
Cost of the drug for outpatient	41.382.264
Cost of the drug outsourced	30.292.580

Table 3 Pharmaceutical logistics in figures

	2009	2010	2011
Order	5.062.118	6.994.339	7.297.300
Total cost of drug	27.115.038	56.714.933	75.805.179
Cost of the drug for inpatient	120.836	222.402	218.479
Cost of the drug outsourced	–	15.253.767	30.292.580
Cost of the drug for outpatient	25.633.613	38.364.143	41.382.264

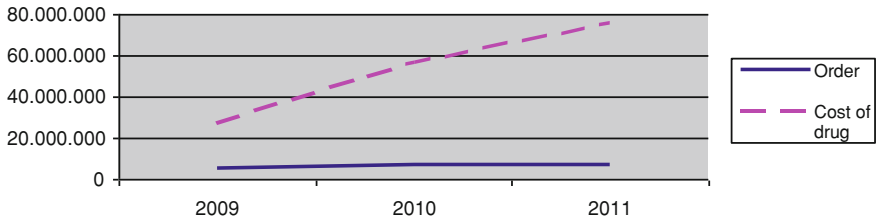

Fig. 1 Pharmaceutical logistics in figures (*Source* the authors' elaboration)

1. Studying information and activities and analysing the resources that are involved and when activities are implemented;
2. Studying the organisational structures of the pharmacies of the ASL to identify the crucial processes of the pharmacies.

In this context, we used a qualitative approach with two basic data gathering methods: *focus groups* and *semistructured interviews*.

5.2 The Case Study

This study also involved an analysis of the relevant processes, and the parameters represented a methodological framework used for the empirical survey. Assessments were made after having visited the pharmacies and interviewing the management and the heads of the local health authorities (the general director of the ASL of Caserta and So.re.sa, the administration manager of the ASL of Caserta,

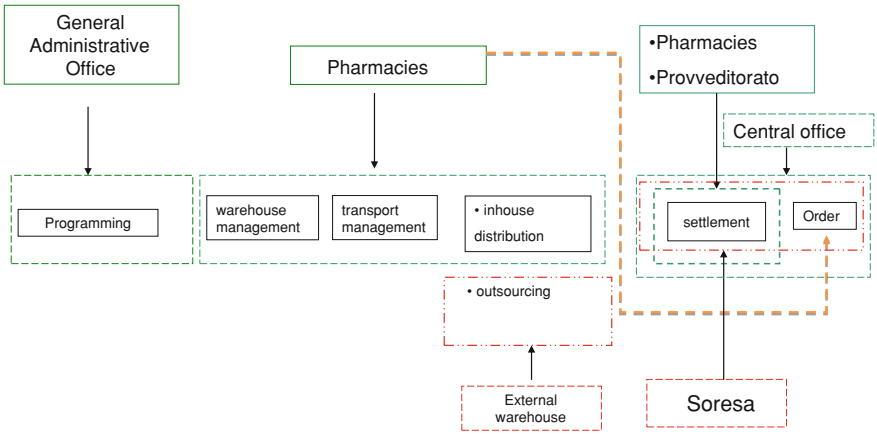

Fig. 2 The process of drug management: activities and units (*Source* the authors' elaboration)

and the health manager of pharmacies belonging to the ASL). In particular, our analysis is based on an interpretative and qualitative investigation [18] with the premise that the data and information that are collected cannot be explained or illustrated in a self-sufficient manner. Rather, it is necessary to become familiar with the material collected and elaborated during the investigation. The nonparticipant observations and the interviews allowed us to analyse and rebuild the path of drug production and distribution, mapping all the logistic and storage activities, roles, structures, workforce, skills and professionals involved, and information systems. Figure 2 shows the activities related to the crucial organisational units and the related interdependences. Planning, storage (issuance of orders and purchases), and supply activities are carried out by many actors at the same time, generating evident problems with coordination [19]. The system managing the flow of information is very articulate, with almost no coordination mechanisms. As a result, the number of warehouses in the Caserta area is nearly equal to the number of local pharmacies and hospitals in the area (Table 4).

With reference to the information system, the ASL of Caserta has a system called EUSIS[2] that is rarely used and functions poorly. As a result, all local pharmacies create their own paper records or files ad hoc. The information system for operations and order management does not determine whether results are effective; therefore, it needs to integrate data generated from the pharmacies' records into the system.

To sum up, the following critical points can be made about the information system EUSIS:

1. there is a lack of information;
2. there is no inventory management;

[2] EUSIS management information system data.

Table 4 Critical points related to pharmacies in the ASL of Caserta

	Critical points
Task	Absence of planning procedure in the phase of orders
	Two different modes of distribution: in-house and outsourcing
	Lack of a procedure for inventory control
	Lack of standard procedures (between pharmacies and Soresa)
	Lack of standard procedures (in pharmacies)
	Use of only paper report and documents
	Manual procedures of loading and unloading drugs
Material resources	Lack of equipment for optical bar-code
	Lack of equipment in the pharmacies (pc, printers, etc.)
ICTICT	"EUSIS" complex and incomplete Information system
	No integration between EUSIS system and So.re.sa system
	Information system of pharmacies not integrated with that of hospital departments
Human resources	Insufficient staff: pharmacists and administrative; Lack of warehousemen
	Low skills and professional

3. the skill level among professionals is low, and no training courses are provided for the staff;
4. there is a lack of equipment for reading optical bar codes;
5. there is a lack of an information system and digital culture among the actors;
6. there are no standard procedures;
7. there is a lack of sufficient physical space in the pharmacies.

Finally, these critical points lead to a waste of human economic and financial resources.

6 Discussion

The analysis in this study based on identifying key processes related to the management of pharmacies facilitates the measurement of the efficiency and effectiveness of new organisational models that use technology to facilitate coordination.

The analysis of the structural organisation of the pharmacies under analysis also demonstrates the need for ICT to improve logistics in the healthcare sector. The data show a high total degree of computerisation and a high level of homogeneity regarding computer equipment (PCs, software), which do not correspond to the productive use of such instruments. In addition, the various functions related to the use of technology are underutilised or, in some cases, not utilised (40 % of respondents stated that they use mostly paperless recording and accounting).

The implementation of information systems can generate value for organisations; however, if work processes are not changed to accommodate such systems

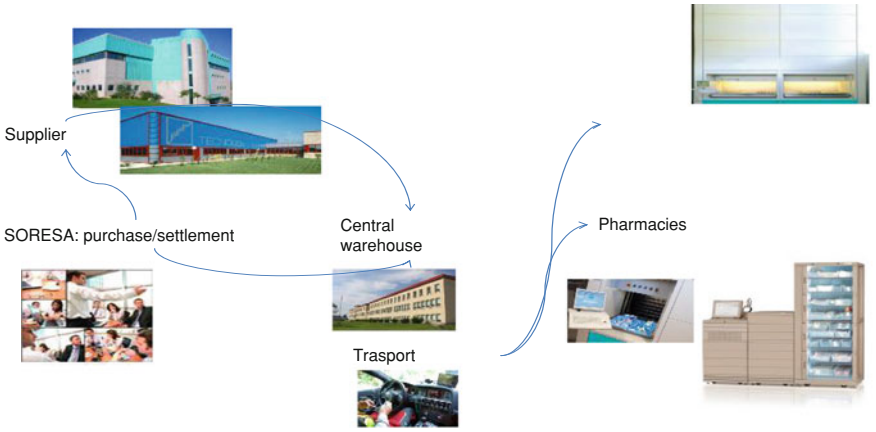

Fig. 3 The new organisational model (*Source* the authors' elaboration)

and careful and thorough training activities are not carried out effectively, ineffective routines and negative attitudes can significantly increase the costs and even prevent the success of a project to implement an information system. Creating a system to connect operations can help to organise, discover, integrate, and disseminate knowledge throughout an organisation by increasing the flow of information, facilitating individual and collective learning and supporting the sense-making and decision-making processes of pharmacy managers in the central office of the ASL.

The new organisational model brought about by the implementation of ICT involves a smaller and more centralised structure in which a central warehouse will directly supply hospital pharmacies and pharmacies within the distribution area. In this way, inventory will be a reduced, and hospital will become regional distribution points, eliminating the double handling and the related costs associated with product distribution (Figs. 3 and 4).

The technologies that were introduced have reduced the expenditures of the department, improved the effectiveness of monitoring medicines and medical devices and controlling their use, improved safety and accuracy in inventory management, reduced the number of urgent requests, provided an electronic record of product movements, optimised the distribution process and inventory management, provided controlled access to the levy through the recognition of the operator, reduced errors related to the exchange of medication, facilitated determination of real-time inventory, and allowed for precise analyses of real consumption (by drug type, department, cost centre, patient, etc.).

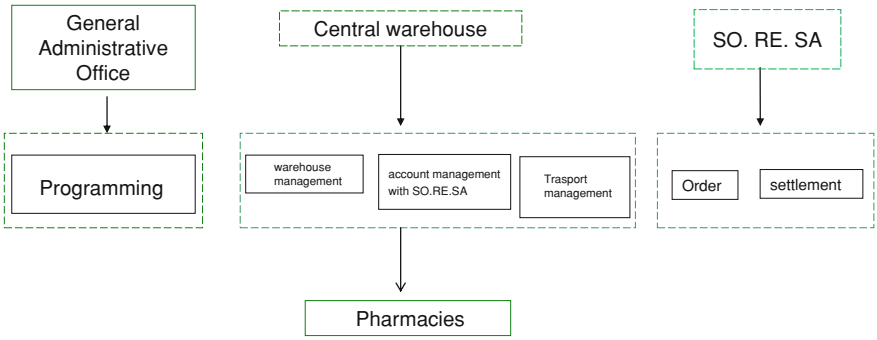

Fig. 4 The system of relationships in the new organisational model (*Source* the authors' elaboration)

7 Conclusion

ICT is considered a strategic resource that is necessary and important for the success of healthcare organisations in the current economic climate [20]. However, there is little empirical research on the use of ICT in the public healthcare sector, particularly related to organisational and technological innovation. Given the characteristics of the processes and services offered, ICT could improve organisational effectiveness in the health sector. Accordingly, this study aimed to provide an understanding of the use of ICT to facilitate not only production but coordination in organisations in the public health sector.

This paper aimed to contribute to the existing literature on organisational structures and change by analysing the impact of ICT on organisational structures. Focusing on a case study from the healthcare sector, we analysed how the external demands for efficiency from the healthcare system necessitate the introduction of information systems to support complex activities, requiring technology that generates radical changes to structure of organisations within the sector.

Nevertheless, the analysis in this paper is limited because of the focus on a single ASL from the Campania region of Italy. As a result, the generalisability of this study's findings may be limited. One limitation of this work is it analyses an completed process of implementing ICT in an organisation so we are not able to extend the results of our case study. Another limitation of this study is that we do not evaluate potential barriers to the implementation of the system, including the training of human resources and the economic return on investment compared to the cost reduction.

The goal of this analysis is facilitate the implementation of new information technologies on a local/regional level in Italy [21]. Implementing such technologies will have a positive impact on not only the performance but also the efficiency and effectiveness of healthcare services.

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A Model to Assess the Technological Level of Small Businesses

Francesca Maria Cesaroni and Domenico Consoli

Abstract In this paper we present a three-dimensional framework (named Cube of Corporate Technological Level—CCTL) to evaluate the technological position of small enterprises from different points of view. This framework has been developed from existing tools with similar goals, already proposed by other authors. Compared to existing ones, this framework differs primarily for the inclusion of a collaborative perspective. It reflects the distinctive features of the latest interactive and web 2.0 tools (chat, blogs, forums, …), that allow companies to manage their relationships with the external stakeholders of the supply chain. The proposed framework has been applied to a sample of small businesses to test its validity. Some business cases with different positions in the Cube are described.

Keywords ICT · Web 2.0 · Technological readiness · Small enterprises · Innovation · Collaborative tools

1 Introduction

After an initial phase of studies on the adoption and use of ICT by large enterprises, a line of research specifically focused on small enterprises (SEs) has been recently developed. It's widely accepted that ICT use is an essential condition for

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strengthening the competitiveness of SEs and to enable them to fully exploit their potential for innovation, growth and development. In fact ICT tools can stimulate new business models and can help SEs to manage their relationships with external stakeholders.

Analysis on the adoption of ICT by SEs are often focused on individual elements—such as use of Internet, web sites, management systems like ERP, CRM, SCM, etc. This approach doesn't allow a comprehensive assessment of the technological level of such enterprises, as it can be better appreciated using multidimensional systems that simultaneously consider different perspectives.

The aim of this paper is to introduce the Cube of Corporate Technological Level (CCTL), a three-dimensional assessment framework that allows us to evaluate the technological position of enterprises from a multidimensional point of view. Compared to previous models, our framework includes a collaborative perspective. It reflects the ability of web 2.0 tools to manage relationships with external stakeholders.

In the second section of the paper a review of the literature on the relationships between ICT and SEs is presented. The third section describes the CCTL framework, in order to explain its basic characteristics and how to use it. The fourth section describes some cases of SEs located in the vertices of the Cube. The analysis of business cases is useful to test the ability of the Cube to highlight the technological specificities of different SEs. At the end some conclusions are drawn.

2 ICT in SMEs: A Literature Review

It is widely accepted that investments in ICT help to improve firms' performances and competitiveness and promote their development [1], although some analysis have revealed conflicting results [2–4]. In some cases, the decision of SMEs to invest in ICT is due to the pressure from external subjects such as customers and suppliers [5].

The entrepreneur-owner plays a key role, through his awareness of potential benefits of ICT [6–8]. The improvement of performances depends very much on the ability of the company to make investments aligned with the business strategy. Levy et al. [9] provide guidance on the main factors that inhibit or stimulate investments in ICT by SMEs. For example in the use of e-business systems there are concerns about the loss of confidentiality of business data, the risk of fraud, costs, etc.

Other factors promoting the use of ICT tools by SMEs are: ICT's down pricing over time, the availability of SaaS (Software as a Service) solutions, new ways of storage and computing (Cloud Computing) and the user-friendly interfaces [10]. More user-friendly electronic devices and the ICT consumerization (integration of smartphones and tablets in Information Systems) encourage the deployment of new mobile digital tools also in SMEs. The new interactive channels 2.0 [11]

facilitate the cooperation and the development of relationships in the supply chain [12].

These technologies allow the company to communicate and interact with its stakeholders and in particular with customers [13]. In this bi-directional exchange customers take a more active role and become proactive "prosumers", producers and consumers at the same time [14]. With their opinions and suggestions they help to improve the product/service of enterprises. Enterprises, thanks to web 2.0 tools, are stimulated to adopt a new way of doing business inspired by new concepts such as openness, collaboration, participation and willingness to share information with outside entities. The main obstacle in the effective use of these new digital tools is the difficulty to understand their deep implications and to adopt new business processes. Investment in web 2.0 tools is an absolutely necessary step for SEs, but it is insufficient, since the introduction of new technologies must be combined with a coherent review of business strategies and processes.

3 The Cube of Corporate Technological Level

To understand the technological level of an enterprise we can use appropriate models. In the literature some frameworks have been developed to measure the ICT maturity and the readiness in SMEs. The maturity represents the presence, inside the enterprise, of digital devices and applications and their proper use. The readiness measures the predisposition of a company to use ICT solutions.

One of these frameworks, proposed by Balocco et al. [15], assesses the ICT maturity by evaluating the use of application software (application maturity) and the allocation of hardware platforms and operating systems (infrastructure maturity). In this framework technologically forward-looking businesses have both a high infrastructure and a high application maturity (Fig. 1).

Starting from the model of Balocco, Spinelli [16] later developed a new framework. He added the strategic vision of ICT, that is the entrepreneur's awareness of the strategic value of applications and digital devices (Fig. 2).

Spinelli incorporated into the concept of ICT maturity the two factors used by Balocco—infrastructure and applications maturity. According to this model an enterprise is therefore considered to be ready when the entrepreneur has a high strategic vision of the technology and at the same time it has good technological platforms.

Starting from the two models of Balocco et al. [15] and Spinelli [16], we developed an original three-dimensional CCTL framework (Fig. 3).

In the two previous models the collaborative aspect, in terms of corporate organization and technology, was not considered. But we believe that today it is very important to consider new business models based on collaboration inside the company and with outside subjects (suppliers, customers, other companies). That is why we have added a third dimension (Collaborative technology) where the level of use of new interactive technologies of Web 2.0 (chat, blogs, forums,

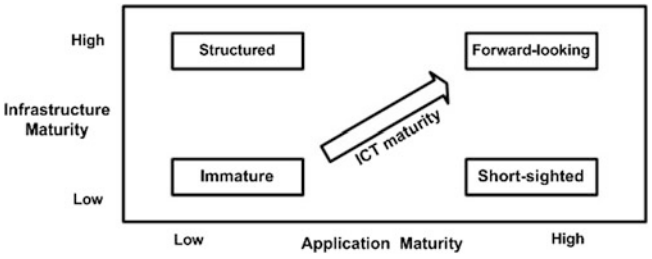

Fig. 1 Framework of ICT maturity. *Source* Balocco et al. [15] (adapted by authors)

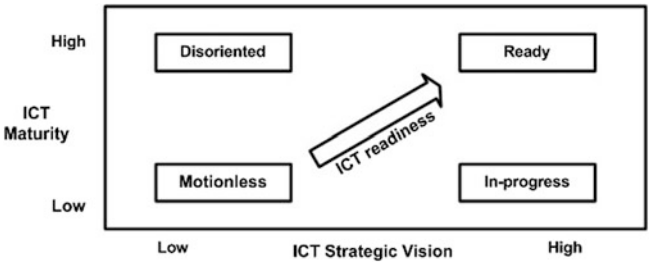

Fig. 2 Framework of the ICT readiness. *Source* Spinelli [16] (adapted by authors)

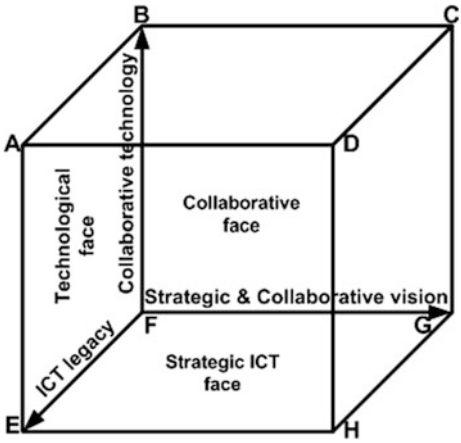

Fig. 3 The CCTP framework. *Source* own

wikis, …) is measured. Moreover we have enriched Spinelli's concept of "strategic vision" adding the adjective "collaborative" (Strategic and Collaborative Vision). In this way we emphasize the enterprise's ability to fully exploit the strategic potential of new technologies, introducing new business models and new ways of organizing and managing internal and external processes, based on interaction inside the company and with external stakeholders.

The dimension "ICT maturity" measures the adoption of traditional software (legacy); it includes applications existing before the development of Web 2.0, such as management software and ERP.

The three dimensions (edges) of the CCTL are the following:

- *ICT maturity*: in the traditional sense (legacy) it refers to the presence of technological infrastructure (PCs, networks, platforms) and business application software like ERP, CRM, SCM;
- *Strategic and collaborative vision*: it is the strategic vision of entrepreneurs, meaning the ability to conceive new technologies as strategic resources used to achieve specific business goals;
- *Collaborative technology*: it evaluates the presence of interactive and collaborative technologies and in particular web 2.0 tools and social networks.

With this approach, the three faces of the cube represent the technological, collaborative and strategic dimensions of ICT. In the *Technological face*, the level of ICT adoption, both legacy and collaborative, is measured. Enterprises with a high evaluation in this face use a rich set of traditional technological equipment and new interactive channels. In the *Collaborative face* the collaborative propensity, both organizational and technological, is measured. Often entrepreneurs who believe in the strategic value of interactive technologies lead enterprises with a high rating in this area. In the *Strategic ICT face* we evaluate the strategic vision of entrepreneurs and the ICT maturity of the organization. Enterprises receive a high rating if they believe in the power of ICT, although they only use traditional technologies.

4 The Position of Small Enterprises in the Vertices of the Cube

A brief description of SEs located in the vertices of the Cube, or in their vicinity, is presented in this section.

The **vertex A** represents the situation of technologically advanced enterprises, that use legacy and advanced collaborative technologies. They are able to process textual and unstructured data present on virtual channels—such as suggestions and opinions of customers (Opinion Mining) and integrate this business data in their information system. Presently this vertex can hardly be reached by SEs, but only by large companies with financial resources and technological expertise. Companies in this vertex have not yet reached a strategic vision of ICT.

The **vertex B** represents very mature enterprises with regard to collaborative technologies but without the adoption of management software and without strategic vision. This is the case of SEs led by young entrepreneurs that use only web 2.0 tools (see Coma1 case described below).

Business case: *Coma1*
Coma1 is a very small company where the owner and only one employee work. The owner is a creative woman who creates jewels in gold and other metals. Her customers are 90 % Italian and 10 % foreign. She collaborates with art galleries, shops and designers and exhibits her jewels together with other objects. In the company there is only one computer Macintosh used for trade relations, Internet, e-mail and Facebook. In 2004, the corporate website was created by an external professional, but when the owner discovered the potential of Facebook, she abandoned the website. Now it is used only to show the e-mail address and contacts. The entrepreneur constantly updates Facebook pages with catalogues and pictures of new jewels. She uses Facebook to manage her virtual community but she does not use any advanced application software to manage the company. To implement an e-shop section in Facebook she needs another person who can support it.

The **vertex C** refers to the case of entrepreneurs keen on using interactive technologies to manage relationships with outside subjects but without a consolidated structure of management software (see Masc case).

Business case: *Masc*
It is a sole proprietorship whose core business is the online sale of cosmetics. The enterprise was founded by the current entrepreneur's young daughter. After finding a permanent job, she left the business to her mother. The current entrepreneur strongly believes in the power of the web, virtual channels 2.0 and social networking. The owner intends to invest in web marketing by Google AdWords and she would like to promote her products through banners in other business sites. At the beginning, the entrepreneur implemented an e-shop section on the open source platform Blomming and later she bought a web space on ebay. Now this section is integrated on the website that she continuously updates. She created a Facebook page that can also be reached from the website. Daily she proactively interacts with users who post comments or request information. The entrepreneur has a strong collaborative strategic vision. She believes in sharing, interaction and cooperation with all the actors of the supply chain and especially with suppliers and customers. Using interactive channels she always tries to build a relationship with the many freelance bloggers who review her products. She often launches, for promotional purposes, mini contests to award prizes such as a make-up kit for users (potential future customers) who create an account on her website.

The **vertex D** represents the highest level in traditional and collaborative technologies. Companies in this position have reached a highly strategic and collaborative vision and use advanced interactive tools. They are fully structured and organized according to market demands identified by virtual and social channels.

The **vertex E** represents mature and well-established enterprises from the point of view of traditional information systems (legacy). Often these enterprises start with a basic technology and gradually acquire additional software and digital devices, without a strategic vision (see Mcme20 case).

Business case: *Mcme20*
In this company 3 entrepreneurs and 20 employees are involved. The core business is the assembly of electronic card programmed via PC. The company also produces electro-mechanical devices used by electricians and installers. There are 6 networked computers and a good ERP, supplied by a local company, that also manages the production process. The company was founded many years ago and has good software equipment for process management, administration and production. The website is static and is updated only at the launch of a new device. The company does not use an e-shop section and virtual channels 2.0 to promote its electromechanical devices, because of lack of time and because it is structured with a network of sales agents. Entrepreneurs don't have a strategic vision of ICT. For many years they have used only management software for daily work. They haven't yet introduced interactive technologies but have always strengthened their sales agents network.

The **vertex F** represents a traditional enterprise, with a very low technological level, that doesn't use legacy or collaborative technologies and has no strategic vision. It may be the case of small artisans such as a carpenter, mechanic, butcher, etc.… Below we describe a micro enterprise (Cmma1) with a very low ICT level.

Business case: *Cmma1*
In the enterprise only the owner and a specialist worker are involved. The core business is the tailoring design, cutting and sewing of home textiles such as curtains and linens. Sometimes the owner exhibits her products in fairs together with pottery and other artistic objects. The owner doesn't have a network of agents and she has only local or regional customers. She uses two Macintosh computers with simple graphical software to retouch photos of fabrics. The entrepreneur has an old website, which dates back more than 8 years, when she was a consultant, and it has never been updated. The owner uses the computer only to send/receive e-mails and to edit photos. She does not feel the need to invest in collaborative technologies because she lacks time and financial resources. At the moment she accepts this type of traditional management based on a low use of technologies.

The **vertex G** represents the typical situation of start-up companies, led by entrepreneurs with an advanced strategic vision and clearly aware of the importance of a collaborative approach to business management. But this strategic awareness is not yet supported by coherent technological equipment.

The **vertex H** corresponds to companies ready from the strategic and technological point of view (see Spinelli's framework). Here entrepreneurs have a strategic vision of ICT. They have not yet invested in collaborative technologies but they have a vision of a collaborative work. This may be the case of old entrepreneurs who fear to lose data and control (see Acam27 case).

Business case: *Acam27*
The owners and 27 employees work in the company. The company focuses on the assembly, packing and sale of furniture for bedrooms, dining rooms and living rooms designed in a classical style. The company sells mainly abroad (98 %) to

resellers and stores. Inside the company there is an employee responsible for ICT who provides digital services to the functional areas. Its technological equipment includes 18 networked computers with office automation applications, such as Word/Excel and Autocad for the technical office. The warehouse is partly automated and products are read with bar code guns. The company has a good ERP system, interfaced with productive processes. The enterprise is equipped with hardware and application software to manage foreign markets. Currently the entrepreneur does not invest in interactive channels 2.0 but only in skype and telephonic channels. Customers relationships are managed using the contact form integrated on the website. The website has been developed by an external web agency. The entrepreneur is now thinking to update the website with 2.0 channels.

5 Discussions and Conclusions

In this paper a multidimensional tool to assess the technological level of SEs has been proposed. Compared to existing tools, its novelty is the inclusion of a collaborative perspective, that is the distinguishing feature of the latest software applications (Web 2.0). Business owners and managers can use this tool to make a self-diagnosis and evaluate the technological level of their company. Moreover, it helps to understand which ICT investments to make in the future in order to move the company towards a point of optimum technological development. In order to improve the usefulness of the Cube, possible future developments are the following:

- use the Cube in a dynamic perspective to define the path that SEs should follow to improve their technological position;
- use the Cube to carry out an empirical analysis to understand the technological level of SEs and in addition their belonging to a certain geographical area. These results could also be used for inter-regional or international comparisons;
- understand whether a correlation exists between the position of a SE in the Cube and some business variables (e.g. firm's size, entrepreneur's level of education, etc.…);
- carry out a case study analysis to understand what are the barriers that prevent SEs from improving their technological position and from moving toward the maximum point of technological development (vertex D in the Cube).

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Part III
Information, Knowledge and Project Management Practices

Improving Information Exchange Effectiveness Through Data Compression Techniques

Ferdinando Pennarola, Leonardo Caporarello and Massimo Magni

Abstract The turbulent environment in which organizations operate requires to effectively manage information. Previous studies highlight that the quantity of digital information is rapidly increasing and it requires to be effectively stored and managed. Data compression methods represent a possible solution for facing these issues. Through conducting an experiment based on the exchange of compressed data, we offer managerial insights useful for a more effective and efficient data management.

Keywords Data compression · Information exchange · Managerial perspective

1 Introduction

The business environment in which organizations operate is characterized by high competitiveness and turbulence. In this context, information plays a pivotal role. As such environment is knowledge-based, information also represents a key driver for innovation. Moreover, according to some authors [6], information is increasingly being regarded as a resource to be used in organization for attaining competitive advantage.

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Thus, the management of information and data is a critical issue which organizations have to pay attention to. Indeed, information is critical either at the highest organizational level or at the operational level [4]. An appropriate information and data management can influence organizational outcomes in terms of efficiency and effectiveness, such as improving and speeding-up decision-making processes, increasing sales, improving customer service, reducing production lead times [1, 6, 16].

In order to achieve these benefits, organizations need to implement effective information and data systems, and much research focuses on how to design these systems (e.g. [2]). Moreover, such systems are necessary because of the increasing volume of data and information which must be managed by organizations. Indeed, many of the business applications are data-intensive applications, and data distribution and storage is highly disordered and complex.

Despite the design and production of electronic data storage and networking systems are in continuous development, allowing an increasing level of storage and transmission, the electronic data storage and transmission still represent emergent issues in the CIO agenda. Moreover, the turbulent and dynamic business environment, together with the information technology advances require organizations to be able to manage large volumes of data. Such an increase in data volumes demands efficient and proactive data quality management. These issues can be traced back to two main reasons: on the one hand there is an average increase in the size of the files that are commonly used and transmitted (e.g. a digital picture for good quality prints has an average size of 3.75 MB). On the other hand there is an increase in the amount of data exchanged between users. These two reasons are often underestimated by managers because of the cost decrease of the storage systems and the increased capacity of transmission of networking systems. Moreover, recent research points out that the available storage will be not enough to store information created in the next few years (Fig. 1).

Therefore, in an environment characterized by complexity, and in which the timeliness of information is critical, it's becoming more important the way through which organizations and users simplify, store, transmit and access to their information. Organizations are therefore required to manage their information respecting both the economical perspective and the timely availability of information.

This scenario has increased the critical role played by the methods that organizations adopt for compressing and transmitting their data, considering compression as the process of encoding the more probable messages in fewer bits than the less probable ones [10]. This issue becomes even more important in the process of information exchange among users because compression methods significantly affect the exploitation of the bandwidth. For example previous studies [10] point out that firms face with network application performance issues caused by the bandwidth exploitation. As a consequence of these aspects, other problems may emerge, such as cueing delays and packages lost, which can negatively affect the consistency of exchanged information. A practical example of such kind of issue can be explained through the exchange of information in teleradiology among medical departments [11].

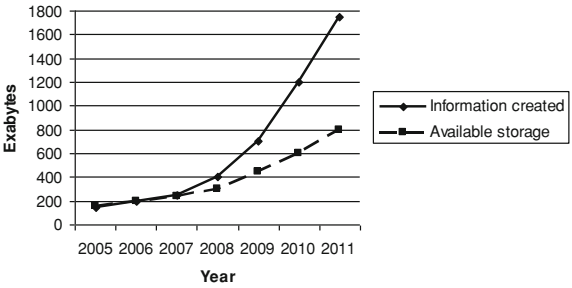

Fig. 1 Information creation and storage availability (*Source* IDC)

Table 1 Volume of data generated by different kinds of medical exams

Data source	Image size (MB)	Number of images per exam	Exam size (MB)
X-ray	5	4	20
Computed axial tomography	0.3	25	8.2
Nuclear magnetic resonance	0.1	40	5.2
Ultrasounds	0.9	30	27.6

Table 1 presents the volume of data generated by different kinds of medical analyses. Looking at the table it is possible to underscore that each exam requires a significant amount of space, which may affect the choices of hospitals' CIOs if we consider the volume of data generated by all the exams that every day are performed in different medical departments.

Starting from this basic practical example, the purpose of our paper is to show how compression may support the emergent need for firms to effectively and efficiently store and exchange information, allowing the CIOs to take decisions that respect both the efficiency and the availability of data principles. In particular, relying on the Shannon and Weaver's [14] theory of information exchange we conduct an experiment simulating the electronic information exchange between two individuals. Results show that effective compression method may affect organizational processes of data storage and information exchange effectiveness and efficiency both in terms of time and space. Thus, our aim is to depart from the mathematical approach to data compression through conducting an experiment that which intends to provide useful insights to managers. The paper contributes to the current literature by extending previous research on compression into the managerial setting, providing insights on the balance between efficiency and accuracy in data compression and transmission. Therefore, on the light of our experiment, managers should be more aware in choosing the right strategy according to the requirements of the situation. Moreover, our paper contributes to the emergent research that looks on how to deal with data storage and how to cope with the continuous increase of data volume and exchange.

2 State-of-the-Art

Data compression represents one of the techniques in the context of information data processing applications. In fact, data compression is widely applied for data storage and retrieval [13]. The objective of data compression is to reduce data rate for transmission and storage [10]. Data compression is coding of data to minimize its storage and transmission.

A way to classify compression is to consider it as static or dynamic. Compression is static when the mapping process of the source message is fixed before compression. That means a given message is represented in the same way every time it appears in the source message. The classic static method is the Huffman one. Compression is dynamic when the mapping process may change over time. Then, a given message may be represented in a different way every time it appears in the source message.

We focus our attention on the data compression based on the Kauffman technique because it is one of the most adopted. As mentioned above, the Huffman coding represents the classic static method [8].

Prior research on this topic studied data compression context through different lens of analysis:

- relations between storage needs and data compression techniques, and its effects on primary memory requirement [3]
- image data compression techniques, in the medical context [8]
- data compression coding and algorithm [9].

The objective of this paper is to present and discuss the data compression benefits through a managerial perspective, considering at the same time the data compression effects on both the storage and transmission processes.

3 Communication Theory

In order to better understand how compression methods may affect the communication process among organizational actors we rely on the theoretical framework of communication theory as proposed by Shannon and Weaver's [14] (Fig. 2).

The sender encodes a message into a signal and sends it to the receiver. On the receiver side the signal should be decoded for being interpreted by the receiver. Encoding and decoding issues are critical because they are fundamental for allowing sender and receiver to exchange consistent messages.

In their seminal article, Shannon and Weaver [14] pointed out that. "The fundamental problem of communication is that of reproducing at one point either exactly or approximately the message selected at another point. Frequently the messages have meaning. … [But] these semantic aspects of communication are irrelevant to the engineering problem" (p. 3). In other words, Shannon and Weaver

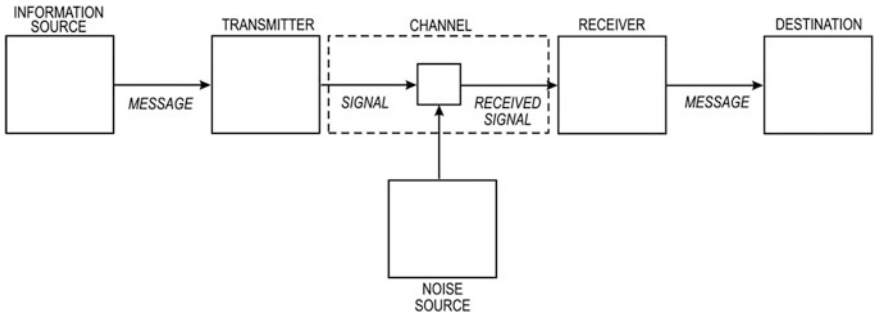

Fig. 2 Shannon and Weaver's communication process

traced back the information exchange as a process for effectively and consistently convey a message reducing the statistical uncertainty that may hinder this process, without focusing on the interpretation of message meaning for sender and receiver. In particular, communication theory points out that the communication effectiveness can be affected by the capacity of the channel, and the number of simultaneous messages that can be exchanged through the channel. According to what we mentioned above these two issues can be solved through investing in hardware and network instruments that allow the information processing capacity (such has increasing the bandwidth). From our perspective, firms that want to improve the communication effectiveness and efficiency, besides increasing their information processing capacity, can invest in effective techniques for diminishing the volume of the messages transmitted from the sender to the receiver, thus increasing the degree of capacity and simultaneous messages transmitted. For corroborating this issue, it should be pointed out that Shannon and Weaver's theory underscores the importance of the encoding and decoding processes that may lead to ineffective exchange or inconsistency between the message sent and the received one.

Thus our purpose is to look at how compression method may be considered as catalysts for improving the effectiveness and efficiency of electronic communication processes operating on the three dimensions defined by Shannon and Weaver (capacity, simultaneous messages, encoding and decoding processes). In particular, encoding and decoding processes may require time and effort, generating production costs that may hinder the advantages generated by compression of data. In other words, the compression process may absorb resources, generating a trade-off between speed and production costs and processing delay costs.

4 The Encoding and Decoding Processes

4.1 Communication Systems and Encoding Process

As previously mentioned, communication is defined as the transferring process of encoded information from a source to a destination point through a channel or transmitting mean (Fig. 1). The source of information is defined as the source (or sender) that generates the message, and is called "discrete source" as the message is composed by an ordered sequence of symbols. The codifier is the device that transforms the message in order to be compliant with the transmission channel.

For example, if the source message is composed by letters referring to the following alphabet A = {a1, a2, …, an}, then the codifier transforms such letters using a new alphabet C = {c1, c2, …, cn} which is more adherent with the characteristics of the transmission channel. Since our paper is focused on compression, we rely on the encoding and decoding process contextualized within the compression systems. In particular, a generic compression system is composed by two algorithm: the first one for encoding, the second one for decoding. The transmitting channel (or channel) is strictly related to the nature of devices for transmitting and receiving messages. According to previous research, transmitting channels can be noisy or not-noisy. Noisy channels can determine that the input message and the output message are not equal because of the distortion caused by this kind of channel. An example is given by the electron thermal fluttering that generates power. In this case, the codifier has also the role to damp the noise and then the related transmission errors. In the case of not-noisy (or low noisy) transmitting channels, the codifier attempts to minimize the number of symbols transmitted per each alphabetical letter of the source message. In fact, an encoding algorithm adds to the source message some bits "informationless" which have the objective to correct errors that can occur during the transmission process. Such kind of bits are called "errors correction codes". Noise can be of different types, i.e. semantic. The semantic noise consists of distortion in the meaning of the message due to, for example, language or cultural differences.

According to the information theory, either the source or the noise are static; moreover, the same theory states that information is measured through a quantitative approach and does not consider a semantic perspective. Therefore, in our research we will not consider this perspective.

The second element of a communication system is the decodifier. The decodifier executes the opposite process made by the codifier. Based on the transmitted signal, and using the established algorithm for decoding, the decodifier rebuilds the original message. The information exchanged through the communication system can be of two types: analogical and digital (or numeric). Analogical information exists when values of the electric signal, s(t), which represent the information, are continuous. Digital information exists when values of the electric, which represent the information, are discrete. In this paper, we intend information as digital information.

To transform an analogical information to a digital information two activities are required: sampling and quantifying. Sampling consists of transforming the continuous signal flow in a sequence of signal's snapshots. The value of each signal sample can range within a set of continuous values. Quantifying consists of assigning to each signal sample a value within a limited set of values. During the digital information exchange process, it is necessary to assure the information accuracy exchanged between sender and receiver. Shannon and Weaver stated that entropy represents the most appropriate measure of information accuracy. Entropy is a measure of randomness and disorder which typically characterize a close system. In particular, information is the negation of entropy. Entropy formula (bit per symbol) is the following:

$$\mathrm{H} = -\sum_{i=1}^{M} P_i \log_2(P_i) \tag{1}$$

where, P_i represents the probability that the event occur.

We can formulate the following two considerations. First, the code can have a variable or a fixed length traced back to the probability assigned to each symbol. Second, since the compression process can suffer information loss, it is possible to establish the inferior limit of the loss, which is equal to the entropy. Consequently, as much a message is randomly generated as much the information the same message carry out increase, and at the same time as the compression level of the message is lower because of the amount of entropy. In case of the symbols in a sequence are not independent each other, redundancy occurs. According to the information theory, redundancy is the part of a message which can be eliminated without experiencing loss of information. In case of redundancy, the compression system can be able to reduce or eliminate it.

4.2 Toward an Effective and Efficient Compression Process

One of the most used codifying system for compressing data is the Huffman method [9]. The fundamental characteristic of such codifying system relates to the relative frequency for each symbol. The Huffman method is well-known for the ability to get a high-efficient compression. Let's consider the following example, which is based on five symbols with their relative frequencies: A, 15–B, 7–C, 6–D, 6–E, 5.

According to the Huffman method, the first step in applying this compression technique is to build a binary tree for the symbols. The underpinning idea is that the higher is the probability that a symbol occurs, the smaller is the sequence of codifying bit associated with it. In order to build the binary tree, symbols must be descending ordered by probability. Now, reading the Fig. 3 from left to right, we can consider the last two symbols as one single symbol. The probabilities of these

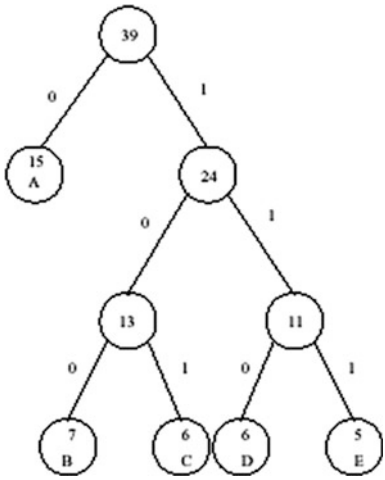

Fig. 3 Binary tree. The result of the codifying system is: $A = 0$, $B = 100$, $C = 101$, $D = 110$, $E = 111$

two symbols are summed up, and the two codes 0 and 1 are assigned to them. This aggregation operation will be repeated until two symbols remain. Thus, we get the following binary tree:

The average length of the code is given by summing up the multiplication of the frequency of each character by its frequency:

(15/39)*1 + (7/39)*3 + (6/39)*3 + (6/39)*3 + (5/39)*3 $\approx$ 2.23 bit per symbol.

Moreover, applying the formula (1) the entropy is about 2.18 bit per symbol. This represents the inferior limit of lossless information derived from the compression process. Thus, the Huffman method produces a result which is close to such limit indicating that the compression is very effective.

Before proceeding with the main experiment, we tested the validity of the above considerations, through running a simple experiment. We conducted a compression process through the Gzip software, which is based on the algorithm [15], and the Huffman method. According to this compression system, the number of bit per symbol tends to the Shannon entropy, thus to the optimal limit. For our experiment, we created two text files, called A.txt and B.txt, both containing a text, with the same length but different frequency of symbols. The initial size for both the files is equal to 207 bytes, but the texts they include are different each other. File A contains the first paragraph of the introduction of a book, while file B contains a sequence of the symbol "a" which is structured in the same way of the text contained into file A. For instance, the first word contained into the file A is "Everybody", then the first word contained into the file B is "Aaaaaaaaa". Indeed, spaces and punctuation are the same in both files. After applying the compression method, we got the following results (Table 2).

The last column shows the compression ratio, which is—as expected—higher for the second file than for the first one. This result is consistent with the above mentioned assumption confirming that the higher is the random generation of the message, the lower is the compression ratio.

Table 2 Experimental results

File name	Size of compressed file (byte)	Size of uncompressed file (byte)	Ratio (%)
A.txt	171	207	28.9
B.txt	77	207	74.3

5 The Experiment

Relying on the Huffman method described above, we conducted an experiment to better understand the effectiveness and efficiency of such method in two different scenarios. This experiment allowed us to verify how the compression method can influence a message in terms of representation of the information and its transmission effectiveness. In this section, we describe the following main phases of the experiment: the experimental context; the preparation of the experiment; the experiment results.

5.1 Experimental Context

We imagined two persons exchanging the text related to some literature masterpieces. As the two persons are not geographically proximate, they need to exchange such documents using some technological tools. We decided to use a personal computer (PC), and an internet connection as technological tools for exchanging the masterpieces text. Person A utilizes her computer at home, while person B at her office.

5.2 The Preparation of the Experiment

Considering the tools, the two PCs relied on a FTP (File Transfer Protocol) software with two components: FTP client and FTP server. The client component was installed on the PC of person A, while the server component was installed on the PC of person B.

One important characteristic of such context relies on the fact that the data connection starts with the beginning of the data transfer process and ends when this process is concluded. This characteristic is particularly critical for our experiment because it allows to compute the time needed to transfer all the data. Indeed, the FTP connection has at least two characteristics: first, the connection remains active during the entire process and refers to the transmission of commands between client and server, second, the connection starts only during the transfer process.

5.3 The Experiment Results

In our simulated environment we decided that person A transmitted 9 masterpieces to the person B (e.g. Divine Comedy, Iliad, Odyssey).

Person A, who acted as the client, could decide for one of the following scenarios:

1. To send all the masterpieces in one single compressed file;
2. To send one compressed file for each masterpiece (for a total of 9 files).

We took into account each of the two options. Monitoring from a quantitative standpoint all the results belonging to each scenario we were able to derive important managerial insights. The first scenario, which relies on the delivery of one single compressed file, reported the following results (Table 3).

The second scenario, which considered the transmission of 9 compressed files, lead to the following results (Table 4).

By merging all the compressed files belonging to the second scenario the overall size would be 4.222.702 Kb. Such size is very similar to that one concerning the single compressed file (4.214.133 Kb). Thus, from a quantitative standpoint the difference in the file size between the two scenarios is marginal, and such small difference can be traced back to the fact that each single compressed file contains some header information about its structure. Indeed, consistent with our previous arguments, it is possible to argue that long text documents present a configuration of symbols that have repetitive patterns, enhancing the redundancy effect. Despite the slight difference, from an efficiency perspective, the two scenarios are comparable and do not point out any significant difference in file size. From an effectiveness-related perspective we verified if the received files were equal to the transmitted ones. In both cases, the files were equal and did not contain any error derived from the compression process. On the light of these results, we can assume that the two scenarios are comparable in terms of effectiveness and efficiency related to the amount of space needed.

However, besides considering the overall size, it is also critical to consider those results that are related to the transmission, and which does not belong to the object that has been transmitted. In doing this, we monitored both the transfer time and the used bandwidth related to the upload and download processes.

The first scenario lead to the following results (Table 5).

The second scenario presented the following results (Table 6).

Table 7 summarizes the two scenarios' results.

This second test pointed out a significant difference from an efficiency point of view. Indeed, the single compressed file has been transmitted almost 3 times faster than the 9 compressed files. Thus, the experiment shows that the scenarios are equal in terms of effectiveness, pointing out that there is no difference in the content of the files before the compression process, while they are different in terms of efficiency when the transmission of data is required. This result shows that the two scenarios are equals when data should be only retrieved because they need the same amount of space, while the differential effect of compression occurs when data should be transmitted.

Table 3 Scenario 1 results

File size (without compression)	File size (with compression)	Compression ratio
10.708.454 Kb	4.214.133 Kb	60.6 %

Table 4 Scenario 2 results

Masterpiece name	File size (without compression) (Kb)	File size (with compression) (Kb)	Compression ratio (%)
Masterpiece 1	3.074.390	1.218.704	60.3
Masterpiece 2	1.125.874	450.192	60
Masterpiece 3	445.084	162.676	63.5
Masterpiece 4	1.547.750	630.902	59.2
Masterpiece 5	156.348	67.260	56.9
Masterpiece 6	154.728	65.181	57.8
Masterpiece 7	2.620.626	980.232	62.6
Masterpiece 8	395.896	156.020	60.5
Masterpiece 9	1.186.740	491.535	58.5

Table 5 Scenario 1 results

File type	Upload time	Bandwidth used
Single compressed file	29 s	16 Kb/s

Table 6 Scenario 2 results

File type	Upload time (s)	Bandwidth used (Kb/s)
Masterpiece 1	29	16
Masterpiece 2	9	16
Masterpiece 3	4	16
Masterpiece 4	14	16
Masterpiece 5	1	16
Masterpiece 6	1	16
Masterpiece 7	24	16
Masterpiece 8	3	16
Masterpiece 9	10	16

Table 7 Scenario 1 and 2: summary of results

File type	Upload time (s)	Bandwidth used (Kb/sec)
Single compressed file	29	16
9 compressed files	95	16

6 Discussion

As mentioned in the introduction of this paper, our results show the pivotal role played by compression in our fast paced economy. In particular, through a laboratory experiment we demonstrated the effectiveness and efficiency of compression. From a managerial standpoint our study points out an important trade-off for CIOs. On one hand they may privilege an efficiency perspective both for transmitting and storing data, on the other hand they may consider as critical a perspective that is more oriented to the accuracy and consistency of the information. In the first case, managers would go in the direction of implementing compression solution, in the second case they would try to diminish the entropy through a strategy that does not fully embrace the paradigm of compression. This scenario is commonly known as speed-accuracy paradox.

Following the call pointed out by the examples reported in the introduction section, our results point out the importance of compression for facing the increasing needs of storage capacity due to the growth of digital information created. For example, in the security industry there is a shift from analogical to digital surveillance, where the networked digital cameras are doubling every year. This necessity for facing the increasing amount of digital data is already a critical issue at the very present moment. Moreover, China invested USD billions in video security systems for the Olympics. Even the city of New York is implementing USD 90 million in surveillance systems for Manhattan area. Our results are particularly critical in those firms that are geographically distributed. Indeed, geographically distributed firms require the constant and continuous exchange of data from one branch to another. Therefore, the managerial choice related to the way through which compression is adopted may affect the efficiency of the exchange process. Moreover, the speed in decision making is getting critical for firms and managers operating in turbulent environments. Being able to guarantee the availability of such information in a short time frame is therefore a necessary conditions for organizational success and survival. Thus, the choices of related to the compression processes may support the efficiency through which these information are rapidly available where needed. However, despite our contribution, future research should take into account the usability and ease of use in the process of compression and transmission, as well as the influence of networks and individual interactions [11].

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Tabularizing the Business Knowledge: Automated Detection and Fixing of Anomalies

Nicola Boffoli, Daniela Castelluccia and Giuseppe Visaggio

Abstract Formalizing the business knowledge makes it easy to understand for decision-makers aiming at improving the business processes. However, extracting, structuring and formalizing the business rules and constraints and then managing the variability of decision points could be difficult without an effective support. The authors' research explores the benefits of the application of decision tables, finding additional advantages in detecting and fixing several anomalies that may affect the business knowledge. Decision tables are able to guarantee non-redundancy, consistency and completeness. The authors have implemented a software tool to automate decision tables in practice and describe a running example to give perception of these advantages.

Keywords Business rules · Decision tables · Verification and validation

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1 Introduction

Recently in companies, achieving continuous innovation and business flexibility implies different business policies, as well as a different impact of the business knowledge to business policy and strategic decisions. When the business knowledge is explicitly formalized, the decision-makers are able to analyze it in order to continuously improve the business processes [1]. However, extracting, structuring and formalizing the business rules and constraints and then managing the variability of decision points could be difficult without an effective support. Moreover, managing the consistency and non-redundancy of business decisions is even more difficult in case of fusion or buyout of companies.

In a previous work [2], the authors proved that decision tables provide a useful and effective container for complex business logic and decisions. By deepening the application of decision tables to formalization and maintenance of business knowledge, the authors find that decision tables strategically support knowledge elicitation and reengineering by means of a complete and consistent representation of the relationships among business conditions, actions and rules.

In this paper, the authors extend their study and propose a technique for verification and validation by detecting and fixing anomalies in decision tables. Starting from the business knowledge, expressed in terms of set of rules, the proposed approach exploits checkers by rows/columns in order to detect the anomalies affecting the rule set and suggest the appropriate fixing procedures to be performed. The outcome is a fixed decision table and if necessary, a new set of rules without anomalies can be generated from the table (Fig. 1). In addition, the authors have developed a software tool, able to automate this detecting and fixing technique.

The structure of the paper is the following: the Sect. 2 explains the type of anomalies, which may affect the business knowledge; the Sect. 3 focuses on the decision table basics and on the proposed approach for detection and fixing of anomalies; the Sect. 4 explains how the fixing phase is performed; finally, the conclusions are drawn. For sake of clarity, in the Sects. 2, 3 and 4, an illustrative example is described in order to show the efficacy of the proposed approach by means of ad hoc software tool in a real case.

2 Anomalies in Business Knowledge

Business knowledge in specifications has to be correct, consistent, complete and non-redundant; therefore, it is strategic to model and manage the corresponding business rules and constraints. The essence of the business rule approach is describing some business features in a declarative way rather than procedural way [3]. Odell defines business rules as “declarations of policy or conditions that must be satisfied” [4]. However, validating a set of business rules is not a trivial task and

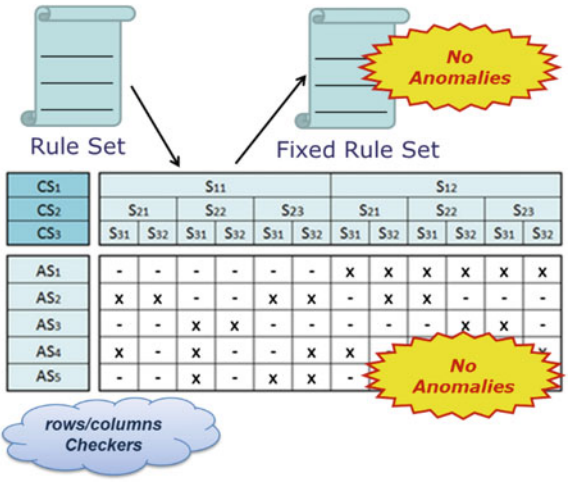

Fig. 1 Proposed approach schema

it often brings unnoticed inconsistencies, contradictions and other anomalies. Referring to the classification by Preece and Shinghal [5], the anomalies can be summarized as follows (more details in [2]):

- *Non-redundancy of decisions*. Redundancy usually does not lead to errors although it may harm efficiency. Redundancy affects maintenance and consistencies when changing the specifications. Some common forms of redundancy are the following: subsumption, duplication, unfirable rule, unnecessary condition.
- *Consistency of decisions*. Splitting the knowledge over a large number of rules, designed independently, may lead to problems of inconsistency, such as ambivalent rules, conflicting rules.
- *Completeness of decisions*. Within a specific domain area, omissions often occur (missing rules or unusable consequent).

Business rules and constraints can hide several anomalies hard to be detected and fixed. In order to point out this difficulty even in case of few decisions, an illustrative example is explained in the following.

Running Example. A courier company provides three types of service: pick up by client, standard service and premium service. Features such as speed, security (for pricey or fragile goods), tracking, weight, etc. distinguish the types of service. Therefore, starting from the business knowledge, a set of business rules and constraints is defined.

Business Rules

1. The pick-up is delegated to client when: the delivery service is standard, the client has a "silver profile", the good is not special (not fragile, pricey, food, dangerous), the weight is less than 70 kg., the destination is in a local range.

2. The delivery service is standard when: the delivery is rapid, the good is special (fragile, pricey, food, dangerous), the client has a "gold" profile, the destination is in a local range.
3. The delivery service is premium when: the delivery is rapid, the good is special, the client has a "platinum" profile, the destination is out of a local range.
4. The pickup is delegated to client when: the client has a "silver" profile, the good is not dangerous, the weight is less than 70 kg.
5. The delivery service is premium when: the delivery is rapid, the client has a "platinum" profile, the weight is more than 70 kg.
6. The delivery service is premium when: the delivery is rapid, the good is food or pricey, except for clients with "silver" profile.
7. The delivery service is standard when: the delivery is standard, the good is dangerous or pricey, except for clients with "silver" profile.
8. The delivery service is premium when: the client has a "platinum" profile, the weight is more than 70 kg, the destination is out of a local range.
9. The delivery service is standard when: the delivery is rapid, the good is fragile, the client has a "gold" profile, whether the good is food or pricey or not.
10. The delivery service is standard when: the delivery is standard, the client has a "gold" profile, the weight is more than 70 kg.

Domain Constraints

1. It is not allowed to delegate pick up to client when: the good is dangerous or the weight is more than 70 kg.
2. It is not allowed to delegate pick up to client when: the delivery is rapid.
3. It is not allowed to delegate pick up to client nor to provide standard delivery service when: the destination is out of a local range, the client has a "platinum" profile.
4. It is not allowed delivery service when: the delivery is rapid, the good is dangerous.

The above mentioned set of rules and constraints seems to be apparently correct; however, the authors will prove that it is not true in the following section. This real case is not complex; however, it involves several parameters and decisions, which may be affected by anomalies. Decision tables support to detect these anomalies and suggest corrective solutions.

3 Decision Tables and Anomaly Detection

A decision table [6, 7] is a four-quadrant table and it can be used for tabularizing a set of business rules and constraints (Fig. 2), where the state (S) of a set of conditions (CS) determines the execution of a set of actions (AS):

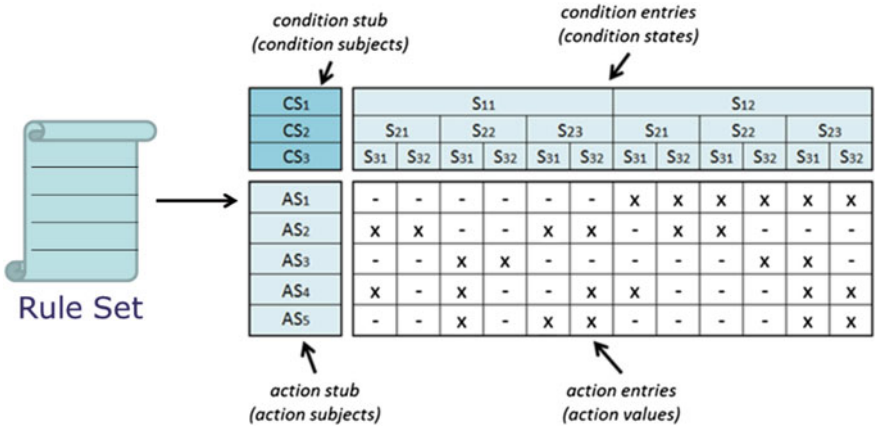

Fig. 2 A decision table schema

- the condition subjects quadrant contains all the possible decision points that may affect the set of actions to be performed;
- the condition states quadrant contains all the alternative values that are meaningful for the condition subjects;
- the action subjects quadrant contains all the possible actions to be performed;
- the action values quadrant identifies the relationship between each condition state and the corresponding actions.

By means of decision tables, it is possible to detect anomalies through checkers by row/columns, according to the criteria listed in the Table 1.

For each detected anomaly, it is possible to determine:

- the type of anomaly (Table 1);
- the level of criticality: high critical anomalies imply that decision table can't be consulted or led to incorrect results, low critical anomalies imply tolerable inefficiency or suggest potential problems. So authors classify criticality in three levels:
  - *error*: anomalies that may imply inefficiencies and a wrong outcome
  - *warning*: anomalies that may imply inefficiencies but no wrong outcome
  - *notification*: potential anomalies that need to be checked by the decision makers

Running Example. The scenario involves eight decision points: Rapid Delivery, Fragile goods, Food, Pricey goods, Dangerous goods, Customer profile, Destination range, Weight. Seven decision points are binary and one decision point is ternary. They led to manage 384 decisions ($2^7 \times 3$). Therefore, the decision table has 384 columns.

Table 1 Decision table-based detection of anomalies

	Anomaly	Automated checker	Alert
Redundancy	Redundant rule	The definition of a decision table only allows for tables where every possible case is included in one (completeness criterion) and only one (exclusivity criterion) column. The exclusivity criterion enables the prevention of duplicate and subsumed column pairs.	warning
	Subsumed rule		
	Duplicate rule		
	Unfirable rule	Check on a column level: Searching for forbidden/impossible combinations of conditional values (conditional states). Such combinations make the referred actions unfirable.	error
	Unnecessary condition	The contracted decision table, which is obtained by merging neighboring columns with identical action values, will show a"-" entry for all condition entries associated with an irrelevant condition subject.	warning
Inconsistency	Ambivalent rules	Check on a column level: searching for columns which have more than one “x”. More than one “x” entry for column may lead to ambivalent conclusions.	notification
	Conflicting rules	Check on a column level: searching for columns which have at least one “x” that is in conflict with a rule constraint.	error
Deficiency	Missing rules	Check on a column level: Searching for columns that have not any “x” entry. Such columns highlight the missing of a rule.	error
	Unusable consequent	Check on a row level: Searching for rows that have not any “x” entry. A completely blank row makes the consequent (the action) unusable.	warning

The automated tool, which is able to detect 59 anomalies (Fig. 3) and report their type, performs the validation of the decision table; there are redundancies, inconsistencies, deficiencies, with different levels of criticality.

4 Anomaly Fixing

Detected by the checkers by rows/columns, the anomalies require to be examined in order to discover the related causes and then apply the appropriate fixing intervention. The authors propose a reference model that, for each type of anomaly (more details in the Table 2), suggests:

- the elements involved in the anomaly. Such elements can be business rules, constraints, conditions and actions;
- the most appropriate solution to fix the anomaly. For example: removing/refactoring of business rules, actions or conditions.

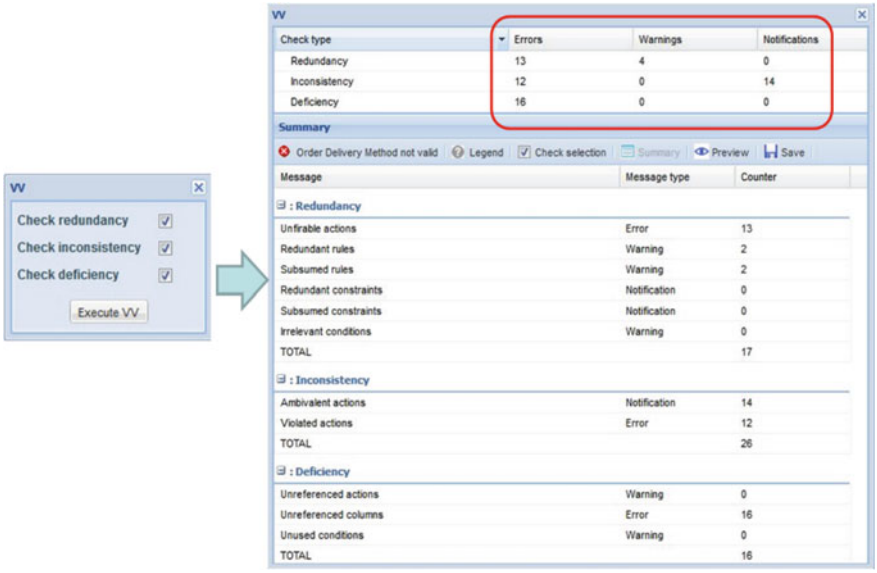

Fig. 3 Report of anomalies

Table 2 Decision table-based fixing of anomalies

	Anomaly	Focus	Fixing procedure
Redundancy	Redundant rule Subsumed rule Duplicate rule	Rule	The rule can be removed
	Unfirable rule	Action	Unmark the cell which links the conditional values to the action
	Unnecessary condition	Condition	The irrelevant condition subject can be removed
Inconsistency	Ambivalent rules	Action	If necessary, removal of the ambivalent "x"
	Conflicting rules	Action	Removal of the conflicting "x"
Deficiency	Missing rules	Condition	Mark one or more cells of the blank column (for introducing the appropriate rule)
	Unusable consequent	Action	Mark one or more cells of the blank row (for introducing the appropriate rule)

The logic of this model is implemented in the software tool, which is able to automate also the fixing of anomalies, as explained in the running example.

Running Example. In Fig. 4, the selected anomaly concerns an action that is not executable because its premise is not consistent (the rule is unfirable). The correction implies updating rules related to that anomaly by removing the part

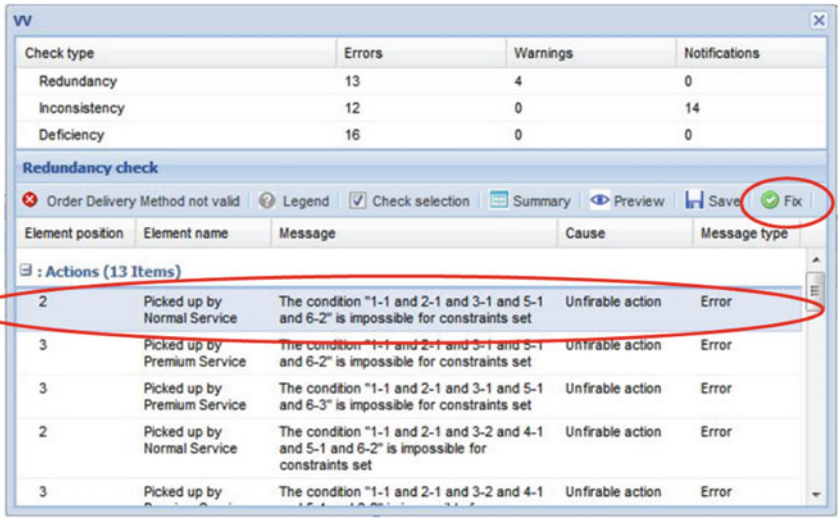

Fig. 4 Anomaly fixing panel

Fig. 5 Decision table that represents knowledge without anomalies

related to the not-consistent premise. In the same way, for each anomaly, the fixing is guided and automated.

As shown in Fig. 5, this procedure has simplified the decision table by providing only 27 columns (−93 %) and it has produced a correct and complete set of rules.

5 Conclusion

In a previous work [2] the authors discussed how the decision tables might be applied to model and maintain the business knowledge.

This paper completes the work, by deepening decision tables as useful tool for the knowledge verification and validation. The decision tables can help detecting and fixing several types of anomalies in decision points by means of automated

verification, which guarantees non-redundancy, consistency and completeness of the business knowledge formalization. In addition, the running example shows:

- the efficiency of detection: i.e. 59 anomalies discovered;
- the effectiveness of fixing: easy fixing of the anomalies and reduction of the decisional space of 93 %.

The proposed approach, deterministic and repeatable, is implemented in a software tool. Such tool supports the automated detection and fixing steps and therefore it makes the approach transferrable and manageable by users without specific competences.

In the future, the authors will perform an experimental study of their proposal in industrial setting. Moreover, in order to manage more complex decisional conditions, future works will be focused on the validation of set of linked tables and on their inter-tabular checkers.

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KMS in a Cluster of Firms: The Role of a Digital Platform

L. Cremona, A. Ravarini and J. Sutanto

Abstract Previous studies widely focused on the adoption and usage of Knowledge Management Systems, namely KMS, within a single organization or within supply chains providing little explanations of the relations behind knowledge sharing and transfer; yet, hitherto few studies have provided empirical results of KMS adoption within cluster of firms. The lack of such studies dealing with KMS adoption within cluster of firms and focusing on knowledge absorption motivated the study focus on how the IT-enabled knowledge capabilities affect firm innovation. To overcome this void in the literature this study presents the preliminary results of a multiple case study conducted on six SMEs within a cluster of firms adopting a digital platform, a KMS, aiming at generating innovation and internationalization opportunities. We carried out a systematic literature review over 200 articles by identifying three main research areas: knowledge management, joint activities and business value of IT. We built an a priori theoretical framework that extends the limitations of previous studies by focusing on the adoption within a cluster of firms. For scrutinizing the theoretical framework on knowledge sharing, a multiple case study approach was chosen and carried out on the six firms. The preliminary results contribute in explaining the role of digital platforms and the strength of interpersonal connections in influencing the performances improvement of the whole cluster.

Keywords Knowledge sharing · Knowledge management systems · Cluster of firms · Absorptive capacity

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1 Introduction

Contemporary organizations have set the effective use of information and knowledge resources as an important goal to reach. More than ever, they are deriving value from intellectual rather than physical assets and they are benefiting from the most profitable resource: employee knowledge. The identification and exploitation of these resources is becoming central to organizational success [1]. Knowledge exists in several locations within an organization, including culturally embedded practices, documents, policies and with individual employees [2–5]. With the growing strategic importance of knowledge management, more firms are implementing knowledge management systems (KMS), "a class of information systems applied to manage organizational knowledge" [6]. Nevertheless, it is relevant not only to design IT tools to manage knowledge sharing but also to understand how to select and manage knowledge resources. Moreover, many studies focused on the introduction of KMS within a single firm [7], leaving almost unexplored the issue at the inter-organizational level. To cover this gap, we studied the variables affecting the impact of digital KMS platforms on the performances of clusters of firms.

The paper is organized as follows: the next section presents the theoretical background of the research by introducing relevant fields of investigation; Sect. 3 presents the methodology adopted in the study; Sect. 4 describes the analysis carried out within the study; Sect. 5 discusses the preliminary results; Sect. 6 draws conclusions and the implications for both academia and practitioners as long as future steps of the research.

2 Background

2.1 KMS

Previous studies about KMS implemented by aggregations of multiple firms were characterized by being referred to a specific type of industrial aggregation, i.e. supply chains, and by being focused on the usage of KMS at the intra-organizational level (i.e. considering the impact of KMS on the internal activities of each single firm). On the contrary, the benefits deriving from the usage of a KMS (here defined as a digital platform for knowledge sharing and management), were not widely investigated when the usage occurred at an inter-organizational level such as within a cluster of firms.

Several studies have tried to demonstrate how IT enhances the knowledge management capabilities of organizations for example by connecting knowledge creation to the development of new products and/or services [8, 9] while others found that these capabilities provide competitive advantage and increase financial firm performance [10].

Along this line, another stream of research studies KMS using the concept of firm's absorptive capacity, i.e., the ability to recognize the value of new information, assimilate it, and apply it to commercial ends. Malhotra et al. [11] showed that enterprises have to build "requisite absorptive capacity to prepare for collaborative knowledge creation with their supply chain partners". In other terms, Absorptive Capacity works as a filter and a moderator of the information exchanged at the intra- and inter-organizational level.

Cohen and Levinthal [12] pointed out that entering into an alliance will potentially expose the firm to a larger knowledge base but the fraction of the knowledge that it can appropriate depends largely on its prior preparation. Finally, [13] studied how inter-organizational information systems could help developing a business community that can produce positive effects such as improving the number of commercial partners or creating joint activities on the market and strengthening supply chain partnership.

2.2 Business Value of IT

Mukhopadhyay et al. [14] refer to the "business value of IT" as the "impact of IT on firm performance". The term "IT business value" is used—rather generically—to refer to the organizational performance impacts of IT, including productivity enhancement, profit ability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance [15]. As the business value of IT is linked to complementary changes in organizational process capabilities, it is necessary to introduce the concept of sustainability and capabilities. Inasmuch, there is still limited understanding about the business value of IT when a cluster of firms of the same industry uses a digital platform. Rather than supplier-customer relationships, firms in a cluster deal with multifaceted relationships (such as competition, co-design, besides the supplier-customer ones). Thus, assessing the value of digital platforms for these firms is both complex and important [16, 17].

In this research we aim at studying the moderating role of Absorptive Capacity [12] on information and knowledge sharing within a digital platform used by firms in the same cluster. Findings of this study add to findings in the extant studies on digital platforms that mainly focus on intra-organizational performances.

3 Methodology

The previous section showed that the available literature studied the business value of IT deriving from the adoption of inter-organizational systems (broadly defined, thus not specifically digital platforms) only within supply chains and focused on joint alliances and not joint activities.

As a first step of the research we carried out a literature review of about 200 articles based on the search for the following keywords: "joint activities", "knowledge sharing exchanging management" and "business value of IT". Among the papers selected for review, those of [11, 18–20], were analyzed to find relevant constructs. According to this review, IT business value of IOS platforms (and specifically: digital platforms) in a cluster of firms is influenced by a number of phenomena such as: the presence of a social network between firms, IT managerial skills, capabilities of the IT system, knowledge sharing and management activities. This literature review allowed us to develop an a priori *framework* (Fig. 1), showing how capabilities of digital platforms, together with the strength of interpersonal connections and joint activities of firms, influence the performances improvement of the whole cluster.

Starting from this research framework we identified those research gaps that we addressed through three research questions, addressed at a firm level:

1. Which are the socio-technical phenomena (at the firm level) that characterize the use of a digital platform by firms in a cluster?
   - 1.1 Does the digital platform produce more effects if the firms already have up-to-date IT tools?
   - 1.2 Does the digital platform produce more effects if the firms already know each other?
2. Which is the effect of a digital platform on the information generated and exchanged by firms in a cluster?
   - 2.1 Is this information relevant and exclusive?
3. Which is the effect of a digital platform on the performances of a firm in a cluster?
   - 3.1 Which is the effect on its activities?

A multiple-case study methodology [21, 22] together with a positivist approach was chosen for exploring our a priori theoretical framework on knowledge management systems within a cluster of firms. A qualitative method was adopted to explore the factors that facilitate the usage of a digital platform by firms in the same cluster, how the information exchange is influenced and which are the effects on performance of each firm. A team of a junior researcher, a senior researcher and a professor collected all the data and analyzed them: this approach was helpful in capturing greater findings and maximizing reliability. Following [22] a case-study protocol was designed including the following sections: overview of the project (objectives and issues), field procedures, questions, and guidance for the report.

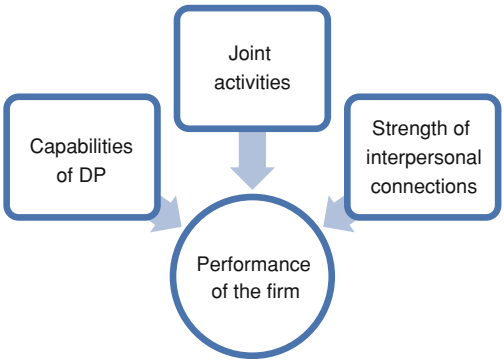

Fig. 1 The constructs of the a priori framework, emerging from the literature review and subject of the research questions

4 Analysis

The context of the empirical study was a cluster of 28 firms operating in the thermo-mechanical industry and located in Northern Italy. These firms, willing to increase their degree of internationalization by improving the sharing of knowledge about international markets, adopted in 2012 a web based digital platform with the typical features of a social networking platform (such as company profile pages, wall where employees can publish posts, online thematic groups with limited access). As reported by [22] we followed a multiple informants design by identifying 6 firms to be investigated and involving key employees. A questionnaire was used and originally designed in English, translated in Italian (with the contribution of a native English speaker) in order to be used in the following interviews. To get a higher data reliability the interviews were carried out in two different timings: at the beginning of the project and after 1 year the firms were using the platform. This was done with the aim to evaluate the platform evolution. Several stakeholders of each firm were interviewed: the CEO or its representative a/o the marketing and sales manager. Together with the interviews, in order to increase the validity of our coding and data analysis procedure, we aggregated multiple sources of evidence: artifacts (i.e. extracts from the platform), documents from each firm (about performances and financial situations) and information from websites. All data were collected from primary sources and secondary sources: documentation, archival records, interviews, direct observations, participant observations and physical artifacts. The data were encoded and structured into "projects" using the software NVivo 10 following a grounded theory approach [23, 24] that aims at finding properties or links between data. The coding activity resulted in an average inter-coder reliability of 85 % according to [25]. In order to control for potential bias of organizational culture, a pilot case study [22, 26], with aim to refine data collection plans and gain insights into the basic issues studied, was chosen which represents an Italian medium enterprise working in the thermo-electro mechanic industry; multiple case study on 5 firms to collect and analyse data to develop and test more robust theories. To increase homogeneity

and comparability, firms were chosen with similar size (medium size: <250 employees) and degree of internationalization (their presence abroad is limited to 1 or 2 countries): although they share the same customers the average entrepreneurial culture makes them act as single player on the market: the entrepreneur sees himself as a single player.

5 Findings

The preliminary findings describe what emerged for each construct of the research framework and showed how companies differently used the digital platform. The following paragraphs present the most relevant results for each element of the framework. Further developments of the study will help in thoroughly answer to the research questions.

5.1 Capabilities of Digital Platform

As emerging from literature review and reported within previous chapters, a digital platform is introduced by taking into consideration specific capabilities such as: presence of IT-tools, IT management skills, the presence and usage of inter-organizational processes and the level of information exchange. We discuss whether they were impacted and how. Firstly, considering the presence of IT-tools, none of the companies within the Energy Cluster is using an integrated system (like an ERP) but they are using dedicated systems to manage production or financial aspects and showing a low degree of IT tools adoption. The community of users of the platform showed a persistent closeness but despite this, several improvements as long as weak points were shown by the usage of the platform. Secondly, dealing with IT-management skills, firms have different perspectives on the role of IT: some firms look at IT as a tool to get better control of the business (Firm 2, Firm 3, Firm 5, Firm 6); others look at IT as a tool to substitute humans labour and, therefore, to reduce costs (Firm 1 and Firm 5). Surprisingly, almost each firm did not have a formal and structured IT development plan. Firm 4 only had a clear vision and path for IT development: "It is not only about updating it, we aim at developing IT at best: exploiting all its functionalities and support" (Marketing Manager, Firm 4). Thirdly, considering inter-organizational processes, only Firm 1 reported at the beginning of the introduction sporadic collaboration that resulted in lack of organized and generally agreed processes. In order to understand the dynamics occurring from new activities or how to preserve its own competitiveness, each firm underwent an assessment period: "Of course participating in the Energy cluster is…I mean is useful, but we still need to understand how we can contribute at best. Dealing with competitors is always hard to do but we believe that we can even find suppliers" (Marketing Manager, Firm 2). When

dealing with information exchange firms are using a common language, thus not asking for conversion or translation of the data coming from the platform. The rationale is that the Energy Cluster is using the same language of the thermo-electro mechanic sector in which firms operate: "[…] almost everything is standardized by international specifications […]" (Head of Production, Firm 1). Finally was shown that information and knowledge exchanged inside the cluster mainly refer to products and services and the same thing happens within the digital platform where they are mainly relevant, high value and complete. "…they talk about their products, we talk about our services…" (Head of Special Projects, Firm 1). "…the digital platform is a commercial tool…" (Marketing Manager, Firm 2).

5.2 Strength of Interpersonal Connections

The usage of the digital platform reinforced the strength of the interpersonal connections existing between the entrepreneurs by raising the frequency of their social and business meetings. Each firm is aware of the activities and products made by other firms of this research. This is happening even if they did not experience any joint activity before. More, we investigated if each manager interviews had specific connections out of the workplace. What is emerging from this analysis is that firms have average knowledge of each other. "…we all know each other. For us, only Firm 3 is the closest one since we produced small samples for them. It is a firm working on complementary activities…" (Marketing Manager, Firm 4). Firm 5 only is the most isolated among them; this is partly due to the peculiar activities it carried out the Energy Cluster.

5.3 Joint Activities

Firms in the cluster usually act as a single player thus not acting jointly and looking at the cluster as a context where there are potential customers, suppliers but even competitors. "…from our point of view, within the Energy Cluster since there are not suppliers, there was collaboration with customers only…" (Head of Special Projects, Firm 1). "…participating in the cluster means…we think it is useful, we still need to know the best interaction possible. The interaction with competitors is always difficult to manage but inside the Energy Cluster we have suppliers too…" (Marketing Manager, Firm 2).

5.4 Performance of the Firm

Considering the constructs related to the performance of the firm the digital platform brought relevant results. In relation to the internal operational efficiency the digital platform is considered as a tool that could boost the growth in new markets thus not focusing the efforts on production and cost reduction. "…what we expect from this digital platform is to have information regarding tenders, requests of offering, specific needs of a product we produce. If I receive so, I will use the platform and make an offer alone or jointly, depending on the strategy I am adopting…" (CEO, Firm 5). When dealing with internal operational efficacy the platform positively influenced the selection of new suppliers and vendors since it is an interesting marketplace for new products and services promotions. "…we have benefited from suppliers and vendors selection since we were able to have more connections and clear information from the firms using the platform…" (Marketing Manager, Firm 6). On the other hand, since the aim of the platform is the internationalization of firms, it can somehow make companies to lose this important target. When considering new markets creation enabled by partners the companies involved in the digital platform usage enjoyed benefits from a better knowledge and understanding of new and emerging markets. Peculiar functionalities, such as an interactive world map, were introduced in order to facilitate the internalization. "…the digital platform helped us in understanding the future: where we thought we could sell products and we thought will have success, such as the nuclear market. Thanks to the platform we acknowledged to focus on different markets…" (Marketing Manager, Firm 6). Some limitations of the digital platform are related anyway to the traditional way of contacting potential customers in new market: while it is useful for a first bird's eye view, entrepreneurs are used to contact them via phone or email. "…right now the digital platform is a wall: I do not find suppliers by using the platform. I already know the firms inside the Energy Cluster. I just have to pick up the phone…" (CEO, Firm 5). Last, competitive advantage obtained through IT is considered as major tool to improve the development and selling of products and to boost production performances by granting an efficient and fast information and knowledge exchange. "…we tried to design new and different products but then we never produced them…" (Marketing Manager, Firm 4). "…talking about IT for improving information exchange is talking about continuously improving production efficiency: if I reduce time and wastes the worker will do a better job because he already has all the necessary information to do it…" (CEO, Firm 3).

An alternative vision of IT emerged from some companies using the platform, since it is believed that the power of IT relies in people's idea and not inside the tools that are used. As a consequence, IT is a tool that can boost productivity and facilitate integration but does not produce similar effects on sales and revenue boosting. "…nowadays it is difficult that a firm has ad hoc IT tools. You have to follow the IT development. For this reason if 10 years ago 1 firm out of 10 was using Autocad, nowadays 11 firms out of 10 are using it….We believe that the rationale

for improving the quality of a product relies on the person working on it and not on the IT tool used. It is not the IT telling you what to do but it is inside the person's mind. If you have people with great insights the IT is helping you to develop the idea. But if you do not have ideas you are stuck there…" (CEO, Firm 5).

6 Conclusion

Preliminary results of this multiple-case study showed how the usage of a digital platform contributed in reinforcing connections between the firms. Knowledge sharing within firms was enhanced by the presence of absorptive capacity-based mechanism of knowledge filtering and selection that positively impacted on competitive advantage. This research has important implications for academics since it brings together Business Value of IT and Knowledge Management domains and studies them in an innovative context; to practitioners it aims at highlighting the factors that enable clusters using a digital platform to be more effective. This study has some limitations. Firstly, we studied a sample of 6 firms among the 28 pool of firms; by considering larger samples, generality and generalizability would be supported. Secondly, the research considered only a specific cluster; by considering different clusters of firms using a digital platform and by comparing them, future researches will certainly give positive contributions to the IS field.

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The Effect of Consistency Between Leadership and Technology on Knowledge Integration in GDTs

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Abstract The literature on distributed work has recognized the importance of enhancing our understanding of how leadership processes change in globally distributed teams (GDTs), and of the interplay between leadership processes and the use of collaborative technologies. However, we still find limited, and sometimes contradictory, empirical evidence on the topic. Following the theoretical framework of e-leadership, the aim of this paper is to explore how emergent and formal leadership processes co-evolve with the use of collaborative technologies in GDTs and their influence on team performance. We conducted a multiple case study in five GDTs engaged in scientific collaborations. Our analysis suggests that the attainment of consistency between leadership processes and technology use is related to better knowledge integration, which is an important antecedent of overall team performance.

Keywords GDT · Leadership · Team effectiveness · Collaborative technologies use

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1 Introduction

Organizations increasingly use Globally Distributed Teams (GDTs) to perform knowledge-intensive tasks and innovative activities. GDTs' features are global distribution (spatial and temporal), pervasive use of collaborative technologies, and, quite often, functional, organizational, disciplinary, cultural, and linguistic heterogeneity of members (e.g. [1]).

The literature on GDTs has recognized the paramount importance of enhancing our understanding on how leadership processes change and are challenged in GDTs, and the interplay between leadership processes and the use of collaborative technologies [2–6]. However, we still find limited and sometimes contradictory empirical evidence on the topic. Most empirical works in fact focus on the early stages of a team lifecycle, e.g. on initial media choice [7], and tend to focus on either formal leadership structures (e.g. the role of appointed project managers [4]) or emergent leadership structures (e.g. [8]). The aim of this paper is to understand how emergent and formal leadership processes co-evolve with the use of collaborative technologies during the lifecycle of a GDT and their influence on team performance. To address this research question, we embraced the theoretical perspective proposed by Avolio and colleagues [9] on e-leadership and we conducted a multiple case study in five GDTs engaged in scientific collaborations. Our preliminary analysis suggests that the search for consistency between leadership processes and technology use is related to better knowledge integration, which is an important antecedent of overall team performance. In the following sections we present our theoretical background, the methodology we followed and an analysis and discussion of our preliminary results.

2 Theoretical Background: Leadership Processes and Collaborative Technologies Use in GDTs

The intense use of collaborative technologies is fundamentally changing the way individuals and teams work in organizations. In this context, the task of leadership is particularly challenging given that leadership processes cannot be based on traditional forms of control, such as direct supervision, and on verbal and social cues that promote desired behaviors and foster collaboration among team members. Traditional leadership perspectives (e.g. trait theories, behavioral theories, contingency theories, behavioral complexity theory, process theories, see [2] for a review) were developed and tested mainly in co-located workplaces where individuals have many occasions to interact face-to-face. However, many authors stress the incompleteness of these theories when they are moved into a distributed environment, where team members need to make use of collaborative technologies for most of their interactions and leadership is mostly conveyed through technology (e.g. [5, 8]).

Some of these studies compared leadership in distributed and co-located teams. For instance, [5] shows that the behavior control mechanisms typically used in traditional teams, such as the definition of explicit work assignments, the specification of rules and procedures, and the filings of project plans and reports, increase the salience of vigilance and reneging, negatively impacting on the formation of trust. Xiao et al. compared two surgical teams, one co-located, the other with the leader located in another room and interacting virtually, and found different communication patterns. In the distributed team the communication between the team leader and junior members was significantly reduced, suggesting a more hierarchical structure of communication and information sharing [10].

Other studies specifically looked at how formal leaders choose and use technologies. For instance, Kayworth and Leidner study the effective behaviors of leaders in distributed settings, and show that the most effective distributed teams were those where leaders adapted the use of collaborative technologies to facilitate task achievement [6]. Thomas and Bostrom further explored the technology adaptation interventions performed by formal leaders by proposing a model that explains how leaders sense the need for technology change in a distributed team [4].

Finally, other studies looked at the interplay between emergent and distributed leadership and technologies. In their empirical study of seven temporary distributed teams, Yoo and Alavi show that emergent leaders played the roles of initiators of communication, schedulers of interactions, and controller [8]. Kruempel [11] further showed how team members collectively participated in knowledge integration in GDTs by delving into the 'moves' they made through emails.

The empirical works just presented focus on the early stages of a team lifecycle, e.g. on initial media choice [7] or tend to focus on either formal leadership structures (e.g. the role of appointed project managers, [4]) or emergent leadership structures (e.g. [8]). However, if we consider the team evolution, we expect different forms of leaderships and different technologies to co-evolve over time [2]. Our aim is to understand how emergent and formal leadership processes co-evolve with the use of collaborative technologies and their influence on team performance.

To address this research question, we embrace the theoretical perspective proposed by Avolio et al. on e-leadership [9]. The authors define e-leadership as 'a social influence process mediated by collaborative technologies to produce a change in attitudes, feelings, thinking, behavior, and/or performance with individuals, groups, and/or organizations.' (p. 617). The framework of e-leadership is based on Adaptive Structuration Theory (AST) [12]. According to AST, human actions and structures are mutually interdependent. When applied to leadership in distributed teams, it means that technology use and leadership processes are mutually constitutive. Avolio et al. [9] theoretically proposes that there should be consistency between the leadership intent and the 'spirit' of a collaborative technology. The leadership intent reflects the purposes and values underlying a leadership structure, e.g. participation versus hierarchy. The technology spirit reflects the normative framework for interpretation and use of a set of feature, i.e.,

how technology features should be interpreted and used. An example is given by a technology that is intended to promote collaboration and bottom-up contributions. In this work we will specifically look at the role of consistency between leadership and technology.

3 Methods

Given the exploratory nature of our research question and the multidimensional nature of the constructs under study we have adopted a qualitative interpretive approach and conducted a multiple case study [13] to build a grounded model [14]. The context for our case studies is represented by team science. The term 'team science' refers to broad scientific collaborations that typically involve researchers from different disciplines and countries supported by technological infrastructures [15]. In our study, we investigated five science teams engaged in European research projects of the 7th Framework Program (FP7). We selected this setting for two main reasons. Former, these projects are developed by large, knowledge-intensive interdisciplinary GDTs. Latter, the European Research Council asks for extreme detailed design and project management activities. This results in formalization of roles, stages, and control. However, given the peer-to-peer nature of work, formal leadership is often coupled with emergent forms of more or less distributed leadership. We conducted 14 preliminary interviews with project leaders and team members from 14 different European projects. Two criteria appeared as particularly relevant for the selection of cases: team size (small/medium/large) and disciplinary area (science vs humanity). Given these criteria and the availability of respondents, we selected five projects in which the first author's University was involved (see details in Table 1) and we conducted additional 38 interviews.

Data on the five cases were collected through semi-structured interviews and document analysis of websites, intranet, wiki, emails, work documents, and proposals. Interviews started with a brief description of the project and inquired into the origin of the project, the creation of the network, the coordination of the research group, the use of technologies, the team effectiveness in terms of task performance and quality of relationships, and the barriers and difficulties faced during the project. We asked specifically about the evolution of the project throughout its different stages. The team members we interviewed were involved in different roles: formal project coordinator, task/activity manager, and participant. The interviews lasted about 1 h and they were transcribed verbatim into files.

We used the techniques described by Strauss and Corbin and Mattarelli et al. [14, 16] to code the interviews and documents. In the first phase three of the authors performed open and axial coding. In the second phase, we consolidated a coding book and moved our qualitative material into a qualitative data analysis software. We selected about 20 % of our files to be coded by two of the authors independently. The average level of agreement on codes and relationships was more than

Table 1 Overview of case studies

Case study	Size	Countries	Sub-groups	Discipline
A	Small	4 (Austria, Italy, Switzerland, UK)	5	Science (informatics)
B	Small/ medium	8 (Cyprus, Italy, France, Germany, Greece, Slovenia, The Netherlands, UK)	8	Human (sociology)
C	Small	8 (Belgium, Czech Republic, Italy, Germany, Portugal, Sweden, Turkey)	9	Human (sociology)
D	Large	10 (Bulgaria, Italy, Belgium, France, Germany, Greece, Poland, Spain, The Netherlands, UK)	11	Human (socio-economics)
E	Large	10 (Belgium, Denmark, Finland, France, Germany, Indonesia, Italy, Luxembourg, Poland, Spain)	11	Science (environmental science)

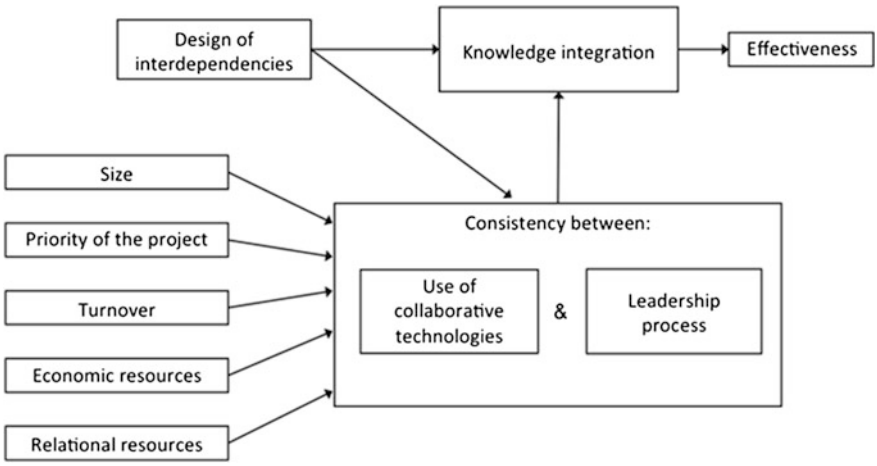

Fig. 1 Theoretical emerging model

95 %. Discrepancies were discussed and the first author coded the rest of the evidence. Third, the authors met multiple times to discuss the grounded model emerging from the analysis (selective coding). Our model is presented in Fig. 1 and discussed next.

Table 2 Perception of effectiveness

Case study	Positive (%)	Negative (%)
A	86.47	13.53
B	63.95	36.05
C	39.06	60.94
D	72.97	27.03
E	54.67	45.33

4 Preliminary Results

The projects that we analyzed passed all the mid-reviews imposed by the European Research Council and are thus to be considered successful in terms of formal goal attainment. However, during interviews we asked our informants to comment upon their perceptions of team performance and we found out that the five teams were not considered equally successful by teammates. Table 2 reports the percentage of people we interviewed that deemed their team as being effective.

When asked to elaborate on their interpretation of team effectiveness, most of our informants mentioned that, in their opinion, a GDT is successful when the knowledge that it produces is integrated over time across some or all subgroups. Knowledge integration is a condition for the joint production of scientific outputs (e.g. patents, journal publications, books), which is considered a fundamental dimension of effectiveness even when not formally required by the European Research Council. The level of knowledge integration [17] within a team is influenced by the interdependences designed when the project is first proposed to the European Research Council. Even if every project had a detailed and strict design of interdependencies, as the European Community guidelines required, our data suggest that not all of them achieved high levels of integration. In analyzing why this happened, we found that the search for consistency between leadership process and technology use played a salient role (see Fig. 1 for our grounded model). Details on single cases follow.

A was perceived as the most effective project. The research results turned out to be very integrated, as one participant underlined: *More papers, more pieces of software, I think that the project was more integrated, there is a collective idea of where you want to go.* Team members extensively used multiple technologies (Skype, e-mail, website, wiki, Google Site, SubVersioN, Latex). Emergent leadership was distributed: many team members took a scientific leadership role to ensure coordination and the integration of their individual and subgroup results across the different stages. The formal project coordinator acted as a facilitator and encouraged the creation of multiple scientific leaderships as well as interactions across subgroups. The wide use of collaborative technologies and unplanned meetings supported integration.

D was perceived as the second most effective project. Coordination needs were limited and guaranteed by the formal coordinator who acted as integrator: *Each team had to write its own part. The coordinator's team compiled all the*

documents, said one team member. Team members used very few collaborative technologies (email and the project website) and leadership was fully centralized: each subgroup carried out its own activities and the leader coordinated and supervised them. The leader was deemed as acting as a knowledge integrator throughout the whole project and minimizing the use of technologies and unplanned interactions between subgroups.

In **B,** the Greek subgroup centralized scientific and administrative coordination, acting as integrator. One member of the Greek subgroup stated: *We haven't really written a lot together, so what we do is that everyone makes their own report and now we bring them together.* Members across subgroups used few technologies (Skype, e-mail) and leadership was centralized because not only were the members of the Greek subgroup present in each work packages, but also took care of every step related to knowledge integration. The Greek team maintained control by making use of some collaborative technologies for bilateral meetings and developing a common research framework to coordinate the research activities.

E team members perceived that integration was not properly achieved during the life of the GDT. Specifically, some subgroups failed to integrate their knowledge with others. The use of technologies was not homogeneous across subgroups (i.e., high in some units and low in others), but leadership was designed as distributed across subgroups. There was a matrix model to share and coordinate activities that required strong interactions between distributed leaders. For this reason, they planned to collaborate intensively using collaborative technologies. Some subgroups, however, did not use them (for example, due to scant familiarity) or did not even have certain them.

C was perceived as the least effective team. Given that team members had very different skills, it was critical to integrate tasks and knowledge: *To integrate the different theoretical perspectives to build a common model is a major challenge,* said a team member. Members used few technologies (mainly email) and leadership was decentralized: each subgroup carried out their own activities, but was expected to interact with other subgroups to integrate the knowledge produced. There were several scientific leaders who emerged during the team lifecycle, but members perceived that a central leader or group able to organize the efforts of the various subgroups was missing, as well as that they were not able to enact all the interactions they needed across subgroups. The limited use (sometimes even rejection) of collaborative technologies (e.g. Skype) limited the integration of the efforts of the various subgroups.

Our data show that the most effective research projects (**A**, **D**, and **B**) gained high consistency between leadership processes and technology use as the project advanced: **A** adopted a distributed leadership and an extensive use of technology and technology played the role of integrator; **D** adopted a centralized leadership and a limited use of technology and the team leader played the role of the integrator; **B** used a subgroup as centralized leader and knowledge integrator by promoting many technology-related interactions between the subgroups and the central subgroup and by limiting interactions across subgroups. On the other hand, the projects perceived as less effective (**E** and **C**) were characterized by low

consistency between leadership processes and technology use. **E** accurately designed the distribution of leadership across subgroups, but failed to provide and promote uniform technologies to subgroups. **C** opted for an emergent decentralized leadership, but limited the use of technologies. Accordingly, neither the leaders nor the technologies were able to ensure integration in this team.

Given that consistency between technology use and leadership processes seems a premise for successful knowledge integration, we analyzed further why some teams were able to gain consistency and others did not. In a preliminary exploration of our qualitative data we found that consistency between leadership processes and technology use is affected by the following factors:

- project size: the higher the team size, the more complex to coordinate the different subteams and attain consistency;
- project priority: if it is a high-priority project, members work harder to ensure that they interact properly with formal or emergent leaders, thus promoting the adaptation of technology use;
- turnover: the change of leaders or members makes the leadership processes fuzzier, and it is more difficult to attain or maintain consistency;
- economic resources: funding paucity makes it more difficult for leaders to set up appropriate technologies;
- relational resources: established networks favor consistency; if teammates are used to work together, consistency may have been already attained in the past.

5 Preliminary Discussion and Conclusive Remarks

The aim of this research was to explore the complex and evolving interplay between technology and leadership processes and its effect on GDTs' outcomes. We have interpreted leadership as a process that is profoundly intertwined with technology choices and uses, and looked at how GDTs gained consistency between technology use and leadership processes over time. Our five case studies show how consistency can or cannot be attained. The kind of consistency that we detail is different from that proposed by Avolio and colleagues [9]. While these authors focused on the alignment between the intentions implicit in technology and leadership styles, we focused on the search for consistency between evolving leadership and technology use. Moreover, we provided new evidence on the outcomes of such consistency, namely knowledge integration and team performance.

Our work also offers practical implications for managing distributed teams. Team members and managers should be aware of the need to pursue consistency during a team lifecycle to favor the integration of dispersed knowledge. Future research directions should be interpreted in light of the study limitations. We focused on few teams in the specific context of knowledge intensive distributed research. Do our insights apply to other types of GDTs (e.g. software development, new product development, consulting teams) where emergent distributed

leadership seems more difficult to take place and individuals have less autonomy in making decisions about interactions and technologies since a hierarchical structure applies? What are the variables that affect the search and maintenance of consistency in different distributed settings? Moreover, our case studies show instances of inconsistency where distributed leadership is coupled with a limited use of technologies. What happens if leadership is centralized and there is an extensive use of technology? We argue that this is another form of inconsistency that needs to be investigated in future studies.

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A New Perspective for Accounting-Based Business Planning Simulation: An Integration with Agent-Based Simulation

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Abstract This paper examines possible future developments of accounting-based business simulation models applied to business planning as knowledge generators. To this purpose, we tried to elaborate a theoretical framework by integrating system dynamics models and agent-based models. Although such an integration has already been put in practice for general purposes, it is still a new issue for planning and control systems.

Keywords Business simulation · System dynamics models · Agent-based models · KGDSS models · Business planning

1 Introduction

The main topic of this paper is to investigate the potential of recent "business simulation" improvements for applications into business planning contexts.

The term "business simulation" may be applied to different fields and as such, it has a number of meanings. In this paper, simulation strictly refers to "accounting-based business planning simulation". Namely, this research examines possible improvement of the traditional "accounting-based business simulation" by integrating a more advanced simulation for social agents.

The crucial passage from traditional planning to "accounting-based business planning simulation" can be pictured through the image of the breakage of a so-called *black box*. This can be compared to a coffer, from which decision-makers get the "treasure", that is, the knowledge and the chance to intervene in the

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relationships connecting the above-mentioned economic and financial key variables. Within the economical-financial planning process thus, the decision-maker has an active role into future action processes.

Traditionally, simulation models based on variables and accounting values are operated interactively by means of the computer as "decision support system" and/or knowledge-generation tool.

Let's consider that in simulations, values (i) are only based on estimates and abstractions, (ii) are produced by a mental process involving the decision-maker/s or net of agents; (iii) result from a synthesis-analysis-synthesis process each actor is requested to perform.

Simulation then, makes use of the computer as a lab to create a virtual world based on autonomous agents with "minds". Here the economic agents interact with each other and the environment modifying their behaviours according to what they have learnt.

What has been said so far is not to suggest substituting the accounting-based business simulation with the agent-based simulation, but serves the purpose to re-define the role of the former: no more as the subject of the simulation but, rather, as the main tool the decision-maker—well-aware of all its relationships—employs as a map to guide his/her whole mental process, which is the object of the simulation itself.

Before introducing the topic, we review literature about accounting-based simulation models and agent-based models. Next, we describe the characteristics of the two categories of models and then we illustrate a theoretic framework to investigate the possible evolution of simulation planning models and their application in the business planning area as knowledge generators. Finally, we provide our conclusions.

2 Literature

As everybody knows, experimentation is not always feasible in the field of social sciences. Here then, computer simulation—in constant evolution since the years after the Second World War—can come in handy. As it is impossible to illustrate all simulation patterns, our study will focus on how effective computer simulation can be to business planning.

Two main streams in the field of business planning simulation models have emerged from literature review: (i) accounting-based simulation models, and (ii) agent-based models.

Choosing to analyse two different main streams was not our initial plan. We started examining accounting-based simulation models. The idea was then to draw a *fil-rouge* on their evolution in the field of business planning. Two dimensions may be defined: (i) the aim of using accounting-based simulation models (decision support vs. knowledge generators); and (ii) the role played by technology—in particular by computers—in each simulation model (main actor vs. support).

While summing up the main evolution stages, we detected some drawbacks characterizing these models as well as a trade-off in the main functions (decision support vs. knowledge generators). These drawbacks geared our attention on other models, the so-called new simulation models [1]. These models—called agent-based models—are frequently used in the business planning area and they may help us to overcome this trade-off.

The main evolution stages regarding the above-mentioned streams will be dealt with in this paragraph.

Regarding the first main stream, Coda [2] gives an interesting definition of accounting-based business simulation models as "a set of key variables and relationships defined on those variables representing any company's income dynamics and financial simulation".

The following streams are classified according to their application purpose, ranging from simulation as decision-making support [3–5] to simulation as knowledge-development medium [6].

About the first main stream, literature shows many fields in which simulation is applied (Fig. 1):

- Business simulation used as an integrated mathematical-accounting model [7, 8–10];
- Business simulation as Decision Support System (DSS) tool [11, 12];
- Business simulation as a tool for understanding the relationships among key variables in the Knowledge Generating Decision Support System (KGDSS) field [13, 14].

The aim of business simulation as an integrated mathematical-accounting model is as decision-making support. These applications were identified as the first attempt to predict environmental dynamics. The main mathematical-statistical tools used were linear programming [8] and Operational Research (OR) [10].

As yet, they cannot be considered as simulation models stricto sensu, but rather as optimization models.

Operational research and linear programming use an optimization approach. This approach is not appropriate to the "actual" business planning process because decision-makers do not look for solutions but rather, for more information and all possible alternatives to make decisions.

Amaduzzi [9] agreed on that. The author revised one of his own previous integrated business planning models [8] since he had realised that the mathematical tool used was not appropriate to support the integrated control of a firm system [9]. The major modification of the model was on the use of cybernetic approach. This modification powered up the passage from linear programming models to business simulation models.

Industrial Dynamics (ID) belongs to the same category. This methodology (Forrester) was between operational research and system dynamics approaches.

Forrester [7] defined ID as "the study of the information-feedback characteristics of industrial activity to show how organizational structure, amplification (in policies), and time delays (in decisions and interactions) interact to influence

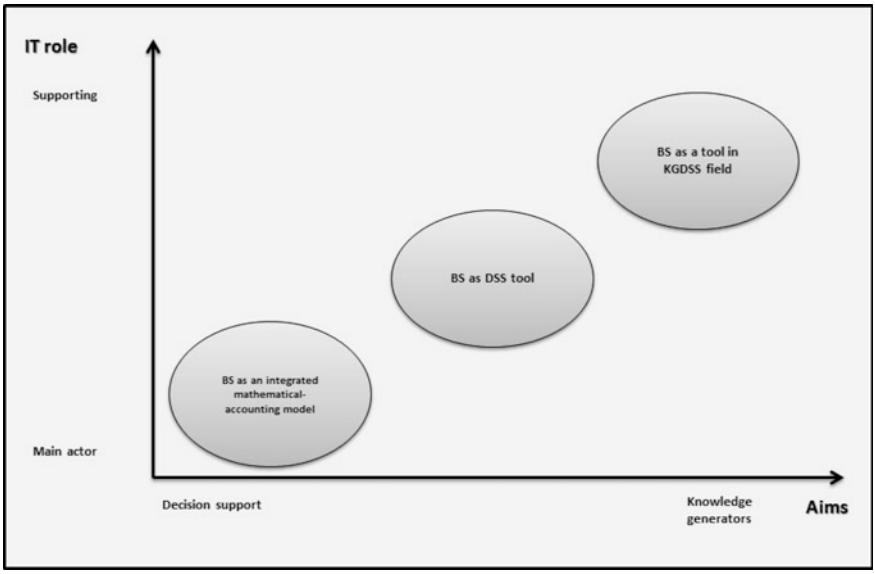

Fig. 1 A representation of accounting-based business simulation models' evolution

the success of the enterprise. It deals with the interaction between flows of information, money, orders, materials, personnel, and capital equipment in a company, an industry, or a national economy".

As for problem solving, there was a change in view. Operational research used an open-loop view, whereas first ID then system dynamics adopted a closed-loop one. More precisely, taking a decision is held to produce changes in its context. These changes would constitute the information input for new future decisions [15].

However, the ID was considered as a simulation approach to problem solving because the approach was only quantitative, with no forms of human participation in the simulation process [16].

The second field refers to the use of business simulation as decision support system in business planning. DSS became a branch of knowledge during the first half of the 1970s. The concept of DSS has evolved from two main areas of research: the theoretical studies of organizational decision-making and technical work on interactive computer systems [17].

A unique yet thorough definition of DSS does not exist [18]. Keen and Scott Morton [17] define decision support systems as "systems which couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision-makers who deal with semi-structured problems".

In this perspective, business simulation can be defined as a decision-making methodology to examine the characteristics of a real system for understanding its behaviour and forecasting its future development to pinpoint the best strategies.

Belonging to this category, there are various accounting-based business simulation models, see Favotto [11], Mancini and Pistoia [19], Mancini [12], Marchi [20].

A number of case studies using system dynamics-based decision support system can be found, e.g. Quaddus and Intrapairot [21]; Chang et al. [22]; Mora et al. [23].

Created by Forrester, system dynamics methodology focuses on decision-making support [24]. By means of SD, decision-makers understand the relationships between the different variables. Business problem-solving approach then—typical of operational research—gives way to a diagnostic one requiring never-ending learning.

System dynamics not only gives decision-making support, but also offers knowledge and learning development.

The third field is the application of business simulation models as means to learn about the interactions among the variables of the system examined. Simulation models not only help decision-making but also contribute to knowledge development. Thus, technology takes a crucial role, that is, software is now KGDSS—decisional systems producing new knowledge [14]. Several authors [14, 25] significantly pointed out that there is no correlation between the software instrument quality and knowledge development. The very opposite occurs in the relationship between knowledge development and decision-maker's intervention on the conceptual side of the model reproducing what is being investigated [25, 26].

Besides KGDSS, SD qualitative approach falls in the same category. System Thinking researchers find it interesting as the approach focuses on the ways the agents involved perceive and interpret reality, thus concentrating on how firm decision-makers manage their knowledge [15].

All that represented a step further for SD, from system modelling through mathematical language to defining tools for strategic thinking.

To sum up, the field of accounting-based simulation models is rather heterogeneous. Simulation models can make use of static (linear programming, operational research and industrial dynamics) or dynamic methodologies (system dynamics), depending on whether the time variable is taken into account or not. There are also methodologies fulfilling both the aims above-mentioned (decision support vs. knowledge development). As nowadays all the models described are equally effective, the choice of methodology shall rely on [27]: (i) the nature of the system being simulated, (ii) the aims of the research.

Accounting-based business models evidenced that they focus on some concepts such as: flow and stock variable measurements and feedback circuits regarding a specific issue. We believe that these models are not fully suitable to strategic planning. A crucial role is played by the human factor [28], whose dynamics is only partly taken into account in such models. These considerations geared our attention on agent-based model (ABM).

Applications of agent-based modelling span a broad range of areas and disciplines, offering accurate results even for complex systems. Since they require computation-intensive procedures, they became widespread in the 1990s and were very different from traditional models and simulation [1].

ABM is a helpful tool for studying adaptive complex systems, like companies. Simulation allows to create virtual worlds, where social agents interact with each other and the external environment, modifying their behaviours according to the knowledge acquired.

The emphasis on modelling the heterogeneity of agents across a population and the need of self-organization are two of the distinguishing features of agent-based simulation as compared to other simulation techniques, such as, discrete-event simulation and system dynamics [29]. ABM is a mindset more than a technology [30]. The ABM mindset consists of describing a system from the perspective of its constituent units, and the computer becomes the lab where those models are simulated.

From literature reviewing, a gap emerges. The literature about the first main stream focuses on the use of accounting models only as subjects rather than as means of simulation activity. Regarding the second main stream, there are many examples of agent-based model applications to the areas of market, organisation, production [29, 30]. There are no examples about the application of these models to business planning.

System dynamics models and agent-based models are two different computer simulation approaches, and the latter is not to be considered as the refinement of the former. The two kinds of software have indeed different (i) theoretical approaches [31]. SD refers to systems theory and makes use of feedback loops, ABM refer to the complexity theory. (ii) They differ also in perspective [32, 33]. SD is a top–down approach. The system being analysed is "broken up" into its major components and their interactions are then modelled. AB modelling techniques are referred to as a bottom-up approach since they study the emergent behaviour and interaction of individuals (agents). (iii) Aims are different: as already said, SD mainly supports decision-makers, though there are also knowledge-generation applications. ABM basically aims at knowledge-generation.

Combining the two research fields may offer a new perspective on the "accounting-based business simulation" that can be linked to the social context the model originates and works to the aim of really increasing knowledge, fitting the definition "agent-based business simulation".

3 An Accounting-Based Interpretative Framework

As already stated, the aim of this paper is to elaborate a theoretical framework about computer simulation models as knowledge generators and their possible application in business planning.

This framework has resulted from revising two models: (i) the accounting-based simulation conceptual models proposed by Marchi [20]; (ii) the one proposed by Marchi and Caserio [14] about knowledge generation into the business planning process.The two models will be described later in this paragraph.

The framework we propose grounds on the assumption that:

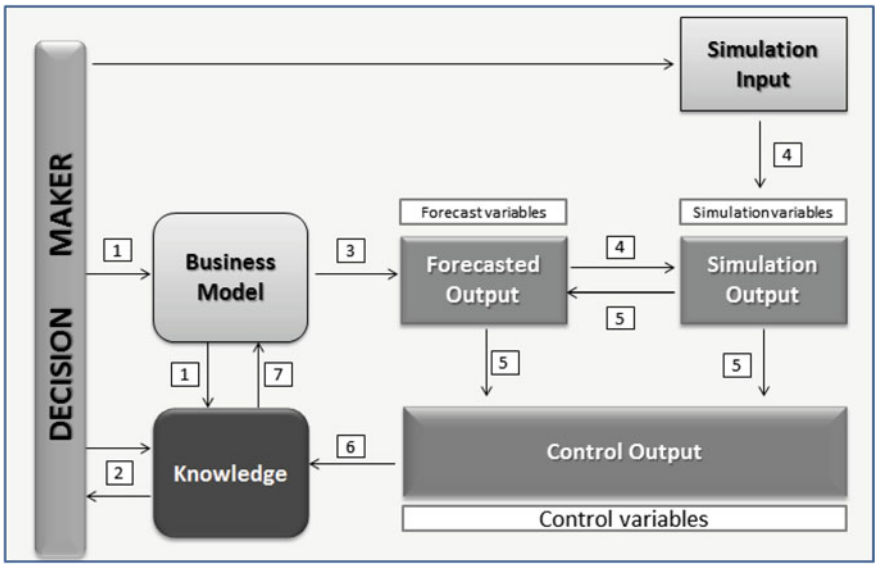

Fig. 2 A representation of simulation conceptual models employed into business planning process (adapted from Marchi [20])

the interaction between decision-maker and conceptual model is a necessary—though not sufficient—condition to generate knowledge.

On this assumption then, planning models taken into account are opened models [26]. These models are characterized by the possibility to open the *black box*, that is to say, to change and/or modify variables and relationships reliability. Through such models, managers interact with the conceptual models partly changing their tacit knowledge in IT language.

Before describing our framework, we would like to explain the path leading to it.

The accounting-based business simulation conceptual model proposed by Marchi [20] is based on financial statement data, external data and on the relations among the different financial statement items. The relations regulating the different items follow the principles expounded by Coda [2]. In particular, two types of variables are distinguished: (i) output variables, directly calculated by the software (forecasting variables); (ii) input variables, introduced by the decision-maker. These variables are divided into historical variables—definite values, as based on the historical financial statements—and simulated variables—estimated values—which summarize the decision-maker's reflections into figures (Fig. 2).

A business planning process starts when the decision-maker defines a business model and updates the existing knowledge (step 1). Next, historical data are analysed by collecting all data available, i.e. technical/physical and economical/financial internal data, as well as external environmental data (step 2). This is the forecasting process starting point. Historical data and business model analysis will

automatically result into forecasted output by making use of suitable future value forecasting techniques (step 3). Here the decision-maker does not intervene: s/he already acted at the beginning of the forecasting process by setting the horizontal relations between data and the calculating technique to employ.

After the forecasting phase is over, the actual simulation process starts and now the decision-maker plays a decisive role throughout the whole process.

The decision-maker inserts her/his own simulation hypotheses and then, on the business model and forecasted output, simulation outputs will come about (step 4). The decision-maker may intervene on the forecasted values by modifying their value according to her/his logic, knowledge and/or intuition. Obviously the simulated value is strongly affected by the manager's subjectivity.

At this stage, control output also comes about (step 5). This can be forecasting or simulating depending on whether the simulation process is in action or not. Control works in two ways: (i) feedback control, that is, between final and forecasted/simulated performance; feed-forward control, that is, between pre-final and forecasted/simulated performance. What results from this stage offers knowledge generation feedback on both human and structural capitals (step 6) as well as feedback on the business model being analysed.

Although the model described appears just as decision-support oriented, it may be used to generate knowledge. To this purpose, we suggest the model proposed by Marchi and Caserio [14] should be integrated.

Marchi and Caserio [14] model develops two types of knowledge: (i) knowledge on the future, resulting from the interaction between future previsions and past values, and represented by software-computed cohesion indicators offered to the decision-maker's interpretation; (ii) knowledge from the past, emerging from the variance of key variables and depending on the mathematical and statistical technique used. The knowledge resulting from this stage can be employed for business models and to define new hypotheses.

What is new then in comparison with the other framework is: a third kind of knowledge development, the continuously-generated knowledge on the future.

Besides periodically-generated knowledge on the future (see knowledge on the future, [14]) resulting from the interaction between future previsions and past values, there should be also continuously-generated knowledge on the future giving the chance of checking previsions before they come into being (feed-forward control). This kind of knowledge will influence or more precisely contribute to building knowledge from the past that will affect the decision-maker and, consequently, periodically-generated knowledge on the future. It goes without saying, the decision-maker's role becomes more active. S/he will intervene on the model by setting the value of a few variables according to his/her experience and intuition at the end and beginning of the business planning process. In addition, she/he will be always ready to intervene, when necessary, so that knowledge and previsions will be better and more accurate being under constant check (Fig. 3).

The three steps of knowledge-generation above mentioned may be embedded in Marchi [20] conceptual model (see Fig. 2).

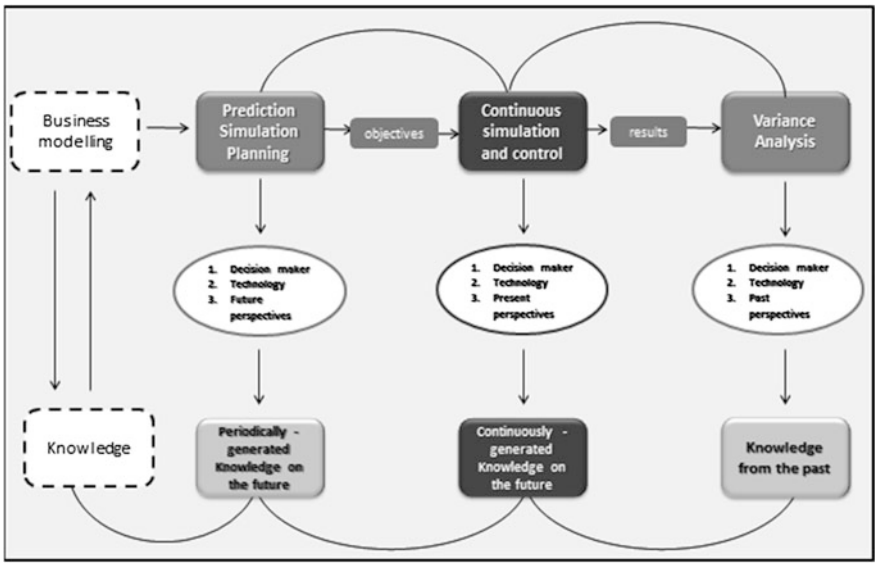

Fig. 3 A representation of knowledge on the present

In particular, inserting the historical data, which automatically results in setting the forecasting/simulation variable historical value, allows to determine the knowledge from the past. This enables interpreting past performances in order to forecast future ones.

The forecasting and simulation steps, whose final output concerns future financial statements allows the periodically-generated knowledge on the future.

The continuously-generated knowledge on the future comes out of the feed-forward control that might modify simulations previously calculated in real time.

4 An Integration with Agent-Based Modelling

The revision of the framework just described, together with what resulted from literature about the features and shortcomings of accounting-based simulation models and agent-based models took to trying out an integration between the two simulation systems in business planning.

In particular, what has led to develop a theoretical framework embedding the two simulation approaches is the different role the decision-maker may have, which affects the kind of knowledge being generated. In SD models, the decision-maker's role is relevant in the simulation process as s/he her/himself can adjust, substitute, add, and/or manage the model variables and relations [26]. As actor, the decision-maker has to analyse the contest, adapt her/his own mental model into a formal scheme, test the feedback of any alterations, be competent in IT. All that

increases the single subject's human capital and slightly contributes to turn part of her/his knowledge from tacit into explicit. Although having an active role, the decision-maker stands out of the model itself as SD models focus mainly on the major representative values of the system being analysed. In such models what is being analysed is the relations among the variables, that is, the values.

Agent-based models instead, analyse a system starting right from its main constituent individual parts, that is, the agents, and their interactions with each other and the environment. Among the different categories of agents, Russell and Norvig [34] define as learning agents those who operate autonomously, learn and adapt in real time. This kind of agents suits our research goal well. A learning agent, being at the same time principal actor and variable of the simulation, is strictly linked to the human capital for the same reasons described in SD models. Interactions between agents instead, are linked to the improvement of relational capital and knowledge sharing. Within an iterative process, human capital development affects organizational capital increase which, in turn, adds to human capital again.

We do not intend to diminish the value of SD models of course: they are crucial to the formalization and simulation of variable relations. Indeed, SD models should be integrated with a few principles of agent-based models in order to make the role of the decision-maker as objective as possible, given her/his relevance in the simulation process. The values influenced by the decision-maker strictly depend on the subject involved, her/his background, relations with the various key-position personae within and without the firm. All these details can be taken into account only by integrating Accounting-based simulation models with Agent-based models.

Literature shows that over the years there had been several attempts to combine SD and AB models (see [32, 33]).

In particular, Borshchev and Filippov's paper [32], showed as AB models can be built from an existent SD model. The authors stated that the ABM approach can better capture real life phenomena than the SD approach, although ABM should not be considered as a replacement for SD models. Macal's paper [33] came to the same results as Borshchev and Filippov's. Macal transformed an SD model in an equivalent agent-based model. The two models were defined equivalent because they were applied to the same context but the results achieved were different. In fact, ABM provided additional information to the information offered by SD model.

Their main shortcoming though is lack of experimentation in the business planning process.

In the framework proposed, we selected the elements best suiting our purpose. In SD models, we took (i) conceptual model development to synthesise the relations among the variables analysed in the models; (ii) the structure based on feedback loop both reinforcing and balancing, to balance the dynamics among the variables.

The elements taken from ABM models are first of all (i) agents. According to Grundspenkis [35], we identified three types of agents: leading agents—the decision-maker/s operating in the planning field; internal agents—all the agents

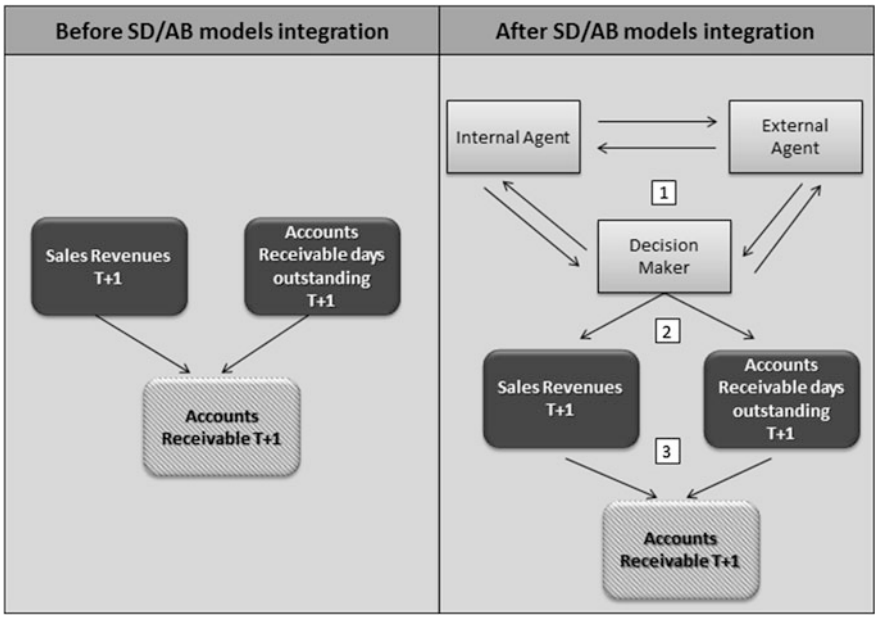

Fig. 4 A representation of integration SD/AB models

operating in the firm decision-makers interact directly with sharing information; finally, external social agents—agents operating out of the firm the decision-maker/s interact directly with. Then (ii) agents' relationships.

The integration between the two simulation paradigms is applied to the conceptual simulation model proposed by Marchi [20] shown in the previous paragraph.

The model has been described synthetically. Now there is an example of how it works in detail (Fig. 4), to explain how the simulation process changes (step 4, Fig. 2) when integrated with the agent-based models. The integration will not affect the forecasting process as the decision-maker does not intervene at this stage.

By means of an example, we have made reference to a simulation process regarding "accounts receivables T + 1". As for the first statement, "accounts receivable" values are defined through a relation linking the value to the "sales revenues" for the following statement and the "accounts receivable days outstanding". Both values are simulation variables (dark box) whose value is set by the decision-maker (Fig. 3).

Before the integration proposed, the decision-maker intervened only as for the estimated figure for the simulation variable. Such value resulted from a kind of logic and knowledge not included in the model.

Thanks to the integration, also the decision-maker will be part of the simulation variables and so will her/his relations with secondary and external agents.

After the integration, the simulation process regarding the single economical and financial values can be seen in three phases. In the first one, sharing/collection of all the information the decision-maker needs through interaction with secondary and external agents. This is a crucial moment as it is influenced by a number of subjective factors.

The kind of information the decision-maker collects will depend on the nature of her/his relationships, the relevance and influence s/he has gained within the company and in competitive contexts, etc. Then the information collected will be revised and synthesized into a figure.

In particular, the simulation value given to the single variable might be affected by the decision-maker's experience, appetite for risks, etc. Finally, the value given to the single simulation variables will modify the forecasted values set earlier.

The simulation output, here "accounts receivable T + 1" value, will then be set by using the relations among different variables which have not changed after the integration.

In this case, the integration suggested is meant for simulated input variables: the framework proposed transforms such input variables (dark box) into output (agent decision) variables (patterned box).

These variables then will be defined through a simulation of the agent's behaviour in relation to them. The variable value will result from the decision-maker's information, his background and his relationships with secondary and external agents. In this case, the simulation will be on how the decision-maker (the personnel leading agent) interprets and develops the conceptual model of the item to be simulated adding his/her own tacit knowledge.

From the mathematical viewpoint, the structure remains the same. What changes is how the variables to be calculated are determined.

5 Conclusions and Further Research

The framework proposed is aimed at investigating possible future developments of accounting-based business planning simulation models as knowledge generators rather than decision-maker supports.

We started our paper with the metaphor of the "coffer" to suggest the passage from prevision to simulation. In our case, such a passage is represented by the breakage of a first level black box when the decision-maker realises all the relations of a given system. The framework proposed might be a possible "key" to unlock a second level black box allowing to systemise the behaviour of the agents involved in simulations. Our attempt is meant to introduce such a component as a variable in the simulation model applied to business planning making use of a few elements of agent-based models.

Literature review has shown that the applications of models and tools in the category of accounting-based simulation models have certainly improved. From

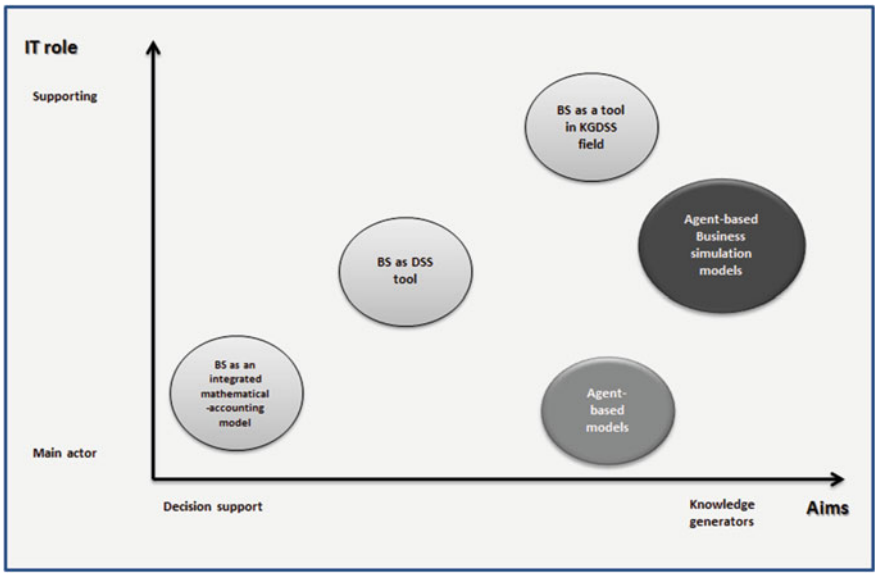

Fig. 5 The position of agent-based business simulation models

models exploited as decision-maker supports, there has been a step forward to the use of models for knowledge development.

Our conclusions start from the analysis of agent-based business simulation models from the perspective of their scope and IT-role (Fig. 5).

As for the aim, agent-based business simulation models are used as knowledge generators. Moreover, they may support the decision-maker's activity. Business simulation approaches belonging to the KGDSS application field, contribute only to the decision-maker's human knowledge development. Agent-based simulation models not only contribute to the decision-maker's knowledge development but also to the organization knowledge as a whole. The decision-maker contributes to the simulation process with his tacit knowledge. Tacit knowledge is now partly formalized because the decision-maker becomes an active part in the models. That allows not only to increase the leading agent's human capital but also the organization capital knowledge.

As for the IT role, a balance with the human factor should be found. In the evolution of accounting-based simulation models IT has now just a main role to having a supporting role. On the other hand, agent-based simulation models tend to give more importance to IT again. The agent-based business simulation models resulting from the integration of the above-mentioned models, should maintain the right balance between the human factor and IT in order to avoid the latter to overcome the former. To this purpose, the decision-maker should have the possibility to intervene on the conceptual model whenever necessary.

Therefore, this framework may offer a new perspective on the "accounting-based business planning simulation" that can be linked to the social context the

model originates and works into the aim of really increasing knowledge, fitting the definition "agent-based business simulation".

Our paper has taken advantage of the gap emerging from literature review—the lack of experimentation of SD/AB integrated models in the business planning area. We have started from the theoretical foundations on combining the mentioned simulation paradigms—experimented in other business fields—and then proceeded with reviewing two existing theoretical models. Our aim was thus of checking the feasibility of such an integration and seeing whether those models were suitable for the business planning area. The passage from conceptual to mathematical-computerized models will be further investigated.

This paper has then investigated on the matter and will be the starting point for our future research. That will focus mainly on two aspects.

The first one will define the knowledge net anatomy among the agents taking care of strategic planning through social network analysis. The second one will establish whether the use of advanced simulation techniques really contributes to knowledge acquisition for both decision-maker/s and the whole agent net by examining case studies.

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Professionalization and Dissemination Processes for Project Management Practices: A Situationist Perspective

Giuseppe Calabrese and Primiano Di Nauta

Abstract The aim of this paper is to propose an alternative interpretation for professionalization and dissemination processes for project management among those prevailing in literature. The considered perspective is that of the situationist, an epistemological option which moves from a critical conceptual framework to the hypothesis of strong rationality for individual and organizational choices. The perspective is enriched, on the one hand, thanks to the contributions of the neo-institutionalist strand and, on the other hand, by the theoretical tools developed in the rich array of cognitive study and phenomenological action and social life, as well as the analysis of the concept of power. The integration of these approaches allows the re-reading, the formation, the structuring, the change and the reconfiguration contexts of organized action (such as that of project management) as the product of two forces, complementary and mutually antagonistic action and institutionalization. Through the proposed lens, it is possible to frame the processes of professionalization and dissemination of project management practices focusing on the skein of both the material and symbolic constraints that the institutions have on human behavior [1]. The thesis is that, starting from the mid 1950s, originating from the Anglo-Saxon world, and due to the action of some institutional entrepreneurs, the construction of an organizational field, as the result of which the 'practice' project management began to be institutionalized, was undertaken. Subsequently, it has been spread triggering a process called 'contagion of legitimacy'. In other words, according to the approach in question, the dynamics

Even though the Authors share responsibility for the entire paper, output of a common research and development effort, note that paras 1 and 2 may be attributed to Giuseppe Calabrese, whereas paras 3 and 4 may be attributed to Primiano Di Nauta.

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of professionalization and dissemination of project management practices, rather than being understood through the analysis of elements of technical rationality, should be somehow relocated to intrinsic processes of social legitimation and institutional processes known as isomorphism. The processes of professionalization and dissemination of project management practices, therefore, appear not so much and not only as an implementation technique, but as a complex web of interaction ritual, held together and stabilized not by sharing cultural values to which individuals have joined, but by way of reducing the uncertainty arising from practical knowledge of behavior deemed appropriate, pro tempore, in a context of organized action.

Keywords Professionalization · Action · Institutionalization · Isomorphism · Power · Organizational field

1 Epistemological Framework

The work focuses on the professionalization and dissemination processes of project management practices. The chosen framework, here defined as 'situationist' perspective, is the main element of not only differentiation, but also originality, in respect to the logic with which a phenomenon is traditionally interpreted in the specialistic literature, which has also been responsible for the development and dissemination of methodologies, techniques and tools of project management [2–6].

Before illustrating the thoughts that flow in the perspective of this lens, two clarifications are needed.

The first concerns the different meanings here assigned to the term 'situationist' compared to the more prevalent in organizational studies. The expression 'situational approach', in fact, is commonly used to classify the *corpus* of research—also known as *Contingency Theory*—developed from the middle of the last century—especially within the *Tavistock Institute*—with the aim of deepening the 'influence of environmental contingencies on the structures and organizational processes [7–10].

In contrast, in this paper, using the phrase 'situationist orientation', we refer to the interpretation proposed by Sparti [11] according to which, for the understanding of social phenomena—such as managerial ones—it is essential to understand the concrete interactional, institutional and symbolic context, in which things happen, and that context is defined as 'situation'. Before we can understand a specific and concrete 'situation', it is also necessary to point out what Paul Valéry called the 'visible unseen', or all those interpretations of the 'world of everyday life' which institutionalize patterns and behaviors which, at a certain moment, 'disappear' and are 'taken for granted'.

The second clarification concerns the nature and main features of this different epistemological option that begins with a conceptual framework, critical to the

hypothesis of strong rationality of individual and organizational choices [12–15], and draws the fruitful theoretical considerations developed in the rich array of cognitive and phenomenological study of the action, individual and social life [16–20].

Thus, two theoretical-conceptual strands unfold, apparently divergent [21, 22], which allow to propose an alternative view of the phenomena of enterprise [23–25].

On the one hand, the political strand centered on the concept of power [26–33], according to which the focus is on the dynamics of negotiation and coalitions that lead to the temporary aggregation of individual interests into groups that formulate strategies for the pursuit of common goals. From such strategies, which include conflicts and collusions, a managerial process emerges, by which coalitions pro tempore dominant tend to build—though never entirely freely—a reality commensurate with expectations.

On the other hand, the lodging micro neo-institutionalist focuses on strategic action constraints posed by institutions, customs, norms, and social procedures [34–38]. On the entangling of these constraints, different isomorphic processes implant a base, which give rise to patterns, practices and procedures that, hand in hand, get standardized and consolidated through institutionalization. Individuals and organizations, in order to obtain legitimacy, tend to conform their conduct to the institutional framework pro tempore that obtained a stabilization not by taking actions, but by fitting into a sequence of parts of a script.

Ergo, the situationist option, thanks to the integration of these approaches, allows to re-read the formation, the structuring, the change and the reconfiguration contexts of organized action—such as that of project management—as the product of the two forces described above, which are complementary and mutually antagonistic: action and institutionalization.

2 The Dissemination of Project Management Practices as an Isomorphic Process

The idea that individuals and organizations are conditioned by external forces in respect to which they tend to react with trajectories of suitability/adaptation is certainly not new in management studies. All contributions pertaining to the theory of systems, by von Bertalanffy [39] onwards, through the *Contingency Theory*, the *Resource Dependance Theory* [40], the *Population Ecology* [41], and arriving at the *Stakeholder Theory* [42], highlight the search for systemic and structural coupling with the environment. Innovation proposals in this direction are the ones by Barile about viable systems management [43]. The same classical approach of institutional analysis in organizational studies [44, 45] focuses on the interpretation of 'institutional framework' functionally to understand decisions concerning the strategies and organizational structure.

With reference to the approach here presented, the differentiation element exists and persists, and concerns the nature of what is termed 'environment', and the role

of the actors in relation to it. In the settings inspired by the systemic functionalism, external influences appear as forces existing 'out there', able to bend the individual and organizational behavior, prompting the actor (individual or organization) to 'betrayal of purpose' in order to safeguard its survival. The situationist approach, conversely, is proposed just to understand the nature and the structuring of institutional constraints and, therefore, the processes of birth, conservation and change of institutions. In this way, the research aims to understand the concrete and operational deployment of granted rules and beliefs (rational myths), which take the practical form of an 'if [situation] then [conduct]', and that the recurrence itself contributes to institutionalize. The border, ontological and physical, between institutions and organizations, between pressing and pressed, between influential and influenced, vanishes. And with this, theoretical and comfortable simplification also vanishes and, in its place rises a very intricate and never a plot without reciprocal influences that comes to life and, at one time, gives life to the organizational field, in a sort of an apparent—and theoretically uncomfortable—loop logic (processes of institutional isomorphism).

The *focus* is the concept of 'institution', with reference to which we find countless definitions [46]. Among these, institutions were defined as "rules, norms and beliefs that describe reality for organizations, explaining what is and what is not, what can and what cannot be followed" [47]. With their 'root', and their subsequent diffusion, institutions tend to become *taken for granted*, influencing behavior—individual and organizational—suggesting the conduct better able to confer legitimacy to action. The neo-institutional literature has deepened, in more than three decades of debate, both the processes of creation of new institutions and those of their maintenance and their change. From these reflections emerge a number of *key concepts* (organizational field, isomorphism, rational myth) that allow to frame the processes of professionalization and dissemination of project management practices focusing on the skein of both the material and symbolic constraints that the institutions have on human behavior [1].

The concept of 'organizational field' is focal for the present work. "By organizational field, we mean those organizations that, in the aggregate, constituted a recognized area of institutional life" [36]. The organizational field, then, as a recognized "area of institutional life" [38], appears as a 'significant' group of organizations that, interacting, creates and gives meaning to the concept of intersubjective environment—'institutional framework'—the knowledge of which is preliminary to the understanding of organizational dynamics, both from a structural and strategic point of view.

In other words, according to the proposed approach, the dynamics of professionalization and dissemination of project management practices, rather than being understood through the analysis of the elements of intrinsic technical rationality, should be addressed in processes of social legitimacy and institutional processes known as isomorphism [36]. The isomorphism (mimetic, coercive, normative) refers to a process of organizational change under which the organizations that operate within the same field are brought to the "incorporation of institutional rules within their own structures" [48] in order to increase its legitimacy and its

ability to acquire valuable resources. In particular, we refer here to the processes of normative isomorphism through which professional and procedural standards are spread on organizational characteristics. The higher the degree of institutionalization of these standards, as well as the influence of the relevant professional groups, the more actors conform to these standards, adopting those practices legitimized by relevant professional groups. Other studies have addressed the spread of practices and professional standards through this lens, for example, in the management systems for quality and the environment, and the special rules for certification, or in the international accounting standards IFRS [49, 50].

The thesis here argued is that, starting from the mid 1950s, with origin from the Anglo-Saxon world, and due to the action of some *institutional entrepreneurs* [51, 52] an *institutional work* commenced [53], which has operated for the purpose of building an *organizational field* [36] as a result of which the project management 'practices' began to be institutionalized and, subsequently, to be spread, triggering a process that has been defined as 'contagion of legitimacy' [54], to the point of becoming powerful rational myths [34]. The spread for the incorporation of these myths is due, in some cases, to their beliefs about the rationality and effectiveness, in other cases, to their legal obligation (laws, regulations, titles, licenses, rights), and still in others, to their strong public opinion (customs, institutional facts). The processes of professionalization and dissemination of project management practices, therefore, appear not so much and not only as a technical implementation, but also as a complex plot of ritual interaction, held together and stabilized not only by the sharing of cultural values to which individuals have joined, but also by way of reducing the uncertainty arising from practical knowledge of behavior deemed appropriate, pro tempore, in a context of organized action [55–58]. Looking at the phenomenon from a different point of view, regardless of the profile of the merits of a given project, its greater or lesser distance from the 'encoding' institutional in terms of project management can generate an impact on its legitimacy and, therefore, the risk of its failure depending on the degree of institutionalization of project management practices in the context in which the project 'lives'.

3 The Structuring of the Organizational Field of Project Management: Work in Progress at the International Level and in Italy

In some contexts (such as the Anglo-Saxon), the process of institutional isomorphism is activated more effectively by allowing the project management practices to achieve a higher degree of institutionalization and, consequently, to compress more effectively the behavior of individuals and organizations. In other contexts—including the Italian—this motion has not yet been triggered. It is not a coincidence that nowadays the major players operating worldwide in this field, in addition to acting by bottom-up strategies (mainly spreading the certification of

knowledge and/or skills in project management), try to implement top-down strategies, generating a 'jump' in the degree of institutionalization of project management practices.

The modern project management can be traced back to the 1950s as aggregation and systematization of techniques and management tools (typically used for planning and control) of complex projects disseminated to professional associations (mostly engineering) for applications in various fields, from civil construction to military posts. Since 1956, professionals operating in project management were established in the American Association of Cost Engineers (now the Association for the Advancement of Cost Engineering). But, it is just in 1967 that there was a further significant 'jump' in the path of institutionalization of project management (and professionals who were using the techniques) through the establishment of the International Project Management Association (IMPA) in Europe, now spread worldwide. The process was consolidated at the international level with an a further 'jump' through the establishment of the Project Management Institute (PMI) in the USA in 1969, which has since started a research and global spread of the techniques and, above all, the system certification for the skills of professionals (at the moment about 700 thousand refer to PMI), operating according to the methods and techniques manned and proposals [59]. The pervasiveness of these processes of institutionalization can be detected by observing the data on the spread of the certifications issued by PMI and IPMA in the world (Fig. 1) and the CAPM/PMP, related to PMI, from the date of its establishment (Fig. 2).

A further 'jump' in the professionalization and dissemination process of project management practices took place in 2007, when the PMI obtained, as the first organization in the field of project management, ISO 17024 (established in 2002), obtained recognition in many countries as the standard for organizations that offer certifications to professionals worldwide.

A rooting then spread to the practices and professionalization in the field of project management, which 'crosses' and 'integrates' another path of institutionalization (that of the ISO), through paths of mutual legitimation.

The system of ISO—International Organization for Standardization has already been largely experienced in Italy, and before that in other parts of the world, for example in the management systems for quality and the environment, with certification of compliance to the norms recognized and shared globally, then declined in European and, in cascade, in countries open to such innovations [60–62]. In Italy bodies of reference are UNI (Italian Organization for Standardization) for implementation of the standards, and Accredia (Italian Accreditation Body) for the accreditation of certification bodies systems and personnel. Again, the professional world is structured through associations which offer, through the verification of specific requirements, certifications skills. In fact, once the 'ISO system' was consolidated in the public and private organizations, we have witnessed the transition from 'compliance audits' (typical of the quality system in accordance with ISO 9001:1994) to 'performance audit' (essential for effective verification of the quality management system conforming to ISO 9001:2000), sanctioning the central

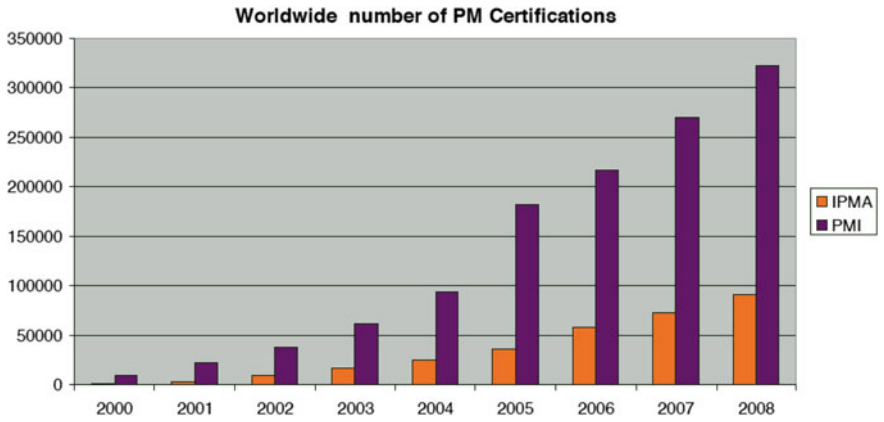

Fig. 1 Worldwide dissemination of PMI and IMPA certifications, 2000–2008 (*Source* Group Demos 2010)

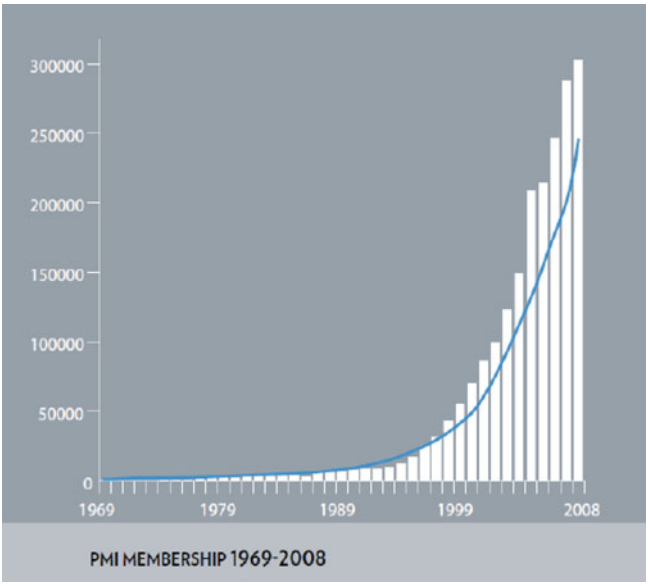

Fig. 2 Worldwide dissemination of CAMP and PMP certifications, 1967–2008 (*Source* Group Demos 2010)

role of professional auditors, and recalling the focus on the need to have the appropriate expertise to the increasingly challenging requirements and continuous improvement.

We are witnessing a similar path in Italy in the attempt to make the certification of project managers (or only some of them and not others) a requirement for the

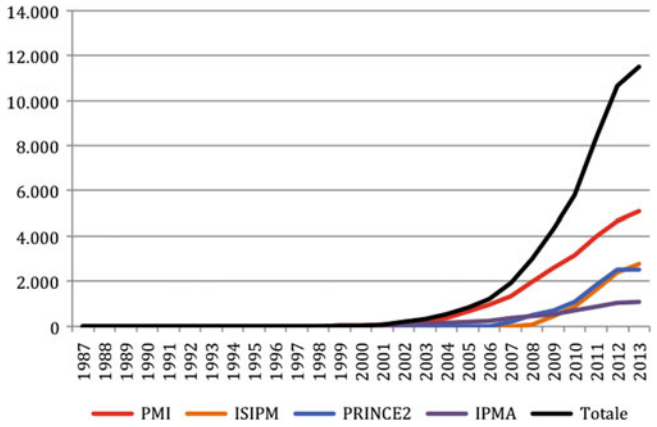

Fig. 3 The dissemination of project management certifications in Italy, 1987–June 2013 (*Source* Authors' elaboration)

participation in tenders and/or public procurement. The recent approval in Italy of the Act n.4 January 14, 2013 ("Disposizioni in materia di professioni non organizzate"), although not specifically dedicated to project management, can be validly placed in the bed of the progress of the degree of project management institutionalization, as evidenced by the immediate 'occupation' of the institutional spaces that the act created, by the most active organizations in this organizational field (PMI, ISIPM, CNIPA).

In essence, the act introduces the right for professional associations not yet recognized (example of recognized professional associations are those of engineers, architects, lawyers, doctors, veterinarians, and so on), including those of project managers, to organize and represent the 'new' (not always innovative) professions through the establishment of a list of 'professional' members, to be accredited, in compliance with specific requirements, among those associations recognized and managed by the Ministry of Economic Development (MISE). Then, this gives rise to a watershed in the professional world, while participating in associations, effectively recognizing those 'professional' and those 'less professional', with the risk to stimulate the run towards that professionalization, with the ambition to be able to access preferential acceleration lanes in the labor market.

We can consider as an example the forthcoming release of UNI on the role of the project manager, as a follow up of ISO 21500:2012—*Guidance on Project Management*, which will give further legitimacy to the 'certifications' issued by the new recognized association of project management professionals [63].

Even in this case, it is useful to observe the data shown in Fig. 3. By using as a proxy the number of project management certifications issued to individual professionals in Italy for the degree of institutionalization of the organizational field, we can highlight a significantly increasing trend, which has accelerated remarkably in effect from 2004 to 2005.

4 Concluding Remarks

Although the present work is part of a wider research whose final results will be available shortly, it is possible to propose some considerations in itinere relating to theoretical implications of such an epistemological option, as well as the opportunity to observe from a different point of view the dissemination of professional practices of project management.

Regarding the first aspect, the situationist option leads to the vision of a decision-maker not yet moved towards a goal orientation approach, but set on the rules of appropriateness. This setting, result of the contributions of the Carnegie Cognitive School since the 1940s, represented decision-making processes less courtly than those described in the flow of rational choice theory and of strategic preferences arising from game theory. In organizations actions are often the ones that allow us to discover the motivation, and solutions are those that go looking for problems, and not vice versa [64], in 'political' decision-making processes that involve many actors in a context of substantial ambiguity about preferences and beliefs [12–14, 65, 66]. A corollary of this approach followed by the criteria of rationality in the organizational action, do not appear more 'pure' just because they are exclusively produced by a 'strong' thought internal to the organization (we would like to mention a thought of scientific evaluation of decisions), but rather 'spurious', more or less hybridized with the 'weak' thought (rational myths) pro tempore Institutionalized within a given organizational field. This creates the problem of the relationship, in terms of coexistence, overlapping, valence, conflict, between efficiency and legitimacy [34], including technical and institutional rationality.

From the practical point of view, to understand the implications of such a thesis, both for the researcher and for the manager, it is self-evident. How many cases in which the evaluation on the adoption of a project management standard are not derived from a kind of 'scientific' cost-benefit comparison, as the reasonable expectation that such a 'packaging' of the project will increase the chances of a positive evaluation? Or don't cases of *decoupling* exist in the reality of organizations [34]? Or, indeed, do situations in which organizations decouple their act setting up, on the one hand, a kind of 'showcase' for the purpose of apparently satisfying the formalities required by the standard, and increasing the external perception of legitimacy and, on the other hand, continuing to manage their projects as always? A similar action leads to the adjustment to a formal institutional pressure retaining structures and pipelines that, in practice, do not conform to it [14]. The signal of compliance with the standard often enables the organization to obtain essential resources for its survival and growth.

The adjustment to the standard, re-interpreted as such, originates from a decision-making process according to which it 'has to be done' because 'it has to be done', because others do it, because others do it to legitimize themselves to others that do it doing it, in turn, expecting that others will do it and so on. On the other hand, it is not possible to characterize those activities as wrong, if it is true

that these very activities allow the organization to intercept a certain flow of funding, or to sit at a table from which arise other opportunities, or to improve and strengthen the image of the brand, and so one. It could be argued that also this type of conduct is, in fact, the effect of a managerial 'calculation'. Nevertheless, it cannot be not shared. If it is just a calculation, it is a calculation of a very different nature than that which tends to make business decisions deriving from sole logics of technical efficiency, opening the field to other forms of rationality, typically of institutional and political matrix.

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