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Profiting from the Accumulation and the Assimilation of IT-based resources and capabilities

An Empirical Study in Small and Medium Enterprises

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"The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill".

Albert Einstein, *The Evolution of Physics*

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Almost three years have passed since I started my studies as a doctoral student. During such period, I attended the Scuola Interpolitecnica di Dottorato, a joint PhD program of high qualification of the three Italian Technical Universities, the Polytechnic of Torino, the Polytechnic of Bari and the Polytechnic of Milan. Looking back, I realize that this work would not have been possible without the support and guidance of many people.

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ABSTRACT

The capability of using Information Technologies (IT) based resources for improving business processes and enhancing the firm economic performance has long been investigated in large firms. Nevertheless, with the decreasing costs of IT solutions, also Small and Medium Enterprises (SMEs) may be able to accumulate and assimilate IT-based resources in order to increase their economic performance. This study applies two conceptual approaches (resource-based view and contingency-based view) to assess the strategic value of IT-based resources in SMEs. Fourteen hypotheses related to these approaches are developed and tested based on survey data collection from the CIOs of 373 SMEs to understand more clearly the entire process from the adoption of IT-based resources to the achievement of higher economic performance, through the development of IT-based capabilities. The influence of internal and environmental factors, and the features of the business environment where SMEs operate are investigated. Results indicate that the resource-based view and the contingency-based approaches provide complementary understanding of the strategic value of IT in SMEs, making five main contributions. First, SMEs that operate under particular environmental (low turbulence and high complexity) and internal conditions (where the IT managerial capabilities are developed) are more likely to adopt earlier IT solutions. Second, SMEs are more likely to develop IT-based capabilities that are internally oriented, rather than the externally oriented. Third, internally oriented IT-based capabilities are developed independently by the environmental conditions where the SME operates, while the externally oriented are developed not uniformly among industry types. Fourth, the features of the business environment in which SMEs operate influence the IT-based resources adopted and the IT-based capabilities developed. Finally, given industry-level differences in competitive environments, the value appropriation of capabilities

that firms developed using IT depends on industry type, with SMEs operate in turbulent environments exhibiting lower profit returns, while in munificent environments exhibiting lower or higher profit returns according to the IT-based capability considered.

Keywords: Small and Medium Enterprises; IT-based resources; IT-based capabilities; firm economic performance; internal conditions; environmental conditions; business environment.

TABLE OF CONTENTS

LIST OF MY PUBLICATIONS

During my PhD studies, I have discussed the results contained in this research thesis in national and international conferences, and I have also published several articles on International Journals and book chapters that are following listed. Overall, I published 6 papers on International Journals, 4 papers in book chapters and 10 papers in National and International Conferences where I received two best paper awards. The data contained in these publications come from all the research activities I conducted during my PhD studies. Specifically, I was not only involved on the research activities of the Politecnico di Torino, but I also collaborated with the research centres Istituto Superiore Mario Boella (ISMB) and CSP - Innovazione nelle ICT, and with the research group on Information Systems of the University "Grenoble Ecole de Management" of the Management of Technology and Strategy department. Furthermore, I was involved in the research activities of the ICT Observatory of the Piedmont region[1] whose aim is to investigate the adoption and diffusion of Information Systems among the society (citizens, firms, public administrations and schools). My publications are following listed.

International Journals

1. Arianna Alfieri, Marco Cantamessa, Francesca Montagna, Elisabetta Raguseo (2013). Usage of SoS methodologies in production system design. *Computers and Industrial Engineering*, 64(2), pp. 562-572, ISSN 0360-8352.
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Book Chapters

1. Neirotti, P. and Raguseo, E. (2012). Profiting from IT investments in Small and Medium Enterprises: How does the Industry Environment Influence the Returns of IT-based Capabilities? Information Systems, Technology and Management, Communications in Computer and Information Science. 285(1), pp. 89-100, ISBN: 9783642291654, ISSN: 18650929, Springer, DOI: 10.1007/978-3-642-29166-1-8.
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4. Neirotti P., Paolucci E. and Raguseo E. (2011). The future of work: trends of telework in Italian SMEs between 2005 and 2009, Information Systems:

Crossroads for Organization, Management, Accounting and Engineering, De Marco M., Te'eni D., Albano V., Za S., Springer, pp. 16-24, ISBN: 97837908278802011.

National and International Conferences

1. Neirotti, P. and Raguseo, E. (2012). Mapping the Accumulation Dynamics of IT Resources and Capabilities in SMEs: the Role of Organizational configurations and Environmental Factors. 13th International CINet Conference, Continuous Innovation Across Boundaries, 16-18 September 2012 - Rome, Italy, ISBN 978-90-77360-15-6.
2. Raguseo, E., Vitari, C. and Piccoli, G. (2012). Gaining Competitive Advantage from Digital Data Genesis Dynamic Capability: the Moderating Role of Environmental Turbulence. IX Conference of the Italian Chapter of AIS Organization change and Information Systems: Working and living together in new ways, 28th and 29th of September 2012, Rome, Italy, ISBN 978-88-6685-085-4. (***Best Paper Award of the Track "Business value of IT"***).
3. Neirotti, P. and Raguseo, E. (2012). Profiting from IT-Based Capabilities in SMEs: The Moderating Effect of the Competitive Environment. Conference EPI 2012, Parma (Italy), 18-19 June 2012.
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Other publications

1. Pigni, F. And Raguseo, E. (2012). Profiting from Data Harvesting and Data Streams. 12(3), Cutter Benchmark Review.

LIST OF FIGURES

LIST OF TABLES

Chapter 1

1. INTRODUCTION

This chapter provides an explanation of the rationale on which this research study is conducted. Specifically, the first paragraph clarifies the unit of analysis and the problem investigated, and shows the primary theoretical considerations, providing the basis for the purpose of this study. Then, the main goals of this work are listed and discussed. After that, the research framework is shown and the research questions are listed. Finally, the chapter concludes with an overview of the thesis' structure.

1.1 Setting the problem

Over the years a lot of interest has been given to understand the relationship between the adoption of Information Technologies (IT) and firm performance (e.g. Revichandran and Lertwongsatien, 2005). IT can lower production costs, can increase company's competitive advantage and can add value to products and service (e.g. Levy et al., 2001). As suggested by Ballantine and Stray (1998), IT and Information Systems (IS) are not simply tools that have only be adopted by firms, but they need to be understood before making any capital investment.

Even though IT has the potentiality of significantly contributing to business performance and despite nowadays IT solutions are subject to an eventual commoditization, there are several studies that show how its implementation fails especially in Small and Medium Enterprises (SMEs) (e.g. Shin, 2006). This may happen for two main reasons. First, management of SMEs does not clearly know the reason why the company has to adopt IT (Levy et al., 2001; Southern and Tilley, 2000). Second, SMEs usually do not have the capabilities to assimilate their IT resources because they lack of IT strategy, have limited IT skills and are financial constraints (e.g. Ballantine et al., 1998). As pointed out by Levy et al. (2001), SMEs

usually adopt IT solutions without any planning and as a result, there is a low percentage of successful implementations. Furthermore, it is unclear whether SMEs see IT as an opportunity or a threat. In addition, specificities of internal and external factors have to be considered when IT is adopted. Related to this, SMEs usually tend to ignore the importance of many factors that directly or indirectly can influence the adoption and assimilation process of IT, and consequently they are not able to understand whether there are the conditions to adopt IT solutions.

In order to successfully assimilate the IT resources adopted and achieve growth and profitability gains through continuous investments in IT, IT has to be used in concert with other resources. Therefore, the value of IT and IS consists in its "capability" to be used. For example, think about two firms that adopt a Customer Relationship Management (CRM) tool. One firm is able to collect accurately data from customers, and analyze them effectively, while the second is unable to extract meaningful insights from data gathered. Consequently, the first firm will be able to outperform the second firm. This example, even though is highly simplified, demonstrates how the relationship between IT adoption and firm performance is not simple and direct. This happens for two main reasons: i) because multi-dimensional aspects have to be taken into account at the same time: the technological issues, the organizational issues, the strategic versus tactile issues, short-term versus long-term issues, and the environmental features where companies act; and because ii) the endowment of critical IT-based resources cannot be directly related to a company's economic performance, since the ability of firms to transform the inputs (IT-based resources) into outputs (Firm performance) depends also on the ability of a company to assimilate the resources adopted (competences and capabilities development) (Figure 1).

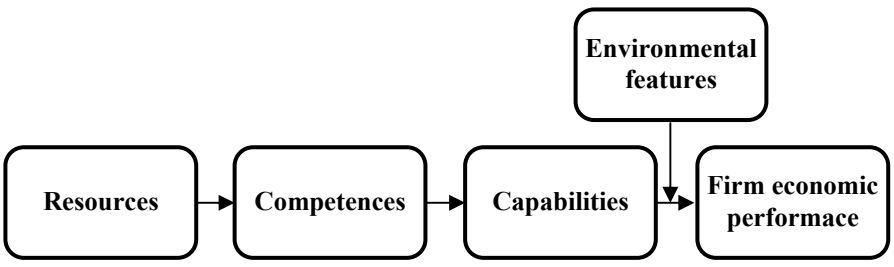


Figure 1 From the adoption of resources to the achievement of firm performance

Although managerial and strategic literature has widely analyzed the relationships between concepts shown in Figure 1 in the large firm context (e.g. Drnevich and Kriauciunas, 2011), few studies have investigated factors that impact the accumulation dynamics of IT resource, and the development of IT-based capabilities at a low level of analysis in SMEs. Previous studies have also mainly focused on providing a static picture of the adoption of IT resources in SMEs (e.g. Fink, 1998; Caldeira, 2002) without looking at which factors may determine their earlier adoption, and have lacked in providing an integrated model for explaining all the process that goes from the adoption of IT solutions to the achievement of SMEs' economic performance.

The reason why this PhD thesis focuses on the process from the adoption of IT resources to growth and profitability in SMEs, as field of analysis, can be summarized in four points:

- First, SMEs are the engine on which our economy is based, therefore a deeper understanding of how their adoption and assimilation dynamics impact on their economic performance is important. The OECD stated that *"These firms (SMEs) typically account for more than 90 per cent of all firms outside the agriculture sector, constitute a major source of employment and generate significant domestic and export earnings"* (2004, p. 32). Indeed, considering SMEs and large enterprises, the former represents the 95% of the overall companies in Italy[2], one of the countries with the higher rate of SMEs, and also generate a substantial share of GDP and are a key source of employment.
- Second, if companies, especially SMEs that represent a high percentage of all the Italian companies, would hopefully be able to invest to a greater extent in IT, there could be substantial productivity improvements in Italy, as happened in the USA economy. Indeed, looking at the worldwide trends, as estimated by the Trade Department of the USA, between the 2004 and 2007, the USA economy was able to grow thanks to IT investments made (demonstrating how the IT investments can lead to productivity improvements). However, this does not happen nowadays in Italy especially because the implementation of IT

[2] This data was computed by downloading the number of SMEs and large enterprises by the he Bureau Van Dijk's AIDA database.

solutions may be long and expensive in SMEs. Furthermore, in such companies business processes are usually more idiosyncratic than they are in large enterprises, and therefore business process idiosyncrasies often lead SMEs to delay the adoption of IT solutions. This may happen because these firms believe that changing their business processes to fit new IT solutions may undermine their long-established routines and lead to lose advantages of their flexible structures.

- Third, the economy globalization is pushing many SMEs to change in order to survive. In such a context, in order to compete in global markets, many SMEs have the necessity to develop new business strategies and to employ new technologies, for being successful.
- Fourth, given that in the second half of the last decade the rise of a new technological paradigm for IT has sparked interest in its diffusion and economic impact, there is a broad consensus that since IT exhibits the attributes of a general purpose technology (GPT) - an innovation that has a pervasive diffusion in a wide range of industries and that enables breakthroughs in operations and organisational models (Bresnahan and Trajtenberg, 1995) - IT could be more pervasive in all companies' processes, especially in SMEs where the adoption rates are lower than that of larger companies. Indeed, based on the decreasing market prices of many IT technologies (Carr, 2003), and on the "as a service" delivery modality (IS are standardized and introduce standardization also in the processes), there could be an acceleration in the diffusion of IT especially in SMEs, which in the past were less likely to adopt IT solutions given their features, their financial constraints and the features of the IT solutions offered by the vendors.

In such a scenario, it is important to understand whether SMEs will continue to under exploit the potential value of IT assets, as they have been doing so far (e.g. Fabiani et al., 2005), or whether they will be able to exploit the advantages of IT adoption.

Looking at the literature studies already conducted, an integrative model, that investigates the influence of environmental, internal, and business environment factors on the process that goes from the adoption of IT solutions to the achievement

of higher economic performance, is still lacking in SMEs and therefore a deeper analysis is necessary. Furthermore, as pointed out by Caldeira (2003), a better understanding of the adoption processes and assimilation of IT in SMEs is necessary, because previous research was limited on such topic and a significant percentage of studies are out of date due to the rapidly changing economics of using IT, which could increase the adoption rates in SMEs. Furthermore, Wade and Hulland (2004) asserted that the RBV has been applied to few IS studies, and therefore further empirical analysis are necessary on this topic.

Drawing on such motivations, the specific theoretical goals of this research thesis are shown in the next paragraph.

1.2 Purpose of the study

The emphasis of theoretical and empirical studies has been traditionally focused on companies of large size rather than on SMEs. Only at the beginning of the ’90, researchers started to study the adoption of IS in SMEs, however considering only in part the specificities of SMEs. Only with the study conducted by Cragg and Zinatelli (1995) and of Iacovou et al. (1995), researchers started to realize that it was necessary to study differently SMEs regard large companies. Therefore, since SMEs need to be studied separately by large companies, this study aims at achieving a better understanding of patterns and factors that bring SMEs to exploit the potential of IT.

Based on the considerations made above, in order to contribute to theoretical and empirical issues that are narrowly theorized by the literature that studies the impacts of IT investments in SMEs, this research study attempts to provide two main empirical contributions that are following explained.

1.2.1 Antecedents of IT accumulation and assimilation in SMEs

The first aim of this PhD thesis is investigating antecedents of the accumulation and assimilation of IT-based resources and capabilities in SMEs. Indeed, even though the extant literature has provided significant contributes on figuring out antecedents of the IT adoption (e.g. Raymond and Pierre, 2005), a deeper understanding can be achieved by investigating factors that influence the accumulation dynamics of IT investments and by linking IT’ s business value to

contextual aspects that are critical to strategic management: the environmental and internal factors, and the features of the business environment in which SMEs operate.

Past research has under-examined why and how some opportunities for innovations provided by IT in SMEs can be distributed unevenly across sectors, each characterized by different environmental conditions. Although multiple arguments support the existence of inter-sectoral differences in the patterns of IT use, diversity in IT use across industries has not yet been fully explored (Chiasson and Davidson, 2000). Differences between sectors have mainly been investigated by considering only IT expenditures and the diffusion of some key technologies, such as Enterprise Resource Planning (ERP) systems or generic infrastructural resources as personal computers and Internet broadband networks. Industry-level data also indicate that IT capital affects productivity and output growth differently depending on the country and industry type (O'Mahony and Timmer, 2009); however, there is still a limited amount of empirical firm-level evidence on the diversity of IT use across sectors that explains these performance differentials (Bartelsman, 2010), especially in the SMEs context.

Accordingly, even though the cost of IT has been decreasing constantly, some sectors may still lag behind others in the rates of adoption of IT among firms due to environmental conditions that make the advantages of adopting IS less evident, and due to the path dependences between the adoption and assimilation of IS. Specifically, SME's need to invest in IT may vary depending on the opportunities for revenue growth available in the market, the degree of competitive intensity, and the complexity of products and supply chain relationships. For instance, rapidly growing markets may require SMEs to adopt IS that support business processes standardisation in place of mutual adjustment and informal coordination channels. Furthermore, as in complex environments firms deal with a large number of factors influencing functional strategies and operations, the implementation of a new IS may entail greater causal ambiguity and higher knowledge barriers (Fichman and Kemerer, 1999). Similarly, turbulence may retard the routinization of existing technologies as competitive pressures may lead firms to leap rapidly from one technology to the next (Abrahamson, 1991).

Past studies have mainly regarding IT in aggregate without considering that firms in the same industry may accumulate and use IT resources in specific ways depending on their heterogeneity in resources, routines, values and managerial attitudes. This aggregate view on IT investments has hindered past studies in assessing whether some IT resources (and their associated impacts on firm capabilities) eventually propagate homogeneously across firms, industries and under particular environmental conditions, whereas other technologies diffuse only in firms and industries that have embraced the new technological paradigm of IT earlier than others. In other words, it is expected that IT may have a dual nature, including two types of technology resources. Some IT resources may require limited implementation costs, and their diffusion may involve a large number of firms, as vendors have eventually transformed these technologies into "standardized packages" that adopters can use as "black-boxes" (Tornatzky and Fleischer, 1990, pp. 127). However, other IT resources can represent "complex organizational technologies" (Attewell, 1992) since - to be effectively used - they require extensive learning, the precursory adoption of interrelated technologies, and investments in human and organisational capital (Attewell, 1992). Whereas the adoption of "standardized packages" may positively affect firms' productivity without requiring late adopters to make considerable investments in organisational and human capital, the diffusion of "complex organizational technologies" may be slow and limited (Fichman and Kemerer, 1999) and may require high investments in organizational capital. This is even truer in case of SMEs for two reasons. First, SMEs' business processes are usually more idiosyncratic than those of large enterprises and cannot be easily supported by standardised applications (Raymond and Uwizeyemungu, 2007). As a result, SMEs often delay IS adoption because changing their business processes to fit new IS may undermine long-established routines. Second, SMEs' managers and external consultants usually lack appropriate expertise and absorptive capacities on applying IT effectively to innovate internal routines and business processes (Thong et al., 1996).

Even though SMEs cannot control the external forces where they act, they can make complementary investments in organisational capital or particular preconditions in order to be successful in the IT adoption routinization. Indeed, some firms are able to adopt and accumulate IT resources more quickly than others based

on their more appropriate internal context and business environment features. This particular ability leads to heterogeneity across firms in terms of the stock of IT resources accumulated which can be constrained by path dependences (Dieriekx and Cool, 1989) and by organizational investments conducted over time.

1.2.2 The moderating role of the environmental features on firm performance

The second aim of this PhD thesis is investigating the moderating effect of environmental conditions on the relationship between the IT-based capabilities development and the achievement of high economic performance, since researchers usually limit to study the direct relationship between IT investments and firm performance in SMEs (e.g. Quian and Li, 2003). Indeed, the external environment can present differing challenges to firms and can determine higher or lower firm performance returns (Li and Ye, 1999). Specifically, the environment can be described along a variety of critical characteristics which may influence a firm's capacity to appropriate the value of IT investments, as under particular environmental conditions, competitors are generally quicker to respond to a firm's initiative to adopt a new technology. In this regard, in hypercompetitive sectors, the extra profit achieved by a firm due to IT cannot be sustained in the long run because discontinuities arising from new ways of using IT that are introduced by some rivals can change the competitive equilibrium (Brynjolfsson et al., 2008).

1.3 Research framework

In studying the relationship between the adoption of IT-based resources and the achievement of higher economic performance through continuous investments in IT solutions, it is important to highlight that the endowment of critical IT-based resources cannot be directly related to a company's economic performance. Indeed, as explained above, the ability of firms to transform the inputs (IT-based resources - the adoption of IS) into outputs (Firm economic performance - ROA and revenue growth) depends also on the internal characteristics of a company ("Internal context" that is represented by the IT management capabilities), on the business structure ("Business environment" that is represented by the business environment complexity – the geographical scope, the foreign sales made and the level of vertical integration –, the customer dependence and the IS vendors support), and the attractiveness of the

industry where the company acts (what I call "Environmental context" that is represented by the munificence, dynamism and complexity variables). Therefore, how SMEs transform the input into output, through the development of IT-based capabilities, by looking at factors that influence such input-output relationship, is the main topic on which this research thesis has been constructed. Such input-ouput relationship refers to different streams of literature and theories: i) to the innovation studies, which describe the process of diffusion and assimilation of innovations in firms (e.g. Fichman and Kemerer, 1999); ii) to the strategic and managerial studies that investigate the strategic impact of resources own by a company on their economic performance; iii) to the resource based view (RBV); and iv) to the contingency perspective whose aim is investigating the contingency factors that may influence the business value of SMEs.

This relationship, that represents the conceptual framework to which I will refer to among the entire thesis and which will be discussed deeply in the following chapters, can be synthesized into three main stages (

Figure 2): 1) IT accumulation; 2) IT assimilation; 3) Profiting from IT.

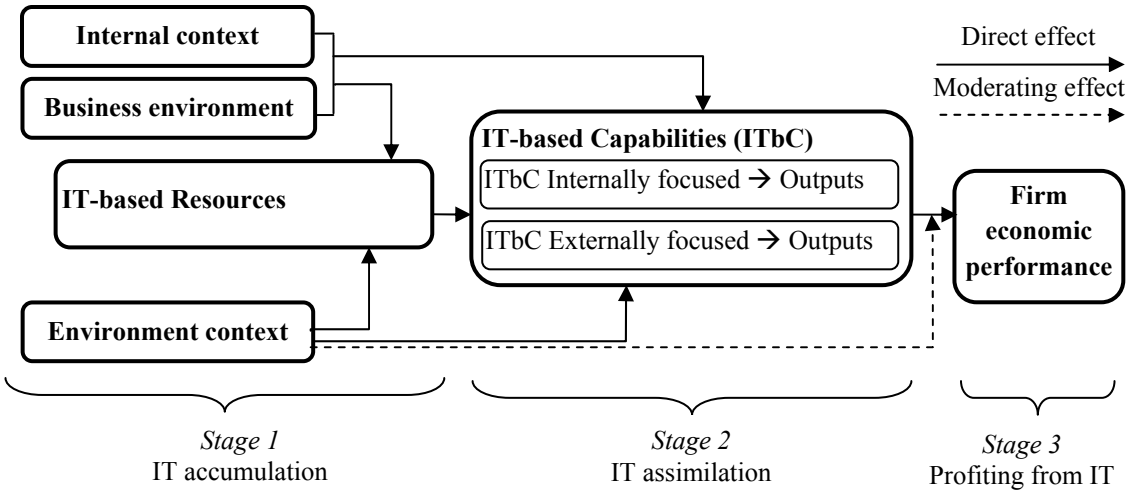


Figure 2 Conceptual framework

1.4 Research question

Based on considerations made above, and framing on the resource-based view and contingency perspectives, this study investigated two research questions:

1. *What conditions (in terms of environmental, internal and business environment contexts) influence IT accumulation and IT-based capabilities development?*
2. *Under what environmental conditions are IT-based capabilities more or less likely to contribute to firm economic performance?*

I theorize and examine these research questions through 14 hypotheses. First, I examine the factors under which companies are more likely to adopt and accumulate IT. Second, I examine the conditions under which SMEs are more likely to develop IT-based capabilities. Third, I find out how environmental conditions constrain or enhance the performance contribution of IT-based capabilities on firm economic performance. Together these three parts help to understand the adoption, accumulation and assimilation IT dynamics in SMEs, as well as understand the conditions that may enhance or limit these contributions in order to achieve higher economic performance.

1.4 Thesis structure

This thesis is organized in seven chapters, whose content is shown in Table 1.

Chapter	Chapter goal
1. Introduction	Motivates the field of study and gives a brief introduction to the field. Formulates the research questions.
2. Research positioning and level of analysis: IS and SMEs	Provides the definitions of three of the main terms used in this thesis: SMEs, IS and IT-based capabilities. Describes the features of SMEs regards the bigger companies (they are useful in order to understand their different adoption behaviours towards IS).
3. Theoretical background	Describes the current state of research in the field. Positions my research with respect to previous research.
4. Hypotheses formulation	Discusses the fourteen hypotheses that will be tested in this PhD thesis.
5. Research methodology	Describes the methodology followed.
6. Results and discussion	Highlights the findings of papers published and hypotheses tested during my PhD studies.
7. Conclusion and Implications	Provides the conclusion underling the theoretical and the practical implications of the study conducted. Lists possible ways for conducting further work in future studies. Presents a number of managerial and policy implications.

Table 1 Structure of the thesis

Chapter 2

2. RESEARCH POSITIONING AND LEVEL OF ANALYSIS: IS AND SMEs

This chapter starts with a clarification of the literature positioning of this research study. Then, the definitions of the key concepts analyzed in this research thesis - SMEs, IS and IT-based capabilities - are provided. Finally, the main differences between SMEs and the larger counterpart, which can impact on the different adoption and assimilation patterns, and on the profiting levels from IT investments, are shown.

2.1 Positioning of the study

This thesis positions itself in the intersection of three research areas: the innovation diffusion theory, the strategic management literature and the information systems literature. It is in those intersections that this thesis seeks to contribute, looking at a particular type of company - the SMEs - and applying the RBV and the contingency perspective.

It has been chosen the innovation diffusion theory, because it helps in explaining the diffusion patterns of an innovation in firms (in this thesis the diffusion of IT innovations), and the strategic management theory because it allows to explain the patterns through which firms can achieve better economic performance. The third research area is the connecting point with these two research areas, since the aim of this thesis is investigating how IS are accumulated, diffused and assimilated in companies (link to the innovation diffusion theory) and how IS can provide strategic value to companies (link to the strategic management research area) (Figure 3).

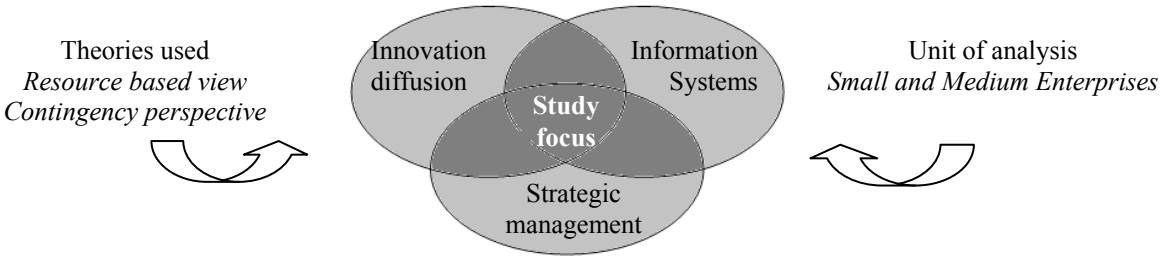


Figure 3 Research areas, theories and unit of analysis most relevant in this thesis

2.1.1 Innovation diffusion theory

The innovation diffusion literature covers a multitude of topics in scientific and management literature. The reason for this interest consists in the fact that innovation is of key importance for survival of an organization. It concerns firms that have the need of competing for market share or profit (Cooper, 2005; Hamel and Prahalad, 1996; Kaplan and Norton, 1992), and also public organizations that need to improve their services (e.g. Mulgan and Albury, 2003). However, at the same time, innovation is not easy since innovation projects need high investments and have usually high failed rates.

McGrath et al. in 1996 posited a question about innovation behaviours of firms "When does a firm benefit from undertaking innovation, as opposed to simply re-inventing in existing products, markets and technologies?" The theory suggests two main answers. A research stream that follows the work conducted by Schumpeter (1950) suggests that only through innovation a firm can renew the value of its assets and can survive. In case the innovation is not chosen, economic forces can lead toward perfect competition, where there are no rents. The second stream is related to the resource-based view of strategy. In this view, competitive effectiveness is a function of firms' ability to create idiosyncratic and relatively inimitable resources though innovation choices, which tend to become "strategic assets" (Amit and Schoemaker, 1993). Consequently, it is impossible for firms to develop identical resources, because they can be combined in routinized, but relatively idiosyncratic ways, implying that firms will develop enduring differences in strategic potentialities over time.

According to the time when a company introduces an innovation, firms can be labelled as "innovators", "early adopters", "early or late majority" or "laggards"

(Rogers, 1995). Specifically, early adopters start using the technology without being able to access to the experience of previous users. Hence, early-adopter companies are usually companies with higher technical, organizational and IT management capabilities.

Additionally, firms may not take their decision of adopting an innovation solely basing their choice on the individual benefit and cost of adoption. Also network, social and emotive benefits can influence positively the adoption of an innovation (e.g. Abrahamson, 1991; Nelson et al., 2004). Within this perspective, an innovation can be adopted or rejected also for the network-effects, coercitive forces and fashions. Moreover, the role of reference groups and channels of communication of the innovation (i.e. professional and technical agents, consultants, opinion leaders or early-adopters) can be also factors affecting the adoption time of an innovation by firms (e.g. Massini et al., 2005). Therefore, the innovation choices of a company can derive from internal requests but can be pushed also by external forces.

For example, consider a CIO that has joined a firm that lags in the adoption of emerging information technologies. He could wonders: Just how innovative should this firm be going forward, and what can be done to place it to be more willing and able to assume the challenge of early adoption? The CIO could decide to adopt new information technologies since it has to be considered that organizations that persistently ignore new technologies risk slide into uncompetitiveness. However, the CIO has to take into account that processes of diffusion and assimilation rarely unfold in a smooth and predictable fashion (Attewell, 1992; Fichman and Kemerer, 1999; Moore, 1991). For example, Chew et al. (1991) report that from 50-75% of advanced manufacturing implementations experience some kind of a failure.

Given the importance of IT as a distinctive resource owned by companies, the innovation theory represents a key area of investigation in the IT field.

2.1.2 The strategic management literature

The fundamental question in the field of strategic management is how firms achieve and sustain competitive advantage. Firms need to possess the ability to earn higher profits which requires not only to create value, but also to capture the value it

creates (Cool and Schendel, 1988). This ability is established by the firms' capabilities to develop and sustain competitive advantage (Grant, 1991).

In literature, there are three main streams of thoughts that are relevant in explaining such ability that has to be owned by firms (Quian and Li, 2003). The first stream is the Porter's strategies, i.e. cost leadership, differentiation and focus (Porter, 1985). The cost leadership and the differentiation support the fact that a firm need to differentiate from the competitors in terms not only of costs, but also of quality. Differentiation strategy requires that a firm innovate earlier regard its competitors in order to establish a first-mover advantage. Focus indicated that a firm could differentiate itself by the other companies in a particular market niche or segment.

The second field highlights the importance of economies of scale and their functions in reducing costs (Hamel and Prahalad, 1996). It asserts that in case a firm is not able to increase, or at least maintain, reasonable sales volumes, it can fall into a strategically disadvantageous position. As example, the internationalization can be a mean to achieve economies of scales.

The third stream stresses the importance of the positional advantages and innovation capabilities (e.g. Grant, 1991). On the one hand, positional advantages can be given by the brand names or status (Saloner, Shepard and Podolny, 2001), are based on market awareness especially in case the life cycle is short (Lambkin and Day, 1989). On the other hand, capabilities are related to a firm's ability to innovate continuously ahead of its competitors (D'Aventi, 1994). Capabilities should be able to provide to the firm the achievement of two main tasks. First, the firm is able to enter into a new market earlier than its competitors (Ghemawat, 1986). Second, the firm can make the competitors' imitation meaningless as it improves quality faster than its competitors (Saloner at al., 2001). Therefore, how the IT-based resources can provided business value to SMEs has to be investigated through a strategic lens.

2.1.3 The Information Systems literature

The Information Systems literature try to answer to two main burning questions: 1) If and how IT can build a competitive advantage? (e.g., Wade and Hulland 2004; Ravichandran and Lertwongsatien, 2005). 2) Which is the influence of the environmental conditions on this pattern (especially under high levels of

turbulence)? (Sambamurthy et al., 2003). Therefore, it is important to provide some answers to these questions. This is the reason why the focus of this thesis is to understand the strategic value of IT in SMEs and how environmental conditions influence this patter. However, given that Chapter 3 extensively mentions and analyzes the IS literature, no further details are included in this paragraph.

Before going on, the definition of the three key terms used in this thesis are shown: SMEs, IS and of IT-based capabilities.

2.2 Definitions of key terms

2.2.1 SMEs definition used

The definition of SMEs changes from region to region[3]. The main criterions that prevail to classify SMEs are the number of employees, turnover and the balance total (Burns, 2001). For instance, the European Union (EU) defines SMEs as enterprises that employ no more than 250 employees, a maximum annual turnover of 40 million euros and a maximum annual balance sheet total of 27 million euros. Instead, according to the Australian Bureau of Statistics (ABS 2001) a SME is defined as business employing less than 200 people. In this thesis companies with less than 250 employees are included in SMEs concept, consistent with the definition adopted by the European Union.

2.2.2 Information Systems Defined

In order to understand what is an IS, a simple example is provided (Piccoli, 2012). Think about the famous Ricasoli winery, the oldest family-owned winery in Italy, which produces in the Chianti region. One of the members of the Ricasoli family, Baron Bettino, that in 1872 made studies and experiments, and finally he started to export wine all over Italy and beyond. At this point a question arises: Did the Ricasoli estate have an IS when the Baron perfected the Chianti recipe? The answer is yes, since its IS allowed the firm to take orders, track payments, organize all activities around the farm, manage its inventory of aging wines, and help the Baron to collect all information about the treatments to apply to the wine. In such a

[3] Besides the EU definition, other definitions include the OECD which considers SMEs to have no more than 299 employees. The US definition considers all firms employing fewer than 500 employees as SMEs (Levy and Powell 2005, p.20).

way, the technology of that time allowed to manage all data and information. From this example, the difference between IT and IS can be understood, since the IT is only a component of an IS, given that the last concept includes not only the technological component, but also the social component. However, in this thesis IT and IS terms are used interchangeably.

In order to deeply understand what is an IS, in the next paragraph the four components of an IS, including the IT, are briefly described.

2.2.2.1 The four components of an Information System

IS are formal, socio-technical, organizational systems designed to collect, process, store and distribute information (Piccoli, 2012). Any formal organizational IS can be represented by four main components that must work together to deliver the information processing functionalities that the firm requires to fulfil its information needs.

Specifically, the four components of an IT-based information system are IT, people, process and structure (Figure 4). They can be divided in two groups. The technical subsystem, composed by technology and process, does not include any portion of human elements, while the social subsystem, composed by people and people in relation to one another (i.e. structure), represents the human element of the IS.

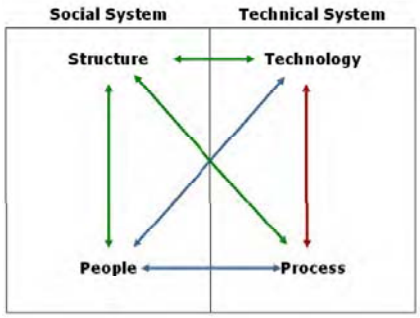


Figure 4 Information system components (Piccoli, 2012)

Information Technology. IT is defined as hardware, software, and telecommunication equipment. The IT component is the main component of an IS since it enables and constrains action through rules of operation that stem from its design. For example, in case Microsoft Excel is used in order to collect and manage

data rather than the relational database management systems as Microsoft Access, the user is limited by the design of the spreadsheet software. The result is substantial duplication of data, leading to redundancy, inconsistencies, and inefficient data management.

Process. The process component of an IS is defined as the series of steps necessary in order to complete a business activity. In order to understand what a process is, it can be considered the job of a small, family-owned grocery store manager to complete a business activity. He has to:

1. Check the inventory and recognize the needed items;
2. Call individual suppliers for quotes and delivery dates;
3. Balance the various quotes;
4. Select one or more suppliers for each of the needed items based on the terms of agreement (e.g. availability, quality and delivery);
5. Call these suppliers and place the orders;
6. Receive the goods upon delivery, checking the accuracy and quality of the shipped items;
7. Pay the suppliers.

It has to be taken into account that a business process can be performed in different ways, and also that there can be a discrepancy between the business process as is designed by the firm and the manner in which the business processes are performed. The manner in which a business process is performed can be often a root cause of IS failure. When a new IS has to be designed or when confronted with IS failure, what possible obstacles exist for employees that have follow the business process have to be considered.

People. The people element includes individuals and groups directly involved in the IS: end users, managers or IT professionals. They have their own skills, attitudes, personal agendas that determine what they are able to do and what they will elect to do as part of the IS. When designing and implementing a new IS, an understanding of people skills, interest and motivations is imperative.

Structure. The organizational structure component refers to the organizational design (hierarchy, decentralized), reporting (functional, matrix, divisional), and

relationships (communication and reward mechanisms) within the IS. It is important to understand the structure component because user resistance, incentive systems, and relationships are often silent enemies of the success of an IS that have to be detected before its implementation or also after, before an IS failure becomes apparent.

2.2.2.2 Why companies build Information Systems

When a company introduce an IS, the main objective is to fulfil its information processing needs in order to improve its efficiency[4] and effectiveness[5].

In order to fulfil its information processing needs, a company must capture relevant data that are manipulated, or processed, to produce an output that will be useful to the appropriate users, either internal or external to the firm (e.g. customers and suppliers). These data are typically accumulated and stored for future retrieval and use (Figure 5).

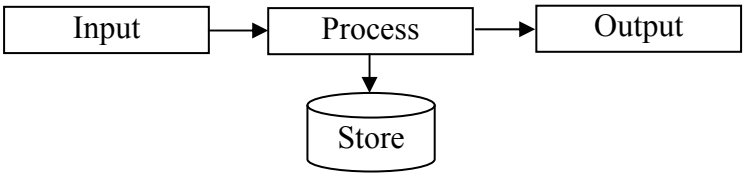


Figure 5 Information processing in an IS (Piccoli, 2012)

An IS has to be built according to specific goals of a company. For example, a large retail store (e.g. Walmart and Auchan) could need an IS in order to increase the efficiency and speed of customer check-out, or a high-end car manufacturer (e.g. Audi) could need an IS in order to improve customer service by allowing individual customers to select finishing and accessories on their car, and quote in real time price changes and delivery data changes.

However, when an IS has to be introduced in a company, since an organtion is unique in many aspects, different aspects that chartacterize a company have to be considered:

[4] *Efficiency* is defined as the ability to limit waste and maximize the ratio of the output produced to the inputs consumed. In other words, a firm is more efficient when it produces more with the same amount of resources, produces the same with less resources, or produces more with less resources.
[5] *Effectiveness* is defined as the ability to achieve stated goals or objectives. Typically, a more effective firm is one that makes better decisions and is able to carry them out successfully.

1. Firm strategy: it represents the manner in which the organization intends to achieve its objectives. For example, consider two competitors: Dell and Hewlett-Packard (HP). While the former focuses on highly customizable, make to order devices that are assembled upon receipt of orders directly form customers and clients, the latter focuses on producing standardized devices to be sold though wide cgannel distribution.
2. Firm culture: it is defined as the collection of beliefs, expectations and values shared by members of an organziation. It represents the way in which the organization operates.
3. Infrastructure: when an IS has to be introduced in a company, it is important to consider the current IT infrastructure of a firm. Indeed, the existing IT infrastructure, defined as the set of shared IT resources and services of the firm, constraints abnd enables opportunities for future IS implementations.
4. The external environment: since organziation themselves do not exist in a vacuum, it has to be considered the external environment where they are embedded, such as the regulations, the competitive landscape, the industry features where they act, and the general and business ternds (e.g. outsourcing, customer self-service).

To sum up, all the previous discussions about the factors that influence IS adoption are summarized in Figure 6. This model indicates that the immediate effect of an IS is whether they are used or not. In case they are used, there are several outcomes, including financial results, effects on people, and impacts on the future opportunities and constraints available to the firm. Furthermore, the model shows that an IS does not exist in a vaacum, but instead it is embedded in a particular organizational context, defined by the firm strategy, culture and IT infrastructure. Moreover, the organization itself does not exist in isolation, since it is embedded in the external environment, which includes social and competitive forces. In the figure, the feedback loops represented by the solid bold line remind that whatever outcomes are produced by an IS, positive or negative, will affect organziational charateristics and future IS decision making.

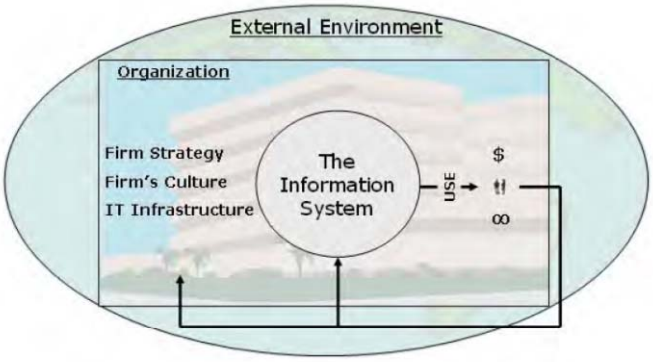


Figure 6 Information systems in an organizational context (Piccoli, 2012)

2.2.3 What IT-based capabilities are

IT-based capabilities are "*complex bundles of IT-related resources, skills and knowledge, exercised through business processes, which enable firms to coordinate activities and make use of the IT assets to provide desired results*" (Dale Stoel and Muhanna 2009, pp. 185). Thus, IT-based capabilities represent the ability of firm to combine efficiently a number of IT resources to engage in productivity activity and attin a certain objectuve (Amit and Schoemaker, 1993). As such, the development or enrichment of IT-based capabilities reflect the outcome of the IT assimilation process, through which firms become able to incorporate and routinize IT resources into their business processes to enhance performance (Armstrong and Sambamurthy, 1999). However, research studies have highlight that it is not sufficient to examine resources and capabilities in isolation, because complementarities shuold be also considered (Helfat, 1997), aspect that will be deeply analyzed in the following paragraphs.

Following the RBV (Barney, 1991), IT-based capabilities are thus an intermediate step between resources and outputs (Dutta et al., 2005) and can be measured by inferring a firm's ability in converting IT resources into outputs related to the performance of its main business processes. Indeed, since IT-based capabilities are only an intermediate step between resources and outputs, and since one can expect to see the inputs that a firm uses and the outputs that it achieves, it is possible only infer its ability in converting one into another. Therefore, it follows that IT-based capabilities represent a lens through which economic returns from IT investments can be observed. They can be classified in two main groups: the internally-oriented and the externally-oriented IT-based capabilities. The former are

related to "doing better the same things" while the latter are related to "doing new things". Further details will be provided in Chapter 3.

2.3 Features of SMEs and large companies that impact on IT investment decisions and firm economic returns

SMEs are a very large heterogeneous group of businesses usually operating in the service, trade, agriculture, and manufacturing sectors. According to Ritchie and Brindley (2005), SMEs are important in the economy because of their entrepreneurial spirit and adaptive capabilities. More significantly, SMEs are recognized for being the driver of economic growth and innovation and are decisive for fostering competitiveness.

However, it is important to take into account that SMEs have different features regards large organizations. These differences lead SMEs to have different behaviour towards innovation and IT adoption practices. Indeed, SMEs have the following characteristics:

- they have a fire-fighting mentality;
- they are susceptible to external forces;
- they have resources constraints;
- they follow informal strategies;
- they are less able to become leader in the adoption process (they are follower investors);
- they are in favour of "tailor-made" solutions;
- they have less human capital available;
- they operate in a highly competitive environment;
- they need more organizational flexibility;
- they have more financial constraints (Fabiani et al., 2005; Qian and Li, 2003);
- they develop competitive advantage through their staff creative potential to develop differentiated products for niche markets (Damanpour, 1992);
- the competitive advantage of the large firms comes from economies of scale, whereas the competitive advantage of small firms can come from their flexibility to vary output volume;

- they tend to move into foreign markets as exporters and/or as foreign investors (Reynolds, 1997) and a key strategy for overcoming the resource limitations that frequently constrain an SME's expansion is the use of alliances with firms that have local knowledge (Lu & Beamish, 2001).
- lack of (or considerably less sophisticated) IS management;
- frequent concentration of information-gathering responsibilities into one or more individuals, rather than the specialization of scanning activities among top executives (Hambrick, 1981);
- lower levels of resource available for information gathering;
- quantity and quality of available environmental information (Pearce at al., 1982).

For all the reasons explained above, SMEs can face difficulties in IS implementations, given especially their insufficient resources availability, the long implementation times and the high fees. Indeed, the resource scarcity, the lack of strategic planning of IS (Cragg and Zinatelli, 1995; Levy and Powell, 2000; Zinatelli et al., 1996), the limited expertise of IT (Levy and Powell, 2000), and the opportunity to adopt a process-oriented view of the business are among the factors that mainly influence IS adoption by SMEs (Buonanno et al., 2005).

Looking at the strategic influence of the adoption of IS, a number of the key differences between SMEs and large companies can be identified (Blili and Raymond, 1993). These issues are first the uncertainty regarding IT and competition, where the limited knowledge of owners makes decisions on strategic IS difficult. Second, SMEs may not be able to respond to the introduction of strategic IS due to limited resources, including implementation and training. Finally, SMEs may not identify the potential from IT due to their operational focus.

By contrast, large firms can capitalize on advantages typically associated with their greater size. Specifically, they can obtain market share based on broad product lines and reputation, exploit patents and scale economies in research and development, exert bargaining power over suppliers and customers, and dominate through leadership pricing (Porter, 1985). Large firms are also more capable of achieving economies of scale in their operations (Hambrick et al., 1982) and

typically have greater slack resources with which to attack competitors and to absorb the shocks of change or business downturns.

Given their features, SMEs have been long under exploit the potential value of IT assets (Fabiani et al., 2005). Indeed, despite IT are an enabler of more internal transparency and better coordination practices in the stage of business growth of small firms (Street and Meister, 2004), SMEs usually under invest in IT due to some of their structural weakness. Specifically, SMEs' managers and external consultant usually lack appropriate expertise and absorptive capacities on applying IT effectively to innovate internal routines and business processes (Thong, 2001). Because of this weakness, these firms rarely approach IT as a strategic lever. Furthermore, the lower human capital and the greater barriers that SMEs face in investing in human resources respect to their larger counterparts may impede them to undertake the complementary investments in the organizational capital that are fundamental for the IT payoff to manifest (Giuri et al., 2008). These flaws are particular evident in Italy, where in the last few years SMEs have exhibited limited innovation capacity, less educated labour and one of the slowest productivity growth in the European Union. To sum up, Table 2 contains a synthesized comparison between features of SMEs and large companies.

Features	SMEs	Large companies
Flexibility level	High	Low
Bargaining power over suppliers and customers	Low	High
Availability of resources	Low	High
Financial constraints	High	Low
Slack resources	Low	High
Knowledge of owners towards strategy	Low	High
Absorptive capacity	Low	High
Human capital	Low	High
Sophistication of IS management	Low	High
Expertise of IT	Low	High
Competitive advantage based on economies of scale	Low	High
Focus on market niches	High	Low
Formal strategies	Low	High

Table 2 Summary of SMEs and large companies' features (high or low level is specified)

2.3.1 SMEs flexibility and the role of IS

There is a long-running debate in the innovation literature related to the adoption of IS in SMEs, since their adoption could determine a loss of one of their advantages: the flexibility. According to Eardley et al. (1997), companies desire

flexibility for three main reasons. First, the ability to respond in a flexible way in turbulent environments may be the base for their survival. Second, flexibility may allow organizations to achieve higher levels of internal efficiency through such activities as business process re-engineering (Hammer, 1990). Third, the flexibility of a response can provide a competitive advantage through its ability to develop new performance-enhancing features and to exploit first mover advantages (Porter and Millar, 1985).

Some researchers support the formality perspective, which can be achieved for example by adopting IS (Bessant and Tidd, 2007; Prakash and Gupta, 2008), while others the informality perspective (Qian and Li, 2003). Specifically, considering the impact that the adoption of IS can have on SMEs' practices, it is reasonable to assume that SMEs need to adopt IS for formalizing their structures and processes in order to become more competitive (Bessant and Tidd, 2007). Nevertheless, on the other side, informality is seen in SMEs at the base of their flexibility and their competitive strengths (Qian and Li, 2003), since IS adoption may disrupt SMEs' operational flexibility as the adaptation of their features to changes in firms' routines and organizational procedures may be complicated and expensive.

Supporters of informality. Looking at supporters of informality, some studies argue how SMEs do not need to formalize their processes, structures and systems because their flexibility is a source of competitive advantage (Fiengenbaum and Karnani, 1991; Appiah-Adu and Singh, 1998; Narayana, 2001; Quian and Li, 2003). Indeed, these authors highlight that SMEs have to avoid introducing IT solutions that determine the lost of flexibility levels since it is fundamental for responding quickly to market uncertainty that characterize the environment where SMEs operate (Appiah-Adu and Singh, 1998; Damanpour, 1992).

Supporters of formality. Contrary to the more conventional perspective, there is reason to believe that SMEs may be better off with formality strategies that can be achieved by introducing IS in firms' routines and organizational procedures. The most compelling reason to believe this is that organizing to meet individual customer needs and fluctuating demand is very complex (Swaminathan, 2001). Because of the uncertainty of demand and costs for individual projects, production scheduling and

pricing are difficult but necessary to keep costs from getting out of control and to preserve adequate margins, and therefore IS are necessary.

Furthermore, according to the theory that support formality in SMEs (Bessant and Tidd, 2007; Prakash and Gupta, 2008), researchers have argued that SMEs necessitate to enhance their organizational capabilities by formalizing their structures and systems in order to be more efficient, to growth and to follow internationalization strategies. Usually, innovation in SMEs is related to process improvements, which require necessary formal structure in order to squeeze costs out. The main elements that past studies have identified as important in formalization of SMEs are procedures and organizational standards (Prakash and Gupta, 2008). These are important since they clarify employees' roles and lead to organizational effectiveness, employee commitment and involvement. Specifically, in past IS studies, formalization has been related to the following aspects: (i) greater decentralization of IS development, (ii) greater control of IS project selection and management, and (iii) better user attributes toward an IS.

Formalization requires that the organizational processes are well understood, with explicit rules, procedures, instructions and communications. If the maturity of the organizational IS function increases, this means that also the formalization increases, since more formal data and models have to be supported. Furthermore, formal organizations are also the one in which management applies techniques as inventory control, quality control, project management, budgeting, cost accounting, and financial analysis (Raymond, 1990). This in turn determines a higher support for a more sophisticated organizational IS.

2.3.2 Risks and benefits in adopting IS in SMEs

Several companies decide to adopt IT solutions in order to survive in the environment where they act and to growth, remaining competitive or enhancing innovation abilities (e.g. Bruque and Moyano, 2007). Some authors declare that SMEs adopt IT solutions in order to answer to particular events or given the pressure from customers or for improving their efficiency levels (e.g. Ballantine et al., 1998). Furthermore, Morel and Ramanujam (1999) stated that companies decide to adopt IT solutions in response to both internal and external pressures. However, when SMEs

decide to adopt IS, they have to know which risks they incur in and which benefits they can achieve by their adoption.

SMEs face a number of issues, risks, and barriers in adopting IS. In general, these fall into five categories: lack of information, lack of expertise, perception that advanced technologies are not affordable, pressure to be productive, and lack of fit (Table 3).

Barriers	**Issue, risk, constrain**
Lack of Information / Expertise	• Unaware of software, benefits, capabilities, ROI. • Lack of knowledge of how to select, adopt, and implement software. • Lack of knowledge of how to evaluate organizational needs. • Lack of training in software use and optimization. • Lack of knowledge of outside sources of expertise. • Lack of strategic and tactical planning skills.
Perception that SME Cannot Afford Technologies	• SME "cannot afford" software e.g., it is too expensive for the expected return. • SME "cannot afford" technical infrastructure (new computers/ networks that the software requires). • SME "cannot afford" training or consulting. • Fear that expenses associated with software will never end. • Fear of wasting money on software or capabilities of no use.
Pressure to be Productive	• SME management perception that they do not have time (or not worth their time) to learn about software. • SME management does not have time to organize and oversee implementation. • SME employees do not have time for training. • SME cannot wait for system to start paying for itself.
Lack of Fit	• Organization not ready for software. Employees may feel it is a nuisance or waste of time. They may be afraid that they will not be paid or judged according to previous standards. • Operations are not ready. Confusion and conflict may exist between departments over roles and responsibilities. Business and production processes may need to be modified to meet software needs. • SME may not have proper systems or networks.

Table 3 Issues, risks and barriers in adopting IS by SMEs (Estrin et al., 2003)

However, IS can provide several benefits across a wide range of intra- and inter-firm business operations and transactions. Certainly, IS can contribute to improve information and knowledge management inside the firm, can reduce transaction costs and can increase the speed and reliability of transactions for both business-to-business (B2B) and business-to-consumer (B2C) transactions. In addition, they are effective tools for improving external communications and quality of services for established and new customers.

Assessing the benefits of IT is a complex task and very difficult to implement. A number of frameworks have been developed for assisting managers and decision-makers. For example, IT benefits have been classified as strategic, tactical and pecuniary (Demmel and Askin, 1996). Similarly, Farbey et al. (1995) have classified IT benefits as strategic, tactical, and operational but acknowledge that benefits at the strategic level are difficult to quantify as they are 'soft' and uncertain. Tactical and operational benefits focus on efficiency gains within specific processes, functions, or departments and so are able to be categorized and quantified much more readily.

More specifically, SMEs can obtain a wide range of benefits from the use of IS adoption:

- enhance the productivity and effectiveness of certain activities or functions: for instance, an IS facilitates the selective automation of processes related to supporting the field sales force and integrating sales activity into the company's information structure;
- favour the adoption of new organizational, strategic and managerial models;
- enable the access to new environments as well as the generation of new markets and business models;
- improve the qualification and specialization of human resources, which increases the efficiency and efficacy;
- enhance a company's ability to exploit linkages between activities, both within and outside the company;
- reduce the operating cost in communicating with customers and suppliers, cost savings and time saving.

2.4 Conclusion

This chapter has been written with the aim of being prodromal for understanding the concepts included in Chapter 3. Three goals have been accomplished: 1) clarify the positioning of the research study conducted in this PhD thesis; 2) provide the definition of the key terms that will be used in the following paragraphs; 3) show the differences between companies of small size and large size in order to understand how such differences could impact on their diverse adoption, assimilation and performance achievements.

Overall, the previous discussion has highlighted that SMEs lag behind large firms in IT usage and that the adoption process of IS in SMEs can be different from the one that follow companies with a bigger size, given the number of differences between these two types of companies. Indeed, SMEs has usually a limited knowledge of owners that makes difficult to take decisions on strategic IS adoption. Furthermore, SMEs may not be able to respond to the introduction of strategic IS due to their limited resources and they usually have not enough financial resources for making IT investments. In addition, some researchers (e.g. Narayan, 2001) support the idea that SMEs do not need to introduce formality in their processes, for example by adopting IS, since they could lose their main competitive advantage: the flexibility in answering to customer needs and environmental changes. However, in case SMEs decide to adopt an IS, they have to follow a clear defined strategy otherwise they could not gain the desired benefits.

Therefore, given that one may conclude that results found in the large company context cannot be directly applied to the SMEs context, due to their differences, it is necessary to understand how IT investments provide business value in SMEs, and which are the contextual variables that may influence such relationship. This is the reason why this thesis is focused in the intersection between the innovation, strategic and information systems literatures, and on SMEs reality.

In order to better understanding the aspects that have been mainly analyzed in the existing literature, the following chapter will deeply show the theoretical background on which this thesis has been drawn.

Chapter 3

3. THEORETICAL BACKGROUND

This chapter presents the main theoretical arguments that this thesis refers to. Specifically, the chapter begins with an analysis of the studies that have investigated the process from the adoption of IS to the achievement of economic performance. Then the theories used in this study, the RBV and the contingency perspective, are shown. Specifically, how these theories have been applied to IS studies will be argued and the main elements of the conceptual framework developed in this thesis will be discussed.

3.1 From the adoption of IS to the achievement of firm economic performance

Extant research has already provided descriptive evidence about how IT investments enable specific business outcomes in large companies (Xue et al., 2012). Some existing empirical studies have demonstrated how IT investments are associated to higher performance and enhancement in firm outputs (Barua and Lee, 1997; Brynjolfsson and Hitt, 1997; Menon et al., 2000), and to the enhancement of financial and market performance (e.g., Bharadwaj 2000; Hitt and Brynjolfsson 1996; Kettinger et al., 1994; Mahmood and Mann, 1993). However, the literature has narrowly analyzed how the IT can provide higher performance in SMEs.

Even though the majority of the studies have demonstrated a positive impact of IT investments on firm economic performance, some studies revealed the contrary. For example, Loveman (1994) concluded that the IT investments have practically no impact on the performance achievements of firms. However, researchers highlighted that these controversial results were probably caused by measurements problems, methodological deficiencies and poor quality datasets. For example, Bharadwaj et al. (1999) argued that the ROI, even though it is an important, is not enough for

measuring the business value achieved from the investments in IT, and therefore its usage could lead to some wrong results. Other researchers instead suggested that since IT investments are related to company strategy, the relationship between IT adoption and firm performance has to be studied within a strategic management framework.

IS studies have tried to overcome such problem by choosing adequate performance measures. A broadly used approach in this field is given by the use of quantitative measures such as the traditional capital budgeting methods (Return on Assets, Return on Sales, Pay-back period, Discounted Cash Flow and Internal Rate of Return), while other IS researchers tried to combine quantitative and qualitative approaches at the same time. For example, Tallon (2006) discussed such approach by highlighting that the differences found in literature could be the reflection of a contraposition between financial measures and perceptual measures (Figure 7). He showed how different authors used different metrics in order to evaluate the business vale of IT investments. He reviewed the IS studies conducted, and identified 5 kinds of objective/financial measures used in literature. They are grouped in market measures, profitability, costs, productivity/output and process measures. Furthermore, he also provided a classification of the perceptual measures used by researchers. He grouped such measures in profit/sales/cash flow, productivity gains, customer service quality, product development, IS effectiveness, competitive advantage and strategic variables.

IT Business Value Measures

Objective / Financial Measures

Market Measures
- Tobin's question: Bharadwaj et al. (1999)
- Market Capitalization: Dos Santos et al. (1993); Hitt and Brynjolfsson (1996); Im et al. (2001); Tam (1998)

Profitability
- Return on Assets (ROA): Barua et al. (1995); Floyd and Wooldridge (1990); Hitt & Brynjolfsson (1996); Li and Ye (1999); Rai et al. (1996, 1997); Tam (1998)
- Return on Equity (ROE): Hitt and Brynjolfsson (1996); Rai et al. (1996, 1997); Tam (1998)
- Profit Margin (ROS): Byrd and Marshall (1997); Li and Ye (1999); Kettinger et al. (1994)

Costs
- Coordination costs: Shin (1997)
- Labor and SG&A: Bharadwaj (2000); Mitra and Chaya (1996)

Productivity / Output
- Revenues: Brynjolfsson and Hitt (1995); Dewan and Min (1997); Hitt and Brynjolfsson (1996)
- Value-added: Bresnahan et al. (2000); Brynjolfsson and Hitt (2000); Kudyba and Diwan (2002)

Process Measures (compiled from objective criteria)
- Food service sales: Banker et al. (1991)
- Inventory turnover: Barua et al. (1995)
- Mortality rates: Devaraj and Kohli (2000)
- Mail sorting (quality): Mukhopadhyay et al. (1997)
- Shipment discrepancies: Srinivasan et al. (1994)

Perceptual Measures
- Profit, sales, cash flow: Bergeron and Raymond (1995); Chan et al. (1997); Venkatraman (1989)
- Productivity gains: Grover et al. (1998)
- Customer service quality: Ray et al. (2004)
- Product development: Ravichandran and Lertwongsatien (2005)
- IS Effectiveness: Delone and McLean (1992); Ragowsky et al. (2000)
- Competitive advantage: Sethi and King (1994): instrument development paper (N=185). Dimensions:
  - primary activity efficiency, support activity efficiency, resource management functionality, resource acquisition functionality, threat, preemptiveness, synergy
- Strategic variables: Mahmood and Soon (1991): instrument development paper (N=31). Dimensions:
  - buyers and consumers, competitive rivalry, suppliers, search and switching costs, market, products and services, pricing, economics of production, internal organizational efficiency, interfirm efficiency

Figure 7 IT Business Value Measures (Tallon, 2006)

Drawing on such study, and on the one conducted by Ravarini (2010) who mapped the researches that investigated the IT adoption process in firms, the IT-based capabilities development and the firm performance achievements, I complemented their analysis providing a classification of the main studies in such context (Table 4). This classification has been conducted for five reasons:

1. to figure out the main performance measures used;
2. to map the studies that have used a RBV perspective;
3. to map the studies that have analyzed how the IT business value has been related to the environmental, organizational and the business environment context;
4. to understand the extent to which the literature have invested the SMEs context;
5. to identify the research gap to fill in in this PhD dissertation.

	Objective Financial Measures					Perceptual measures							RBV theory	Context			Company type
	Market measure	*Profitability*	*Costs*	*Productivity/ Output*	*Process Measures*	*Profit, sales, cash flow*	*Productivity gains*	*Customer service quality*	*Product development*	*IS Effectiveness*	*Competitive advantage*	*Strategic variables*		*Environment*	*Organizational*	*Business environment*	
1996 MISQ Hitt	...	ROE; ROA; sales growth	Debt/Equity	Value added	...	...	...	...	...	...	...	...	No	No	No	No	Large
1999 I&M Li		ROA; ROS	...	...	...	...	...	...	...	...	...	...	No	Dynamism	Yes	No	Large
2000 MISQ Bharadwaj	...	ROS; ROA; operating income to asserts (OI/A); to sales (OI/S); to employees (OI/E)	Total operating expense to sales; COG/S; SGA/S	...	...	...	...	...	...	...	...	...	Yes	No	No	No	Large
2001 JSIS Andersen	...	...	...	...	...	Organization's profitability and sales growth relative to close competitors	...	...	...	...	...	Level of innovation in the organization	No	Dynamism Complexity	Yes	No	Large
2001 SMJ Spanos		Profit margin; ROI; Financial liquidity	...	...	...	...	...	...	...	...	...	...	No	No	Yes	Yes	Large
2002 ISR Zhu	...	Sales per employee; Gross margin	Costs of goods sold	...	Inventory turnover	...	...	...	...	...	...	...	Yes	No	No	Yes	Large
2002 EJIS Cragg	...	...	...	...	...	Costs reduction, company image improvement; sales revenue improvement; profitability	Staff productivity improvement	...	...	Quality of decision making improvement	Computers have helped us compete	Internal integration improvement	No	No	Yes	Yes	SMEs

						improvement											
2002 SMJ Schroeder	...	...	Manufacturing costs as a percentage of sales		% of deliveries customers receive on time; cycle time; length of fixed production schedule	...	...	...	...	...	...	...	Yes	No	No	Yes	Large
2003 SMJ Quian	...	ROA; ROE; ROS; Sales growth	...	...	...	...	...	...	...	...	...	...	No	No	No	Yes	SMEs
2003 Sambamurthy MISQ	...	...	Fixed costs of production	...	...	...	...	...	...	...	...	...	No	Dynamism	No	Yes	Large
2003 MISQ Santhanam	...	ROS; ROA; OI/A; OI/S; to employees (OI/E)	COG/S[6]; SGA/S[7]; OPEX/S[8]	...	...	...	...	...	...	...	...	...	Yes	No	No	No	Large
2003 SMJ Tippins	...	...	...	...	...	Profitability; ROI; sales growth		Customer retention	...	...	...	...	Yes	No	No	No	Large
2004 MISQ Barua	...	ROA; ROIC[9]		Revenue per employee; gross profit margin	...	...	...	...	...	...	...	...	Yes	No	No	Yes	Large
2005 MISQ Ray	...	...	...	...	...	...	...	Customer service performance	...	...	...	...	Yes	No	No	Yes	Large
2005 MISQ Tanriverdi	Tobin's q	ROA	...	...	...	...	...	...	...	...	...	...	No	No	Yes	Yes	Large

[6] Cost of goods sold to sales.
[7] Selling and general aministration expenses to sales.
[8] Operating expenses to sales.
[9] Return on invested capital.

2006 JSIS Rivard	...	Profit margin; ROI; Financial liquidity	...	...	...	...	...	...	...	...	...	...	...	No	No	Yes	Yes	SMEs
2007 DSS Melville	...	...	...	Value added	...	...	...	...	...	...	...	...	...	No	Dynamism	Yes	No	Large
2007 ISR Saraf	...	...	...	...	...	More profitable; higher economic performance; higher sales growth than our competitors'	...	...	...	...	...	...	...	No	No	No	Yes	Large
2008 ICC Giuri	...	...	...	Value added	...	...	...	...	...	...	...	...	...	No	No	Yes	Yes	SMEs
2009 I&M Stoel	...	ROS; ROA; OI/S; OI/A;	COG/S; SGA/S	...	...	...	...	...	...	...	...	...	...	Yes	Dynamism Munificence Complexity	No	No	Large
2012 MISQ Xue	Tobin's q	...	COG/S/ total payables; SGA/S	...	Inventory turnover	...	...	...	...	...	...	...	...	No	Dynamism Munificence Complexity	No	No	Large
2011 SMJ Drnevich and Kruauciunas	...	...	...	...	...	Profitability	...	...	...	...	...	...	...	No	Dynamism	No	No	Large

Table 4 Applying Tallon's (2006) taxonomy to map the measures of IT impacts in the IT capability related literature (Adapted from Raverini, 2010)

Analyzing the research studies contained in Table 4, it is evident that none of them makes use of measures belonging to the objective financial perspective and to the perceptual measures at the same time. This is probably due to the difficulties that researchers find in merging the outcomes of these two different lenses of investigation. However, the papers are homogenously divided in the two perspectives. The majority of these studies use profitability and costs measures for evaluating the IT business performance in firms. Just to provide an example, Cragg in 2002 proposed a framework for measuring the perceptual indicators in SMEs (Table 5).

IT/IS strategic alignment	Please rate (for the following statements related to the strategy in your company in the last two years), to what extent you agree and how you think you could measure the competitive advantages achievable by using the IT currently available in your company: • Differentiate with products with a higher quality than competitors; • Differentiate with products that are different from the competitors' ones • Differentiate with new products • Continuously improve the efficiency of production processes • Differentiate from competitors with a large range of products • Differentiate from competitors with customized products • Differentiate from competitors with high quality services • With competition by means of strong marketing campaigns • Pursue a growth strategy focusing on entering new markets	IT effect performance: subjective/ qualitative measures	Please rate the degree of satisfaction for each of the following issues: • To what extent are you satisfied with the increase of sales achieved thanks to IT? • To what extent are you satisfied with the increase of the market share of the company achieved thanks to IT? • To what extent are you satisfied with the increase of cash achieved thanks to IT? • To what extent are you satisfied with the improvement of the company image achieved thanks to IT?
IT impact on the firm	Please indicate which of the following you believe are the effects on the IT on your company in the past two years and to what extent you agree to the following statements: • Reduce administrative costs • Improve company's image • Increase productivity • Increase the quality of decisions • Improve internal integration • Improve external integration with suppliers and clients • Improve teh ability to compete • Increase sales revenue • Increase profit	IT effect on performance: financial (objective) measures	Please indicate the value of the financial data listed below: • Turnover in the last three years • Profits in the last three years

Table 5 The indicators to measure IT influence on business performance

Given that the process from the adoption of IT solutions to the achievement of economic performance is complex and can be influenced by contextual factors, these

studies have been analyzed also by looking at which contextual variables influence such relationship. Specifically, the majority of them has complemented a RBV perspective with the analysis of the contextual factors that may influence the business value of IT investments, even though it can be observed that an integrated model for understanding how the different contexts and the resources own by SMEs impact on the economic firm returns is still lacking. Indeed, the majority of these studies have as unit of analysis the large companies and have lacked in investigating companies of smaller size. This can be due to the fact that until few years ago, the technology was too costly for companies of smaller size, since they are more financial constrained, have not the IT management capabilities to understand the real business value of IT solutions, and have usually low levels of available resources. However, since nowadays the cost of IT is decreasing and there are new delivery modalities that do not require high initial IT investments, such as the software delivered in an "as a service" modality, the SMEs could change their adoption behaviours and could benefit more from the IT investments.

Studies cited in Table 4 have made some contributions about the environmental influence on the potentiality that the IT can provide to large companies. Indeed, researchers have underlined that the IT potentially allows large firms to improve their strategic flexibility and thus to undertake a gradual number of competitive actions to deal successfully with the dynamic competitive environment (Sambamurthy et al., 2003). Because of these properties, some earlier studies have found that in more dynamic industries, there is higher payoff of IT investments for firms exhibiting superior external IT-focused capabilities (i.e. Li and Ye, 1999; Stoel and Muhanna, 2009). However, in dynamic environments, SMEs could be less likely to make IT investments are profit from their adoption. Indeed, SMEs, because of their lower availability of slack resources, could be less eager to commit their financial resources to IT investments (Chau and Tam, 1996) and could prefer to reduce the need for information processing in various ways (Galbraith, 1974) such as crating self-contained tasks or by focusing on a less turbulent stage of industry's supply chain. Indeed, in such environments, companies need a high responsiveness level to markets, rapid product design, and the adequate IT management capabilities to redeploy resources in response to environmental instability, which can be lost in case SMEs adopt IT solutions, since their adoption can introduce rigidity in their

processes. Therefore, a further investigation of the impact of environmental conditions, such as the level of dynamism, on the adoption patterns and returns of IT investments in SMEs, is necessary. Furthermore, it is important to understand also how SMEs behave under high levels of munificence and complexity, because SMEs need to invest in IT may vary depending on the opportunities for revenue growth available in the market (environments characterized by high levels of munificence), the degree of competitive intensity, and the complexity of products and supply chain relationships. For example, high growing markets may require SMEs to adopt IS that support business process standardization in place of mutual adjustment and information coordination channels.

Environmental conditions may also influence the organizational learning required to firms for the assimilation of IS in business processes and for the development of new organizational capabilities from IT resources. As shown by Giuri et al. (2008), the complementary organizational investments are fundamental for explaining the IT pay-off to manifest and contribute in explaining the SMEs' lower returns from the IT adoption. Therefore, given that the IT business value has to be linked to other contextual aspects that are critical to strategic management, such as the internal context that characterize SMEs and the business environment where these companies operate (such as the geographical scope of their operating units, the level of vertical integration, the customer dependence and the support that IS vendors can provide to SMEs), how these contexts and the environmental context together influence firm economic performance achievements have to be investigated.

Given that an integrative model in SMEs is still lacking, and that the IT-based capabilities have been analyzed only at a high level of aggregation, this thesis has the attempt to overcome such literature lacks by investigating the different typologies of IT-based capabilities that can be developed by SMEs and looking at how the contextual factors impact on their development and on the achievement of higher economic performance.

In order to complement this analysis, in the following paragraphs, the main features of the theories applied to the field of IS, the RBV theory and the contingency perspective, that I will apply in this research thesis, are shown.

3.2 Theories applied in the IS field

3.2.1 The Resource Based View

In this thesis the RBV is applied in order to understand how the adoption of IT-based resources can be a mean to achieve competitive advantage. Specifically, the RBV is a theory that was developed and proliferated in the early 1990s. It was emerged as one of the several explanations of persistent firm performance differences in the strategic management field. Indeed, the field of the strategic management is organized around one main research question: "How do some firms persistently outperform others?" (Barney and Arikan, 2001). This means that in some cases and in some conditions differences of performance between companies will persist over time.

The RBV is currently the dominating theoretical concept in the field of strategic management. According to its underlying logic, the success of a firm and performance differences between firms of an industry can be explained by the existence of firm-specific, strategically valuable resources (Barney, 1991). In order to use firm resources as a source of sustainable competitive advantage, it is necessary that resources are heterogeneously distributed and immobile between firms. This theory is based on the fact that companies possess tangible and intangible resources, and can develop capabilities in order to gain a competitive advantage. After that, companies have to develop a strategy for completely exploiting firm's resources and capabilities. In such a way, companies have to identify the resource gaps and invest in augmenting and updating their resource base (Figure 8).

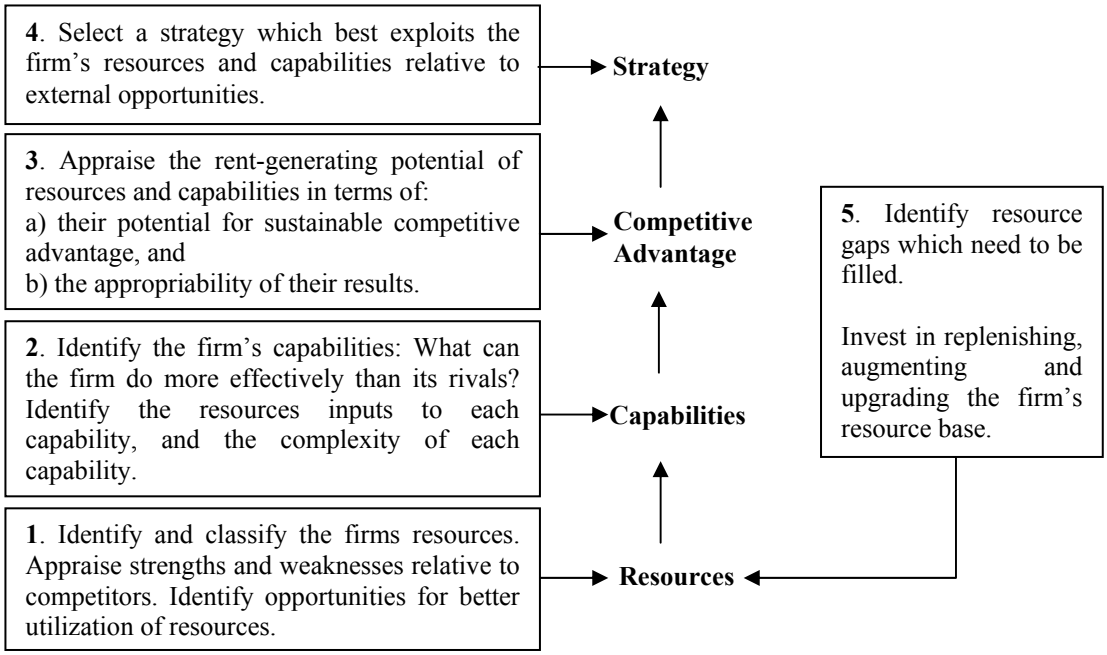


Figure 8 Resource-based theory and strategic analysis

By analyzing the previous figure, it should be noted that the endowment of critical resources (IT-based and non IT-based) cannot be directly related to company's economic performance, since the latter also depends on the specific structure and attractiveness of the industry in which the company acts, and on the ability of the company to translate resources (inputs) into capabilities and in consequent output, in order to subsequently achieve a competitive advantage.

In the next paragraphs, the assumptions on which the RBV theory is built are discussed, and the explanation of the main elements that are referred to the RBV theory are argued.

3.2.1.1 Assumptions

The RBV theory is based on two main assumptions (Barney, 1991): 1) resource heterogeneity: resources are distributed heterogeneously across firms and competing firms may possess different bundles of resources; 2) low resource mobility: these productive resources cannot be transferred from firm to firm without cost (i.e., resources are "sticky") and differences may persist.

These assumptions are the axioms of the RBV and they suggest that some firms, some of the time, may have resources that enable them to more successfully develop and implement strategies than other firms, and that these resources differences can last.

Given these assumptions, Barney (1991) made two fundamental arguments. First, resources that are both rare (i.e., not widely held) and valuable (i.e., contribute to firm efficiency or effectiveness) can produce competitive advantage. Second, when such resources are also simultaneously not imitable (i.e., they cannot easily be replicated by competitors), not substitutable (i.e., other resources cannot fulfil the same function), and not transferable (i.e., they cannot be purchased in resource markets (Dierickx and Cool, 1989)), those resources may produce a competitive advantage that is long lived (this means sustainable). Thus, rarity and value are each necessary but not sufficient conditions for competitive advantage, whereas non-imitability, non-substitutability, and non-transferability are each necessary but not sufficient conditions for sustainability of an existing competitive advantage (Figure 9).

Figure 9 Relationships of the RBV (Barney, 1991)

From these core ideas, arguments have been advanced that single-business firms can achieve sustainable competitive advantage from such resources as:

1. information technology;
2. strategic planning;
3. organizational alignment;
4. human resources management;
5. trust;
6. organizational culture;
7. administrative skills;
8. top management skills.

Specifically, this thesis will focus on the first type of resources, the information technology resources (IT-based resources), since the main goal is investigate whether and how such resources enable SMEs to increase their economic performance.

3.2.1.2 Elements of the RBV

When a theory has to be applied, it is important to provide definitions of critical terms used. Given that in this thesis I have to evaluate how the adoption of resources impacts on the development of capabilities, and subsequently on the organizational and firm performance, the definition of the key terms of the RBV - resource, rents, routines, competence, capability, competitive advantage and sustainable competitive advantage - will be provided.

a. Resources

The first term that is necessary to define is the term "resource". Even though this term has been defined in past research studies (Wernerfelt, 1984) (Rumelt, 1984) (Barney, 1991) (Barney, 2001), its current use has the following definition: *resources are tangible and intangible assets that firms use to conceive of and implement their strategies*.

The economic and strategic value of these tangible and intangible resources varies. Generally, resources are valuable when they enable a firm to develop and implement strategies that lower firm's net costs and/or increase firm's net revenues beyond what would have been the case if these resources had not been used to develop and implement these strategies. The value of resources can also be determined by their ability to enable firms to conceive of and implement strategies that are appropriate to the market within which a firm operates. However, the possession of valuable resources does not always mean that the firm will surely gain a superior advantage, persistent or otherwise. For instance, if competing firms in an industry possess the same resources and use them to conceive of and implement the same strategies, these resources will not be a source of superior performance, even if the costs of all these firms are lower and revenues higher than what would have been the case if these resources had not been used to conceive of and implement these strategies. In this sense, setting aside the role of luck, possessing valuable resources is a necessary, but not sufficient, condition for firms to obtain superior performance.

As said before, resources can be tangible or intangible. For example, tangible resources can be factories and intangible resources can be the reputation of a firm. Following studies on the RBV, resources can be classified in four general categories.

Financial and physical capitals are related to the tangible resources, whereas human and organizational capitals are intangible resources. Specifically, financial capital can include the equity capital, the debt capital, the retained earnings and the leverage potential of firms. Physical capital can include the machines and the buildings that each firm owns, and the IT infrastructure. Firm's human capital can be the training, the experience, the judgment, the intelligence, the relationships, and insights of individual managers and workers in a firm. The organizational capital can be the attributes of collections of individuals associated with a firm, including a firm's culture, its formal reporting structure, its reputation in the market place and its brand.

According to the RBV, it is clear that resources are the inputs for implementing a successful strategy, which in turn allows the firm to gain a competitive or sustained competitive advantage. As said before, since not every resource provides a firm a competitive or sustained competitive advantage, the focus of the RBV is on those resources that are valuable, heterogeneous, and immobile to the firm that enables a firm to achieve a competitive advantage or a sustained competitive advantage so that it earns rents. In order to earn rents, the resources or bundles that a firm possesses must be valuable, rare, imperfectly imitable, and imperfectly substitutable (Barney, 1986).

b. Rents

As defined by Mahoney and Pandian (1992), the rent can be defined as *returns that are in excess of opportunity costs*. Firms can earn rents for several reasons: from collusive relationships between competitors, from disequilibrium effects (such as luck), and from unique factors. The last class is called Richardian rents.

Ricardian Rents are earned from resources that are limited in supply (scarce), such as valuable land, a patent, etc. In case resource supply is limited, this is a barrier to competitors that would like to imitate the resource. However, when the supply of a resource is not limited and thus controlled by the firm, these rents generated are classified as Monopoly Rents. While, in case rents are attributable to entrepreneurship, they are called Schumpeterian Rents, and are earned by the entrepreneur until they are imitated by others (Peteraf, 1993). Specifically Schumpeterian rents are short lived due to the volatility of the competitive

marketplace, whereas Ricardian rents, due to limited availability of resources, are more durable, and provide a sustained competitive advantage.

All these considerations are based on the fact that one important way firms' factors may vary is in their specificity. Specifically, less specific factors as those that lose less efficiency as they are applied farther from their origin. These factors will normally yield less advantage because they are in wider supply. Because less specific factors normally support wider diversification, their relatively lower value will tend to strengthen the negative relationship between the extent of diversification and average rents (Montgomery and Wernerfelt, 1998).

Owning or having access to valuable and heterogeneous resources is one of the factors that give a firm a competitive advantage.

c. Competitive Advantage and Sustained Competitive Advantage

The third and fourth terms that need a definition is the concept of competitive advantage and of sustained competitive advantage. A firm has a competitive advantage when *it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors* (Barney, 1991). Whereas, a firm has a sustained competitive advantage when *implements a value creating strategy that is not simultaneously implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy* (Barney, 1991).

The previous definitions do not only consider the firms that already operate in an industry, but also potential competitors poised to enter an industry at some future date (Baumol et al., 1982). In such a way, a firm that has a competitive advantage or a sustained competitive advantage is following and implementing a strategy not simultaneously being implemented by any of its current or potential competitors. Secondly, the definition of sustained competitive advantage does not depend on the time during which the company gain a competitive advantage. Thus, the sustainable is not measured in calendar time. Empirically, sustained competitive advantage will last a long period of calendar time. Nevertheless, what defines the existence of a sustained competitive advantage is not this period of calendar, but the inability of current and potential competitors to duplicate that strategy that makes a competitive

advantage sustained. Thus, sustainable suggests the advantage lasts long enough that competitors stop trying to duplicate the strategy that makes the advantage sustained.

Finally, saying that the competitive advantage is sustained does not imply that it will "last forever". It only suggests that it will not be competed away through the duplication efforts of other firms. For example, a not anticipated changes in the economic structure of one industry may make, what previously was a source of sustained competitive advantage, no longer valuable for firms and thus not anymore a source of any competitive advantage. This structural revolution in firms is called "Schumpeterian Shocks" and may allow some resources that previously were not source of competitive advantage, to become source of competitive advantage in the new market (Schumpeter, 1950).

As resources need to be valuable, rare, imperfectly imitable and with no substitutes in order to give a firm a sustained competitive advantage (Barney, 1991), also the routines/competencies and capabilities of a firm have to own such attributes.

d. Routines

Routines refer to a 'repetitive pattern of activity' by which organizations get things done (Nelson and Winter, 1982, pp. 97). They are built off of interactions with the processes of the firm, which are the culmination of experience and learning that comes from putting those processes into action. Consequently, organizations are made up of many routines, and those routines are idiosyncratic to the firm. By turning the actions or steps of the way something is done into a routine, it becomes a part of organizational memory. Sometimes routines are best explained by saying it is just the way that something is done, or that it is how something is accomplished (Dosi, et al., 2000).

Organizational routines are for example put into use when employees perform their job duties, because they have to receive and interpret information from the external and internal environment. Due to the need of interpreting that data, several routines are recalled from the memory when the need arises and then are performed. As a result, the performance of these routines in turn sends data to other employees who subsequently perform other additional routines, and so it continuous to spread throughout the overall company.

Considering what is assessed above, organizational routines can be interdependent one upon the other. It can also be inferred that routines can repetitious and with rote memory. Routines performed by employees, who correctly interpret the data and implement the appropriate routine, allow the organization to accomplish its objectives and move forward in a coordinated manner. As a consequence, the more an organization uses a routine, the more embedded in organizational memory it becomes. In such a way, as skills are owned by employees, routines are owned by organizations. Therefore there is a tacit component to skills, which implies that there is a tacit component to routines.

To clarify the concept of routines, the following examples illustrate the execution of routines and sub-routines:

- a purchasing routine that is used by an organization for obtaining raw materials, products, and services for the firm;
- the process of matriculating students at the university;
- the process of checking someone into a hospital;
- the security routine at an airport where identification is verified by a security agent inspecting and comparing the passenger's identification and flight information with that in a database.

Additionally, such routines, if codified, allow their transference into other areas of the firm. For instance, if a company decides to expand its operations and open another plant, where there is the opportunity to replicate the routines that the firm already has in place, the new plant will be able to function more quickly at the necessary level to enable its smooth operation. Of course, there are many other issues involved in the replication of a routine, such as finding the right personnel, and providing adequate training, coaching, etc. All of these issues will impact the effectiveness with which the routine is performed (Nelson and Winter, 1982; Zollo and Winter, 2002). When routines and sub-routines are combined to achieve an outcome, they form a high-level routine, or a capability.

e. Capabilities and competences

A general equivalence between competencies and capabilities is often assumed within the literature. However, they are different. Prahalad and Hamel (1990)

developed the concept of "core competencies" and, building on Selznick (1957) and others, added the term "competence" to the resource-based lexicon. Specifically, a core competency is *a specific factor that a business sees as being central to the way it, or its employees, works*. This definition fulfils three key criteria:

- it is not easy for competitors to imitate;
- it can be re-used widely for many products and markets;
- it must contribute to the end consumer's experienced benefits.

Stalk et al. (1992) argued that there was a difference between competencies and capabilities, and thus the latter term was added to the terminological fray. A capability is usually considered as *a "bundle" of assets or resources to perform a business process (which is composed of individual activities) and indicate what a firm is able to do*. Capabilities can be defined as "intermediate goods" developed over time, and built upon organizational processes and human capital to make firm resources more effective (Amit & Schoemaker, 1993).

As discussed by Dosi et al. (2000), the capability is a fairly large-scale unit of analysis, with a recognizable purpose expressed in terms of the significant outcomes it is supposed to enable, and that is considerably shaped by decisions both in its development and deployment. However, intentions and conscious purposes may be remote from capability's instances such as observed activities and outcomes, which often are automatic and habitual.

In order to better understand the concept of capabilities, an example of capability classification is provided (Rangone, 1999):

1. innovation capability: it is a company' ability to develop new products and processes, and achieve superior technological and/or managerial performance (e.g. development cost, time-to-market, etc.);
2. production capability: it is the ability to produce and deliver products to customers, while ensuring competitive priorities, such as quality, flexibility, lead time, cost, dependability, etc.;
3. market management capability: it is a company's ability to market and sell its product effectively and efficiently.

3.2.1.3 How can the RBV contribute to IS research?

The RBV has been applied in several fields, such as strategy and marketing. What is important to understand is whether the RBV theory is also useful in the IS research. Specifically, as assessed by Wade and Hulland (2004), which made a literature review on the studies that applied the RBV theory to the IS field (see Appendix 2), this theory provides a very valuable way for IS research to think about how IS are related to the firm strategy followed and the performance levels achieved. In particular, the RBV is able to provide a cogent framework to evaluate the strategic value of IS resources in firms. However, few evidence exists in the SMEs reality.

When the RBV is applied to the IS field, it has to be taken into account that unlike some resources, such as the brand equity or the financial assets, IS resources rarely contribute directly to the sustained competitive advantage. Instead, IS resources are part of a more complex chain of assets and capabilities that may lead to sustained competitive advantage (Clemons and Row, 1991). Indeed, IS resources influence firm activities through complementary relationships with other firms resources and capabilities.

In the parlance of Wade and Hulland (2004), there are three aspects of the RBV that give rare and valuable benefits to IS researchers. First, since there is the necessity of defining a set of resource attributes, the RBV is a way through which the specification of the resource attributes can be done. Such specification offers the base on which mutually exhaustive and exclusive IS capabilities and assets are defined. Therefore, an IS resource set can be defined by using the RBV theory. Second, by employing the same set of resources attributes defined above, IS resource can be compared together and more importantly with non-IS resources. Therefore, the RBV encourages cross-functional research through comparisons with other firm resources. Third, the RBV sets out a clear link between the resources and SCA through a defined dependent variable, providing a useful way for evaluating and measuring the strategic value of IS resources. As a result, the relationship resource-performance can be evaluated.

In the following paragraphs IS research studies that refer to the main building blocks of the research framework I refer to among the entire research thesis, previously introduced in

Figure 2, will be discussed.

a. IT-based resources

In this paragraph I will start to focus on analyzing the first step of the input-output relationship analyzed: the adoption of IT-based resources in SMEs.

Looking at studies conducted by Grant (1995), he classified the key IT-based resources in three main categories: 1) IT infrastructure; 2) Human IT resources; 3) IT-enabled intangibles. Since the majority of authors refers to such chategorization, in the next paragraphs their explanation will be provided.

IT Infrastructure. Tangible resources include the physical IT infrastructure components. Indeed, the physical IT assets that are the core of a firm's overall IT infrastructure include IT, and the technical platforms and database (Ross et al., 1996).

The IT infrastructure in firms has been defined as a major business resource and a key resource for achieving and reaching long-term competitive advantage. The IT infrastructure supports a firm's competitive position by enabling initiatives such as cycle time improvements, cross-functional processes, and cross selling opportunities (Sambamurthy and Zmud, 1992). As Keen (1991, pp. 184) notes, "it is the IT platform that determines the business degrees of freedom a firm enjoys in its business plans". Accordingly, in case a firm has a non-integrated IT infrastructure, it can have restritions in the organization's business choices. However, a firm that has to create an integrated IT infrastructure needs both time and expertise. Indeed, it has to be able to integrate all activities with suppliers, customers and all actors that act in the same supply chain.

Nonetheless, some RBV theorists do not agree that physical assets can serve as a source of competitive advantage, given that IT systems can be purchased or duplicated fairly easily by competitors (Mata et al., 1995). This view, however, is reductionist since seems to vale the infrastructure solely in terms of its individual components assuming the separability of the IT assets, and ignoring the synergistic benefits of integrated systems. However, even though the technology components may be commodity-like, the architecture that removes the barriers of system

incompatibilities and makes it possible to create a corporate platform for launching business applications is not at all a commodity (Keen, 1991).

Human IT resources. The human IT resources generally comprise the training, skills, experience, relationships and insights of employees (Barney, 1991; Grant, 1991). They include two main categories (Bharadway, 2000):

- the technical IT skills, such as system analysis and design, programming, IT competences;
- the managerial IT skills, such as ability of managing effectively IS functions, ability of coordinate and interact with user community, leadership skills, planning skills and ability of managing external relationships.

Complementing such classification with the one provided by Wade and Hulland in 2004, examples of human IT resources are: 1) manage external relationships; 2) IS-business partnerships (manage internal relationships); 3) IS planning and change management; 4) technical IT skills; 5) IS development.

As pointed out by Bharadway (2000) firms that own a strong human IT resources reach positive outcome. Indeed, they are are able to:

- combine the IT and business planning process more effectively;
- conjure up and develop reliable and cost effective applications that support the business needs of the firm faster than competition;
- communicate and work with business units more efficiently;
- anticipate future business needs of the firm and innovate valuable new product characteristics before competitors;
- coordinate the several activities in the implementation of IT systems.

Both the technical and the managerial skills evolve during the time in companies and they are accumulated during the experience. Especially managerial skills, are often tacit and depend highly by other relationships that may take years to develop and that may be local or organization specific. For example, in case a large software development project has to be developed, there is the need of having interactive teams of IT staff which have to use their tacit skills in order to reach desired goals. Specifically, individuals that take are part of the team have to develop distinctive styles and coordination mechanisms which are over time learning-by-

doing. According to this, Nelson and Winter (1982) called these regular and preditable activities with the term "routine" as explain previously. There is evidence that firms able to develop and perfective sophisticated IT development routines decrease the development costs and time. In such cases, when new workers are employed in one firm, they are trained in software systems and in development methodologies unique to firms, and therefore it is expected for firms to have higher returns due to the added qualified professionals to the existing IT team.

IT-Enabled Intangibles. The RBV theory recognizes the value of intangible organizational resources in firms. Scholars have enumerated several key organizational intangibles as key drivers of superior performance such as: 1) know-how (Teece, 1998); 2) corporate culture (Barney, 1991); 3) corporate reputation (Vergin and Qoronfleh, 1998); 4) environmental orientation.

In general, firm-specific intangibles tend to be tacit, idiosyncratic, and deeply embedded in the organizations' social fabric and history. A question that is becoming very important for CIOs and other managers in the context of a firm's IT capability, is "how do investments in technology create superior intangible resources for the firm?". Accordingly, effective IT users usually tend to pay greater attention to the intangible benefits of IT, thus to the output of IT capabilities, such as the improvement of the customer service, the enhancement of the product quality, of the market responsiveness, and a better coordination of actors that operate in the same supply chain (especially buyers and suppliers), when the IT systems are evaluated (Brynjolfsson and Hitt, 1997).

b. IT-based capabilities

Following the focus given on this thesis on the concept of IT-based capabilities, literature highlights two types of meta capabilities that firms may develop from the use of IT resources: (i) "externally oriented" or (ii) "internally oriented" capabilities (Dale Stoel and Muhanna 2009). The former is based on the use of IS to support new product development (NPD) activities, supply chain management (SCM) activities, e-business initiatives and customer relationship management (CRM) processes and allows firms to respond in a timely manner to market changes and customer and supplier shifts. Thus, these capabilities reflect a firm's ability of 'doing new things'. By contrast, the latter is based on the use of IS,

such as ERP, that may assist in efficiency improvement and operations control by favouring data integration across functions and allow firms to "do better what they usually do".

From the time that firms adopt new technologies until they develop new capabilities or they enrich their pre-existing ones (Fichman, 2000), firms must go through certain assimilation stages in which the innovation must be first accepted, then adapted, and finally routinised and institutionalised within the organisation. Firms may therefore incur an "assimilation gap" (i.e. failing or delaying in assimilating information systems) when they lack technical competencies and managerial expertise on IT or when implementation of the technology requires complex organisational changes (Fichman and Kemerer, 1999).

In SMEs, two further factors may hinder or delay the assimilation of IT resources. First, the implementation of an IS may be long and expensive, as business processes are usually more idiosyncratic than they are in large enterprises. In addition, SMEs tend to underestimate the importance of their managers' involvement in defining their business requirements for the new system, relying too much on the support of external IT consultants (Thong et al., 1996). Furthermore, business process idiosyncrasies often lead SMEs to delay the adoption of IS because these firms believe that changing their business processes to fit new enterprise systems may undermine their long-established routines. Second, SMEs and their IT consultants do not usually have the managerial expertise to combine the adoption of IS with business process improvements or with re-engineering programs (Thong et al., 1996). Earlier studies (e.g., Bresnahan et al., 2002) show, however, that complementary organisational investments are fundamental for the IT pay-off to manifest and contribute in explaining the SMEs' lower returns from the IT adoption (Giuri et al., 2008). Furthermore, innovation studies (Chang and Hughes, 2011) suggest that SMEs may encounter difficulties in using IT in support of their ability of develop both internally and externally-oriented IT-based capabilities, as the limited availability of slacks make them unable to balance contradictory tensions when they try to combine continuous improvement goals for their established markets with more radical innovation endeavours (Raisch et al. 2009; Chang and Hughes, 2011).

3.2.2 The contingency perspective

The adoption, accumulation and assimilation of IT-based resources and capabilities may be influenced the environmental features where each firm operates, which are described by the literature as contingent factors. Although the extant literature has made significant strides towards explaining IT's performance implications, I believe that a deeper understanding can be achieved by linking IT's business value in SMEs to contextual aspects that are critical to strategic management: environmental; organizational; and the features related to the busienss environment.

3.2.2.1 Environmental context

Drawing on the work conducted by Aldrich (1979) and consequently by Dess and Beard (1984), three main dimensions of an environment can be define and contribute to the environmental uncertainly and as a consequent to the relationship between IS resources and performance: 1) the environmental dynamism; 2) the environmental munificence; 3) the environmental complexity.

Environmental dynamism. Environmental dynamism (turbulence) refers to the rate of instability in an industry (i.e., changes in the preferences of customers, development of new products and technology). Turbulent environments are fast changing environments where different assets and capabilities, regard to those in stable environments, need to be acquired in order to achieve superior performance (Eisenhard and Martin, 2000). In stable environments, since changes happen slowly, any advantage achieved by companies is likely to be sustained over time. Instead, in turbulent environments, many advantages may be defined as short-lived and environmental pressures may quickly undermine any resource value of heterogeneity. Therefore, in this environment, the management has to be on top of business trends in order to quickly respond to market needs.

Environmental munificence. Munificence reflects the extent to which the environment can support sustained growth (Dess and Beard, 1984). Environments that are mature or shrinking are generally characterized by low levels of munificence. By contrast, rapidly growing markets are typically associated with a high degree of munificence where firms are less likely to be financially constrained and may be more inclined to adopt technologies in the earlier stages of their diffusion curves.

In low munificent environments there is often a stiff competition that can negatively impact on the achievement of organizational goals or even on organizational survival (Toole, 1994). In these environments, companies often strive to maintain profits by maximizing internal efficiencies. Indeed, in low munificent environments that are relatively mature, firms are inclined to assume a static competitive picture and tend to focus more attention on improvements in firm efficiency.

Environmental complexity. Environmental complexity depends on the number of products offered by the firm and product technical complexity. Complexity makes difficult for firms to understand the key drivers of performance. Such ambiguity creates difficulties, for competing companies, of identifying critical resources for potential imitation, acquisition or substitution. Therefore, in high complex environments, the link between key resources and superior performance will tend to be stronger and more durable.

Essentially, three types of effects of industry and environmental fetaures on the accumulation of IT-based resources and on the consequent development of IT-based capabilities can be listed. First, within a sector, firms share the same competitive environment and thus face similar conditions with regard to competition intensity, the growth in market demand and in the availability of financial resources (munificence), the rates of change in technologies and customers' preferences (dynamism), the complexity of products and supply chain relationships. These conditions shape the requirements and financial resources available for IT use. Thus, they influence the firms' decisions regarding the purchase of IT resources and the ways firms aim to develop/enrich their capabilities from the use of these resources (Zhu et al., 2006; Stoel and Muhanna, 2010). Environmental conditions may also influence the burden of the organizational learning required to firms for the assimilation of IS in business processes and for the development of new organizational capabilities from IT resources. For example, as in complex environments firms deal with a large number of factors influencing functional strategies and operations, the implementation of a new IS may entail greater causal ambiguity and higher knowledge barriers (Fichman and Kemerer, 1999). Similarly,

turbulence may retard the routinisation of existing technologies as competitive pressures may lead firms to leap rapidly from one technology to the next (Abrahamson, 1991).

Second, within an industry, firms face the same market supply of industry-specific technologies. This fact reflects a typical feature of GPTs in general, i.e., the sector-specific nature of the application templates that shape the use of a technology within firms (Fabiani et al., 2005). Due to differences in environmental conditions and the organisational characteristics internal to firms, the supply of technologies is non-randomly distributed across sectors and has evolved to follow different development trajectories within each industry. For IT, in many countries, vendors have mainly targeted the retail, automotive, chemical and pharmaceutical sectors, in which large enterprises are prevalent and business processes can be more easily standardised. Therefore, some sectors have enjoyed a richer supply of standardised IS than others. Consequently, the costs and timing of a firm's adoption of IT may depend significantly on the industry, with some industries exhibiting more favourable conditions for IT investments and benefiting from a broader supply of specific IT products and related services.

Third, opportunities related to the adoption of IT are not exogenous to industry because firms may develop some IT-based capabilities in response to industry-specific business conditions. For example, forgery-proof RFID solutions have been implemented in the fashion, luxury goods, and pharmaceutical industries because these sectors are highly exposed to counterfeiting. Thus, industry effects on the accumulation of IT resources also arise from similarities that firms in the same industry have with regard to organisational and technological conditions, such as size, human capital, and the complexity and information intensity of products, production methods and supply chains.

3.2.2.2 Internal and business environment contexts

Although the economic and institutional forces at work in an industry may lead to within-sector homogeneity in the adoption of IT resources and in the accumulation of related capabilities, firms in the same environment may accumulate and use IT resources in specific ways depending on their heterogeneity in resources, routines, values, managerial attitudes and busienss environemt where they act. Moreover, the

role of IT in developing or enriching some firm's capabilities is influenced by path dependencies, as some technologies require the previous accumulation of other capabilities and technology resources to be fully implemented and routinised. The cumulativeness of IT adoption implies that the realised opportunities for innovation enabled by IT and the capacities for pursuing these opportunities are local and firm specific (Dosi, 1988).

Following these arguments, I have identified four types of firm-specific effects - related to organizational factors and the business environment features - that influence firm-level differences in IT use within an industry.

First, high-level meta-rules that managers tend to follow in considering IT investments may influence the selection of technologies to adopt, their timing of adoption and the way in which they are deployed in firm routines (Armstrong and Sambamurthy, 1999). Thus, IT use in business processes may be more pervasive in firms whose senior managers assign a more important role to IT in supporting operations and business-level strategies.

Second, firms are also diverse in terms of the management systems applied to investment decisions related to IT (Wade and Hulland, 2004). These systems include the governance rules on IT investment decisions and the practices used to assess the costs and benefits of IT adoption decisions a priori. Over the long term, such differences become relevant because governance systems may support firms in blocking rent dissipation, minimising agency issues and checking strategic missteps (Teece, 2007).

Third, the base of resources and capabilities already accumulated by a firm influences the marginal costs and returns of adopting an additional IT resource. Resources that are likely to affect the development of IT-based capabilities in the short term include a firm's liquidity and financial position, whereas those affecting the development of these capabilities in the long term include the available IT resources and complementary organisational components (i.e., work practices and organisational routines) that have been created over time. Returns from IT investments increase with larger previous stocks of IT resources (Knott et al., 2003) and the accumulation of other types of intangible assets, such as managerial IT expertise, qualified human capital for IT use and organisational capital. The

influence of the portfolio of precursory assets on the adoption of a given IT resource has two consequences. First, although many IT resources are readily available to firms on the open market, the need to predicate new IT purchases on existing resources explains competitors' response lag in replicating the IT resources portfolios of early adopters. Second, late adopters may not bridge the gap in capabilities separating them from early adopters by simply accelerating the pace of annual expenditures on IT. In other words, time compression diseconomies exist due to the interconnectedness of stocks of IT resources (Dierickx and Cool, 1989). For example, without information repositories, such as customer purchase records in transactional databases, firms may not experience returns from Customer Relationship Management (CRM) initiatives aimed at improving their cross-selling performance through better customer knowledge.

Fourth, organizational characteristics and business environment features that facilitate the initiation and the implementation of innovations, such as the adoption of IT-based resources and their consequent assimilation, are different. The "ambidextrous model" of innovation suggests that high structural complexity, low formalization, and low centralization facilitate the initiation of innovations but that the inverse conditions facilitate their implementation (Duncan, 1976, pp. 179). Therefore, organizations with diverse and differentiated task structures tend to initiate more innovations, instead by contrast those with formalized and centralized structures are more likely implement more innovations.

3.3 Conclusion

This chapter presented the theoretical background on which the study has been performed. Specifically, by reviewing the literature, I have figured out that an integrative model for SMEs that link IT investments to IT business value and to contextual aspects in SMEs is still lacking, and that the IT-based capabilities have been analized until now at a high level of aggregation, without looking whether SMEs are more likely to focus on doing better the same thing (development of internally-oriented IT-based capabilities) or on doing new things (development of externally-oriented IT-based capabilities). Furthermore, in case of the same internal and external conditions, SMEs could react differently regard their larger

counterparts, given their different features. Drawing on such considerations, chapter 4 contains the hypotheses that will be tested in this research study.

Chapter 4

4. HYPOTHESES FORMULATION

This chapter provides a description of the hypotheses that are tested using regression models. Specifically, they are grouped in two blocks: the first has the aim of defining the hypotheses related to the IT adoption and assimilation process; the second investigates the moderating effect of environmental conditions on the relationship between the development of IT-based capabilities and the achievement of high economic performance.

4.1 Effects on IT adoption and assimilation

4.1.1 The influence of the internal context

The adoption of IS in SMEs is fragmented and it is usually based on the operational support (Blili and Raymond, 1993). Smaller firms usually adopt IS in order to improve the production processing but without thinking of integrating the new technologies with the other processes, such as the order or the supply chain process. It is also unlikely that the IS adoption is planned strategically (Premkumar and Roberts, 1999). Indeed, in the majority of such businesses, the investments in IS, where there are, are incremental and not planned (Levy and Powell, 2000). SMEs failure in planning the introduction and the consequent assimilation of the new technologies is mostly due to management limitations. These incorporate the fact that the management has not enough time to spend in future business developments and management teams usually lack in the experience skills and interests in exploiting new IT technologies. The fact that some SMEs do not adopt IS is also due to the lack of trust or knowledge of the external IT solutions, as SMEs do not have enough in-house IS skills to understand their potentialities. Indeed, there is generally a lack of internal IS expertise in small businesses (Thong, 1996). Due to the financial constraints of SMEs, usually employees work to daily operations of the business and

not for their abilities to program the adoption of IT technologies. In addition, it is difficult to retain IS professionals in SMEs given their tight labor market and their unlikely carrier ladder in small businesses.

Nonetheless, in case the management is involved in the planning of IS investments, they can contribute more effectively to the adoption choices of IT solutions, through their involvement in both the requirements and the design phases. Therefore, it is expected that the characteristics of the internal context is likely to increase the adoption of IT solutions. Thus, it was hypothesized that:

H1. Firm internal context influences positively the earlier adoption of IS.

Based on the idea of a dual nature of IT[10], it can be expect that the development of some capabilities from IT use is not necessary grounded in a firm's organizational particular context. Based on this consideration, certain IT-based capabilities may result from the adoption of IT resources that do not require complementary investments in organizational capital or particular preconditions, such advanced management systems for planning IS adoption. This case may hold true for the capabilities related to the enhancement of the internal efficiency levels of a SME. This happens because many business processes in this area are transactional and relatively homogeneous across sectors. As a consequence, these processes can easily be codified and standardized in IS (Malone et al., 1999) and can thus be replicated across firms and industries (Davenport, 2005; Mithas and Whitaker, 2007) independently by their organizational context. To achieve this standardization, vendors have progressively transformed the IS supporting these processes into "standardized packages", thereby reducing their implementation costs (Merrifield et al., 2008; Shin, 2006). Indeed, IS strategies have undergone a profound change to minimize the custom-built system and to include advanced and standard business processes. Consequently, late adopters of technologies supporting increase in the internal efficiency of SMEs have directly adopted these standardized packages, without incurring into considerable adjustment costs in their organizational and

[10] I expect that IT may have a dual nature, including two types of technology resources. Some information systems may require limited implementation costs, and their diffusion may involve a large number of firms, as vendors have eventually transformed these technologies into "standardized packages" that adopters can use as "black-boxes" (Tornatzky and Fleischer 1990, p. 127). However, other information systems represent "complex organizational technologies" (Attewell, 1992) since - to be effectively used - they require extensive learning, the precursory adoption of interrelated technologies, and investments in human and organisational capital (Attewell, 1992).

human capital (Attewell, 1992). Thus, at present, we expect these capabilities to be largely and uniformly distributed across firms.

Following similar considerations, firms with an appropriate organisational context are more likely to accumulate types of IT-based capabilities that are related to the adoption of technologies requiring complex and path-dependent transformations. This can be the case of the changes that IT enables in four areas: the product development process, the supply chain management process, the market relationships and in case growth opportunities have to be reached. First, product development process is inherently more knowledge intensive and less transaction based than the business processes that lead to improvements of the internal efficiency (Cantamessa et al., 2012). Thus, IT-based best practices in the product development process cannot be easily subjected to standardisation and replication across firms. Moreover, firms may enrich their organisational competencies in product development only once they have used IT to develop a good knowledge of customer requirements and market trends or have established effective IT-based routines of collaboration with suppliers in product design and engineering (Malhotra et al., 2005). Second, SMEs may achieve a better use of IT in market relationships only once they have automated some back office activities, introduced data warehouse technologies for managing large amounts of data, and have multiple transactions with each customer to collect a time series of data points that is sufficiently long to infer his/her purchase patterns (Piccoli and Yves, 2005). Third, SMEs may be able to use in a better way IT in supply chain relationships only once they have automated all the approaches utilized to effectively integrate suppliers, manufacturers, warehouses and stores (Levy et al., 2000), since all parties on the chain can beneficiate of the IS adoption through co-operation and information sharing. Indeed, information sharing between members of a supply chain reduces uncertainty and improves the performance of the whole supply chain system (Srinivasan et al., 1994). Fourth, SMEs are able to enter in new markets, only once they have developed new business strategies and have employed new technologies in order to manage the relationships with the new markets and to handle the higher number of customers. Indeed, the adoption and assimilation of IT solutions reflect how the IT solutions penetrate in the way through which companies sell and in the business model followed. One way to achieve a greater number of customers is provided by adopting

e-commerce solutions, which are revolutionizing how the organizations conduct their business operations (Love et al., 2001) in order to improve their performance and gain a strategic competitive advantage.

Therefore, the ability to redesign the organisational structure is dependent on firm-specific conditions related to human capital and management capabilities. In this regard, the role of IT management capabilities may assume particular importance for the externally-oriented IT-based capabilities because executing changes in organisation design principles requires strong backing and executive support (Armstrong and Sambamurthy, 1999; Elam and Morrison, 1993). These observations lead to the following hypothesis:

H2: SMEs internal context does not affect the development of internally-oriented IT-based capabilities (H2.a), whereas affects positively the development of externally oriented IT-based capabilities (H2.b).

4.1.2 The influence of the business environment

4.1.2.1 The influence of the business environment complexity

The complexity of the business environment where firms operare - considered in terms of vertical integration, geographical scope of SMEs' operating units and foreign sales - may affect the adoption dynamics of IS in SMEs.

Research studies show that structural complexity is positively associated with innovation behaviours (Ettlie et al., 1984; Zmud, 1984) for three main reasons. First, organizations characterized by the exhistance of several subunits are characterized by the exhistance of several stakeholders and people that interact each other. In such a way they increase the knowledge base that, as a consequence, determine the rise of new ideas and the probability that such interactions lead to a greater awarness of the benefits of the IT solutions, leading to higher IT adopt rates. Second, companies that are vertically integrated may be more likely to adopt IT solution, since IT can be used to manage the flow of goods, services and information between the productive activities along each industry value chain (Clemons, 1991). In such a way, IT can reduce the basic transactions costs that are involved in the vertical flow of goods and services along the value chian. Furthermore, vertical integration can reduce the information technology gap by sharing planning and control systems (Vaaland and

Heide, 2007).Third, even though exporting could be seen as a relatively easy strategy to be implemented because a firm does not have to deal with the complexities of establishing a foreign subsidiary (Lu and Beamish, 2006), IS are necessary since they are the way through which companies can achieve a good knowledge of customer requirements and market trends, and manage the relationship with them. Therefore, such conditions may push the company to achieve higher adoption levels. Based on such motivations, the following hypothesis has been formulated:

H3: The complexity of the business environment influences positively an earlier adoption of IS.

Even though the structural complexity of the environment where a firm operates may stimulate an earlier initiation and adoption of IS, it could have a different impact on their assimilation. The structural complexity may exercise a resistance in assimilating the adopted IS due to greater causal ambiguity and higher 'compromise costs' that can occur in IS implementation. For example, compromise costs arise from the low flexibility of IS in responding to the unique requirements of the specialized sub-units that SMEs must create for managing each product or market line in case of high complexity (Gattiker and Goodhue, 2004). Indeed, in case IS are implemented across differentiated sub-units, there would be lack of flexibility to respond to every unique need of individual sub-units. Therefore, each sub-unit could sustain additional costs including decreased operational performance or decreased data significance. This could happen because one or more sub-units' could start to use an IS that is not well-tailored to the specificities of the tasks that the sub-unit must carry out. Furthermore, potential conflict and diversity arise from business complexity may lead to resistance in accepting the innovation, moderating the impact on the assimilation process. These observations lead to the following hypothesis:

H4: The business environment complexity negatively influence the IT assimilation.

4.1.2.2 The role of customer dependence

Small businesses are under increasing pressure to employ IS for maintaining their competitive positions or simply to survive. At the same time, however, there are more barriers to IS implementation in small businesses than in large businesses due to the high capital investment and skilled manpower involved in implementing and

operating IS. One of the factors that may pressure SMEs to assimilate IT solutions are the customers. They may exercise a high pressure over SMEs since they usually are a limited number, and thus may have a prominent role IT technologies choices (Premkumar and Roberts, 1999). Indeed, customers usually place substantial emphasis on the need of quality processes and products, and on order processing that has to be done automatically. As a consequence, firm's dependence on few strategic customers, and thus the pressure that customers exercise on SMEs decisions, can influence the development of IT-based capabilities. Indeed, when SMEs revenues are dependent on few "strategic" customers, they are more likely to be stuck in one market segment or to be more specialized in a certain stage of an industry value chain, leading to a more focalized use of IT is support of their business processes. In such conditions, higher customer dependence may be beneficial for the organizational learning of small partners regarding the innovation routinization. Furthermore, also in case of a large amount of customers, SMEs should necessitate to assimilate IT technologies, such as data warehouse technologies, which are fundamental for managing the large amounts of data about customers' preferences and behaviours (Piccoli and Yves, 2005). As a result, we expect the following relationship.

H5: The relationship between the strategic dependence on few customers and the development of IT-based capabilities is curvilinear (U-shaped), with the lower level at intermediate strategic customer dependence.

4.1.2.3 The role of IS vendors

While the resource-based theory emphasizes the importance of internal resources in a firm, external resources are also important in the context of small businesses. Indeed, in such businesses, IS vendors have an important role since they lower the knowledge barriers and make it easier for small businesses to implement IS successfully. Therefore, small businesses should need to engage consultants and IS vendors to develop and support there IS. As stated by Thong (2001, pp. 154): "due to the lack of internal IS expertise, small businesses need to engage experienced consultants and IT vendors to undertake their information systems implementation". Under such circumstances, it is imperative to connect with external IS experts who are experienced and understand the requirements of small businesses.

The responsibilities of a vendor generally include providing the computer hardware, software packages, technical support, and training of users. It is also important to maintain a good working relationship among the various parties (i.e. the CEO, users, consultant, and vendor) in the IS implementation. Therefore, in IS implementation of the small businesses, the vendor may also play the role of a consultant, and thus performs additional duties besides the usual responsibilities (Thong, 1996). In view of the possibility of the consultant being the vendor, the responsibilities of the external experts can be seen as a combination of the duties of the consultant and the vendor.

IS vendors usually try to structure the IS according to the best practices of the sector where the company operates. In many cases, IS will enable the company to operate in a more efficient way than it did before. However, in some cases the system's assumptions about the way companies operate in general will run counter to a company's best interests (Davenport, 1998). Therefore, IS vendors should try to fit the need of companies in IT implementations, through an enhancement of the degree of IS customization/personalization, because it can be a source of competitive advantage for SMEs. Some degree of IS customization is possible due to their modularizability. Because IS are modular, companies can install only those modules that are most appropriate to their business, and they also can use the configuration tables to achieve the best possible fit with company's processes and business choices. Therefore, through the IS customization, companies can try to lower the rigidity and the less flexibility that an IS introduce, for example, in the management of customers' orders. Motivated by these issues, the following hypothesis has been formulated:

H6. The degree of customization of IS (H6.a) and the support of IS vendors (H6.b) positively affect the development of IT-based capabilities.

4.1.3 The influence of environmental conditions

4.1.3.1 Impacts on the adoption of IS

Drawing on the strategic management literature, features of the environment where companies act impact on their ability to adopt and accumulate IT resources more quickly than others. When considering environment influence, studies on IT

diffusion have concentrated mainly on competition intensity (e.g., Mithas and Tafti 2009), regulatory support (Zhu et al. 2006), environmental dynamism (turbulence), complexity and munificence. The latter three synthesise several environmental characteristics (Dess and Beard, 1984). For example, environmental hostility is high when dynamism and complexity occur together with low munificence (Covin and Slevin, 1989). Similarly, environmental uncertainty refers to a high degree of complexity and dynamism (Lawrence and Lorsch, 1967).

In this thesis, the influence of the dynamism, complexity and munificence on the adoption and assimilation behaviours of SMEs have been considered. Specifically, environmental dynamism (turbulence) refers to the rate of instability in an industry (i.e., changes in the preferences of customers, development of new products and technology). Environmental complexity refers to the heterogeneity of the technology base incorporated in the product/service, the degree of the information intensity of production or service delivery methods, the geographical extension, the coordination with the upstream suppliers and downstream buyers, and the degrees of related and unrelated market diversification. Munificence reflects the extent to which the environment can support sustained growth. In munificent industries, firms are less likely to be financially constrained and may be more inclined to adopt technologies in the earlier stages of their diffusion curves.

With regard to munificence, a firm may find the required resources for their strategic factor markets more easily in a period of high industry growth (Sirmon et al., 2007). When environmental munificence is high, firms can more easily find IT vendors providing "vertical" industry IT solutions. Furthermore, under these conditions, firms have greater cash flow and a higher need for IS to augment managerial control and improve external orientation to sustain phases of business growth (Lybaert, 1998). Indeed, in munificent industries, firms are less likely to be financially constrained and may be more inclined to adopt technologies in the earlier stages of their diffusion curves. Consequently, firms dealing with munificence are more likely to have completed the assimilation process of a given technology earlier than other firms. Furthermore, munificence can affect IT investments positively, as standardised and integrated IT platforms can allow firms to scale up their operations. IS can indeed enable more internal transparency and better coordination practices in

the stage of business growth in small firms (Street and Meister 2004), allowing managers greater control and a better use of external information (Lybaert 1998). Furthermore, as munificent environments tend to be less hostile, SMEs may be less inclined to implement wait-and-see approaches when engaging in IT projects that generate sunk costs (Christensen and Bower, 1996).

Looking at the influence that the dynamism may exercise on the adoption behaviours of SMEs, in more turbulent industries, SMEs, because of their lower availability of slack resources, could be less eager to commit their financial resources to IT investments (Chau and Tam, 1996) and could prefer to reduce the need for information processing in various ways (Galbraith, 1974), such as by creating self-contained tasks or by focusing on a less turbulent stage of their industry's supply chain. Indeed, under high levels of dynamism SMEs are more parsimonious in the use of IT. This may happen because the more SMEs achieve business processes integration through standardized IS, the harder it is for them to reconfigure themselves around new "organisational architectures" to respond to environmental rapid changes. Due to the high costs that are needed to change business processes once they have been formalized through the implementation of IS, SMEs may be discouraged by adopting these IT resources in turbulent environments. Specifically, unstable environments may hinder the use of IT to improve a firm's capabilities because most of the IS packages are rigid in supporting business practices. As a result, even marginal adaptation of IS to changing operating conditions requires a large amount of time and money (Merrifield et al., 2008).

Finally, it is expected to have a greater need for IT resources also in complex environments since they are difficult to monitor and understand (Thompson, 1967), and IT can be a way through which manage these greater information processing requirements. Based on such considerations the following hypothesis has been formulated:

H7. The higher the environmental munificence (H7.a), the lower the environmental dynamism (H7.b) and the higher the environmental complexity (H7.c), the earlier is the adoption of IT resources in SMEs.

4.1.3.2 Impacts on the IT-based capabilities development

Based on the idea of a dual nature of IT, we expect that the development of some capabilities from IT use is not necessarily related to the environmental features where companies act. This case may hold true for IT-based capabilities that are internally-focused (related to efficiency improvements of internal activities), because many business processes in this area are transactional and relatively homogeneous across sectors. As such, these processes can easily be codified and standardised in IS (Malone et al., 1999) and can thus be replicated across firms and industries (Davenport, 2005; Mithas and Whitaker, 2007). Consequently, late adopters of technologies supporting efficiency improvements of internal activities have directly adopted these standardized packages, without considering any particular environmental condition. Thus, at present, it is expected that internally-focused IT-based capabilities are largely and uniformly distributed across firms and industry types. Thus, the following hypothesis has been formulated:

H8. Environmental conditions do not affect the extent to which firms develop internally-oriented IT-based capabilities.

However, based on the arguments related to the impact of the internal context on the development of IT-based capabilities, it is plausible to expect environmental-specific effects in the types of capabilities developed from IT use, even when controlling for firm effects. This influence may result from the fact that opportunities for innovation enabled by IS (and consequently the usage of these technologies in organisational routines) are endogenous to industry. Specifically, we may expect that the influence of the environment on the development of IT-based capabilities may be particularly salient in the operational domains where business processes, routines, and work practices exhibit more industry-specific conditions, such as in marketing, supply chain relationships, business growth opportunities and product development processes. Environmental conditions may also play an important role in influencing a firm's ability to use IS to redesign its structure around new organising principles, as sectors differ in terms of human capital and labour market flexibility. Specifically, the environmental influence on the development of IT-based externally-oriented capabilities will be following show.

Looking at the effects of environmental dynamism on the development of IT-based capabilities, its influence may vary in strength across assimilation stages of an innovation. Indeed, dynamism is likely a positive factor for initiation and adoption, but may retard the routinization of the technology and favour a longer assimilation gap. According to the institutional view, this effect may be due to the fact that in more dynamic industries firms would be driven by "bandwagon" phenomena - pressures to adopt an innovation that increase according to the number of other organizations that have already adopted it (e.g. Katz and Shapiro, 1985) - in adopting new technologies and will thus leap rapidly from one technology to the next.

Consequently, firms are less likely to undergo a gradual learning-by-doing process to develop skills for routinizing existing technologies (Zhu et al., 2006). In SMEs, IS may be particularly prone to this pattern because of these firms' lower absorptive capacities in routinizing such technologies. Ironically, smaller firms might be spared by some of these negative consequences because they are more conservative about management fashions (Abrahmson, 1991), have less resources to invest in innovations and the social networks with whom their managers have ties are usually small (Powell and Di Maggio, 1983). However, smaller businesses may suffer more from their inability to adapt their IS efficiently and effectively to changing requirements in a turbulent environment. Specifically, unstable environments may hinder the use of IT to improve a firm's capabilities because most of the IS packages are rigid and not malleable in supporting business practices (Raymond et al., 2009). As a result, even marginal adaptation of IS to change operating conditions requires a large amount of time and money (Merrifield et al., 2008). This lack of flexibility may be particularly critical for small firms also due to constraints on the endowment of IT technical expertise and the financial resources available for the evolutionary maintenance of their IS. Furthermore, under high dynamism companies with smaller size may more easily be flexible by using heuristics in strategic decisions than by using IS (Eisenhard et al., 2010). Moreover, responding to rapid changes in the environment and in technology may require managerial competences, which are usually underdeveloped in companies of smaller size (Levy and Powell, 1997). Thus, it is expected that:

H9. In dynamic industries, the higher the size of the firm is, the more developed its externally-oriented IT-based capabilities will be.

For studies following contingency theory (e.g. Stoel and Muhanna 2009) in low-munificence industries, the stronger competition in prices may induce firms to use IT to improve their internal efficiency, whereas in high-munificence industries, firms may be more inclined to improve their external orientation through IT (e.g., improve product development capabilities or the economies of scope in distribution). Munificent industries indeed offer SMEs the opportunity to enter and penetrate various market segments and this tends to enhance their demand for IS that can support increased collaboration with partners and product innovation capabilities, besides efficiency improvements (Storey, 1994; Levy et al., 2002).

Furthermore, some of the IS that support external orientation - CRM systems in particular - usually entail more rapid organisational learning cycles for SMEs than implementation projects for more complex systems such as ERP technologies. Moreover, SMEs may exploit these opportunities through IT by utilizing e-commerce initiatives or improving their product development processes and market capabilities (i.e., better knowledge about customer purchasing patterns, better cross-selling capabilities, greater control and better support on/to the sales/distribution network). This approach is evident in the fashion industry where a specific colour or style of clothing may become the top seller, and suppliers need to sense when this specific item is desirable. Thus, the value adding potential of superior externally focused IT capability is likely to be more pronounced in highly munificent environments. Thus:

H10. Environmental munificence positively affects the development of externally-oriented IT-based capabilities.

In evaluating the impact of the complexity on the development of IT-based capabilities, for providing a more comprehensive evidence, the jointly effect of the product complexity and of the structural complexity, in terms of vertical integration levels, has been considered. In case of complex products, IT favours reductions in coordination and market transaction costs in product development and sales processes (Malone et al., 1987). Indeed, firms facing a complex environment perceive greater uncertainty and have more information processing requirements than

those in a simpler environment. This assertion is consistent with the information processing view of the firm (Galbraith, 1974) which supports the theory that decision makers that face with task uncertainty need to process more information in order to achieve higher performance level. Given such consideration, the externally-oriented IT-based capabilities are more likely to be important in highly complex environments, since IT is a way though which increasing the overall information processing capacity of the firm, enabling firms to collect, process, and assimilate complex external information, and to provide an effective response in a timely manner (Stoel and Muhanna, 2009). Based on these observations, it is expected that:

H11. SMEs that exhibit high levels of product complexity and vertical integration are more likely to develop externally-oriented IT-based capabilities.

4.2 Environment effects on the relationship between the development of IT-based capabilities and firm economic performance

4.2.1 The contingency perspective

Following the discussion above, the focus on IT-based capabilities may allow to investigate the competitive value of IS more in-depth. In this perspective, the RBV (Barney, 1991) and the contingency approaches to organization design and management of IS (e.g. Lawrence and Lorsch, 1967; Raymond, 1990) provide appropriate arguments to understand how IT may impact a firm's performance.

Dynamism and munificence are the two contingency factors considered in evaluating the competitive value of the capabilities that SMEs develop. For example, IT-based capabilities affecting a firm's external orientation towards its customers and suppliers may be more valuable in more dynamic industries, as environments where new threats can appear suddenly and opportunities may be short-lived require firms the ability to recognize these changes and respond quickly. In a similar way, in high-munificent industries growth in the demand and the existence of greater market opportunities make firms with greater product development capabilities, superior market knowledge and entrepreneurial capacities more likely to improve their performance. Conversely, "internally-oriented" IT-based capabilities might have a more critical importance on a firm's competitiveness in more mature (less

munificent) and stable environments, being such markets less forgiving on operational inefficiency. As such, we could expect what follows.

H12. The lower the environmental dynamism (H12.a) and the enviornmental munificence (H12.b), the higher is the impact of internally-oriented capabilities on firm economic performance.

H13. The higher the environmental munificence, the higher is the impact of externally-oriented IT-based capabilities on firm economic performance.

4.2.2 The strategic perspective

Voluntarily in the previous section an hypothesis on the moderating impact of the dynamism on the relationship between the externally-oriented IT-based capabiliteis development and firm economic performance has not been formulated, since the contingency theory does not take into adequate account that - in the light of a broad diffusion of IT due to commoditization trends in IS - on the long run some of the capabilities that firms develop from IT investments might not allow firms to sustain superior profitability respect to competitors. This may especially occur when capabilities are the results of "frugal" innovations that reflect the industry norm for IT investments and when they are based on the adoption of "off-the-shelf" technologies. Thus, as the RBV suggests, the returns from IT investments are more likely to be lower in industries exhibiting high market turbulence and competition among enterprises, as these environments are more likely to exhibit rapid responses from competitors to a firm introducing a new technology (Piccoli and Yves, 2005). Where these conditions occur, firms may not appropriate returns from their IT-based capabilities, as the productivity growth enabled by IT-based innovation is transferred to greater consumer surplus and not to higher firms' profitability (Hitt and Brynjolfsson, 1996). Indeed, the presence of low barriers for followers to imitate early adopters' successful IT initiatives favours more aggressive price competition, in industries with a stagnating demand in particular. Furthermore, in industries with high dynamism, isolating mechanisms and barriers to imitate IT resources may be weak also because these industry have historically attracted a great number of vendors offering industry-specific IT solutions (Neirotti and Paolucci, 2011). This fact may have favoured a greater number of firms to adopt IT assets in the earlier stage of their diffusion curve, thus at a higher cost (and at a lower "appropriability

rate") respect to firms in other industries. Based on these arguments, we expect what follows.

H14. The higher the dynamism and IT adoption rates within an industry, the lower is the impact of a firm's IT-based capabilities on its profitability differentials respect to competitors.

The 14 hypotheses formulated have been tested in the three of the papers published during my PhD studies. They are following listed:

- **Paper A**: Neirotti, P. and Raguseo, E. (2012). Mapping the Accumulation Dynamics of IT Resources and Capabilities in SMEs: the Role of Organizational configurations and Environmental Factors. 13th International CINet Conference, Continuous Innovation Across Boundaries, 16-18 September 2012 - Rome, Italy, ISBN 978-90-77360-15-6.
- **Paper B**: Neirotti, P. and Raguseo, E. (2012). Profiting from IT investments in Small and Medium Enterprises: How does the Industry Environment Influence the Returns of IT-based Capabilities? Information Systems, Technology and Management, Communications in Computer and Information Science. 285(1), pp. 89-100, ISBN: 9783642291654, ISSN: 18650929, Springer, DOI: 10.1007/978-3-642-29166-1-8[11].
- **Paper C**: Neirotti, P., Paolucci, E. and Raguseo, E. (2013). Is it all about size? Comparing organizational and environmental antecedents of IT assimilation in small and medium sized enterprises. International Journal of Technology Management, 61(1), ISSN 0267-5730[12].

Specifically, Appendix 1contains the list of hypothesis formulated, the paper in which they have been tested and the stage of the input-output relationship (shown in the conceptual model) to which they refer to.

To better clarify the relationships investigated in this thesis, the hypotheses are incorporated in the arrows of the conceptual framework (Figure 10).

[11] It can be downloaded from the link: http://link.springer.com/chapter/10.1007/978-3-642-29166-1_8.
[12] It can be downloaded from the link: http://www.inderscience.com/info/inarticle.php?artid=50245.

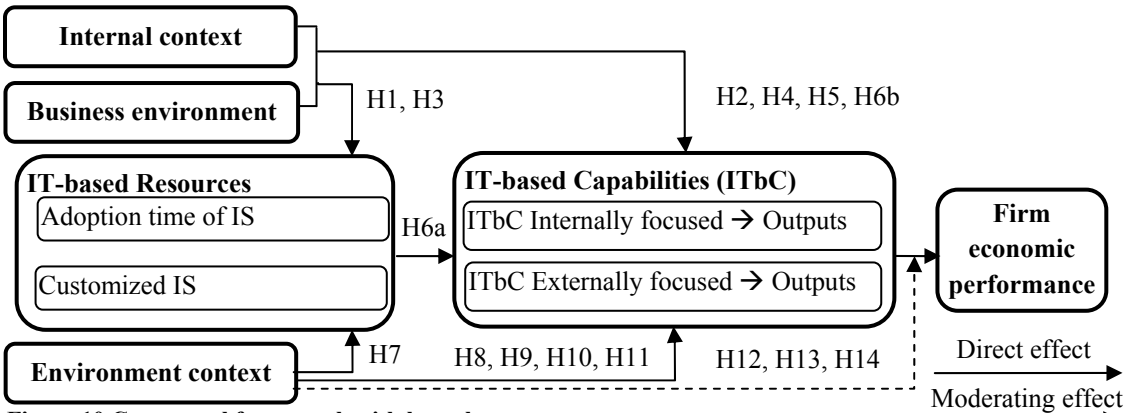


Figure 10 Conceptual framework with hypotheses

Chapter 5

5. RESEARCH METHODOLOGY

This chapter contains indications about the research methodology followed. First of all, the macro activities conducted have been shown. Then, the two data sources used are listed and the sample design and survey design have been discussed. Finally, the operationalization of the variables that are included in the models are shown.

The research methodology followed to conduct this study, can be summarized in four main macro activities (Figure 11).

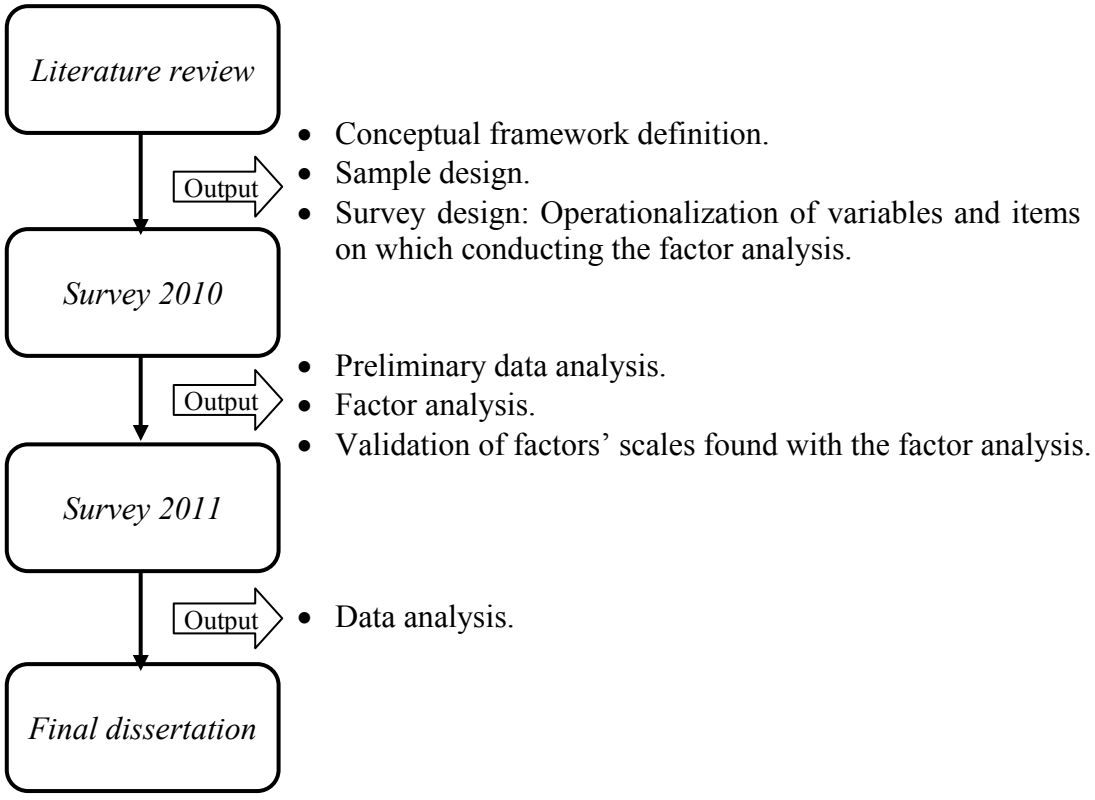


Figure 11 Macro activities that constitute the research methodology

The first macro activity regards the conduction of the literature review in order to define the research gaps which have been previously shown, and to determine the survey design. Specifically, the questions to be included in the survey have been formulated according to the constructs present in the literature. However, since I have operationalize the IT-based capabilities at a low level of aggregation, I introduced in the questionnaire also the items on which conduct the factor analysis.

The second macro activity consists in delivery the first survey in 2010 in order to conduct a preliminary data analysis on data gathered and to conduct an explorative factor analysis and a confirmatory factor analysis, for finding factors that represent the IT-based capabilities developed by SMEs.

The third macro activity is related to the delivery of the second questionnaire in 2011, whose aim is to collect data on which the analyses have been conducted and to validate the factors previously found. Finally, I started to write this research thesis.

In the following paragraph, a more detailed description of the methodology followed, with the data sources used, the reference population, the operationalization of the variables, and the results of the factor analysis will be provided.

5.1 Data sources used

In this research study, two main data sources have been used to assemble the data set:

1. data of the ICT Observatory of the Piedmont region;
2. the Bureau Van Dijk's AIDA database.

I was directely involved in the sample design, survey design and data gathering process of the ICT Observatory of the Piedmont region, a regional observatory born in 2005 whose aim is to understand the adoption and usage of the IT in firms, public administrations, schools and citizens[13]. The ICT Observatory of the Piedmont region conducts every year (from the 2005) a survey analysis among a sample of companies located in Piedmont. Specifically, data gathered in two years, 2010 and 2011, are used in this thesis for constructing the models on which hypotheses have been tested. The second data source used, the Bureau Van Dijk's AIDA database, is the main repertoire of annual financial information about Italian firms that covers all the population of small, medium-sized and large enterprises in Italy.

Specifically, the first data source was used for operationalizing all the variables contained in the models that I will following show, except the environmental variables, the industry variable and the firm economic performance thet were computing by using data of the Bureau Van Dijk's AIDA database.

[13] For further information visit the web-site http://www.osservatorioIT.piemonte.it/it/.

5.2 Sample design

The sample design phase was organized in two main steps: i) the population charateristics definition in terms of company size, industry, country, region; ii) the definition of the sample type (probability versus non-probability sample).

5.2.1 Population characteristics

According to the population characteristics definition, given the thesis goals previously defined, it was decided to take the population of SMEs located in Piedmong region and that belong to the five industries: Traditional Manufacturing, Medium-Tech, High-Tech, Material Services and Information Services. This taxonomy of sectors is based on the information intensity of production processes (e.g., Porat and Rubin, 1978) and the intensity of product and process innovation (e.g., Pavitt, 1984; Miozzo and Soete, 2001) capture inter-sectoral differences in firms' IT requirements and in the environmental forces that are likely to affect IT adoption.

To guarantee a homogeneous sample of IT requirements, I did not survey industries that are known to use IT in highly specific ways, such as multimedia, software, IT services and financial services. Other excluded industries were agriculture, mining and construction, whose potential use in core operations is inherently limited by the characteristics of the business.

Specifically, the population was extracted by the Bureau Van Dijk's AIDA database and was composed by around 5,000 SMEs in 2010 and 2011.

5.2.2 Definition of the sample type

After having defined the population features, the sample extraction has been conducted. In order to define the sampling design type, I followed the scheme shown in Figure 12.

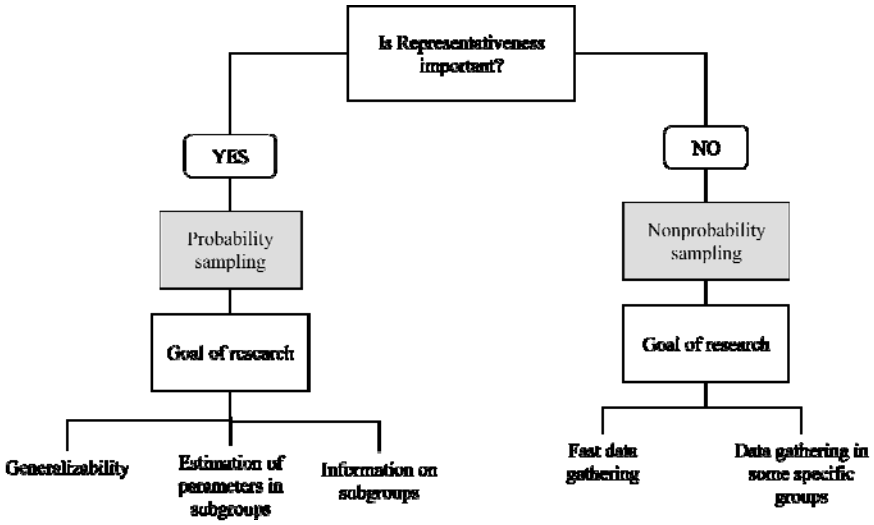


Figure 12 Probability versus non-probability sampling design

Since the representativeness of the sample was important, a probability sampling method have been chosen. However, I had to define the type of probability sample method to be applied to data, choosing between the following:

1. simple random sampling: it consists in the generation of random numbers;
2. systematic sampling: it consistes in the generation of first random number to select first unit in the list, then selection of n/m units (n = sample size; m = population size);
3. stratified sampling: it is a random sampling in each sub-category of the population (or sample frame) according to the needed proportion;
4. differential probability sampling: it samples having different percentages of subcategories compared to the population, (e.g. similar number of companies in each industry, even if not aligned to the actual proportion of companies per industry).

I decided to follow a stratified sampling method, since I had to randomly sampling in each industry of the population according to the needed proportion (number of companies that belong to one industry sector regard the overall population). Therefore, in order to finally have a representatite sample, considering an attended response rate of about the 20%, approximately 2,000 SMEs in 2010 and 2,000 SMEs in 2011 from the population were randomly selected.

5.3 Survey design

As mentioned above, two surveys were delivered: one in 2010 and one 2011. Specifically, the aim of both the surveys was to investigate factors that influence the adoption and usage levels of IT in companies, by not only looking at how they are adopted, accumulated and assimilated by companies (main topic of this research thesis), but also by looking at how IT investments impact on the organizational practices followed by companies (additional topic investigated during my PHD studies). For example, the IT impact on the work transformation was analyzed by looking at which type of teleworking forms are more diffused in companies and which factors mainly influnce such adoption behaviors[14].

Looking at the structure of each survey, it is composed by 8 sections. The first section was introduced in order to clarify the company profile, gathering general information such as the number of employees, the year of foundation and the percentage of export (Table 6). The second section contained information about the internal organization of the company. It was asking whether in the company there is a CIO and which activities with customers and suppliers are conducted thanks to the use of IS. Through the third section, it was possible to gather data about the adoption trends of IS in SMEs and about the level of personalization of the IS adopted. Furthermore, it was asked when each company introduced each IS (ERP, CRM, SCM, PDM) and whether each company adopted such IS in a software "as a service" modality. The fourth section had the aim of gathering data about how employees use the IT and whether teleworking forms are diffused among the companies surveyed. The fifth section had the aim of analyze the delivery of online service while the sixth the usage of online services. Then, the seventh section allowed to understand how IT solutions are employed by firms in order to achieve energy savings. Finally, the last section contained all the question related to the impacts that IT investments have on

[14] For more details look at my following publications: 1) Neirotti, P. Paolucci, E. and Raguseo, E. (2013). Mapping the Antecedents of Telework Diffusion: firm-level evidence from Italy, New Technology, Work and Employment. Forthcoming in 2013; 2) Neirotti, P. Paolucci, E. and Raguseo, E. (2012). Telework configurations and labor productivity: some stylized facts, International Journal of Engineering Business Management, vol. 4, Special Issue Digital and Mobile Economy; 3) Neirotti P., Paolucci E. and Raguseo E. (2011). The future of work: trends of telework in Italian SMEs between 2005 and 2009, Information Systems: Crossroads for Organization, Management, Accounting and Engineering, De Marco M., Te'eni D., Albano V., Za S., Springer, pp. 16-24, ISBN: 97837908278802011.

the business activities conducted by firms and that were used for operationalizing the IT-based capabilities variables. The questionnaire is shown in Appendix 1.

Section number	Section name
1	Company profile
2	Internal organization of the company
3	IT adoption
4	Usage of IT by employees
5	Delivery of online services
6	Usage of online services
7	IT and energy savings
8	IT investments

Table 6 Survey sections

5.4 Data collection

As mentioned above, data collection was organized in four steps. First, approximately 2,000 companies in 2010 and in 2011 from the population were randomly selected, contacted by phone and informed of the research existance. In this stage, appropriate key respondents were identified for each company by asking for those appointed to manage IS (a Chief Information Officer, CIO, or the equivalent). In case of firms where there was no formally appointed role for IS management, we asked for the CEO. Second, after this phase, in 2010 and 2011, 320 and 385 companies were respecitively dropped from the contact list because their respondents considered themselves to be "not well-informed" about the use of IS in their company. Third, a questionnaire was then delivered to the companies in the sample. To prevent respondents from reporting personal perspectives on the issues covered by the survey, it was required them to express positions regarding the business impact of IS, which were shared by the CEO and those in other managerial roles. A total of 443 and 414 questionnaires respecitvely in 2010 and 2011 were returned (corresponding to a 20% response rate) but only 415 and 373 questionnaires gathered respectively in 2010 and in 2011 were usable for the purpose of this research (see Table 7 and Table 8). As said before, data gathered in 2010 were used in order to conduct the explorative factor analyses. These had the aim of defining latent factors on which making confirmatory factor analyses in 2011 for validating the factors found in 2010. Fourth, response bias were tested. Specifically, non-response bias was found on the basis of size, industry type, profitability, fixed assets and value added per employee. Indeed, none of these comparisons revealed any sample bias.

Industry type		Size [no. of employees] Small 1- 49	Medium 50-249	Total
Traditional manufacturing	Sample	22.65%	13.49%	36.14%
	Population	29.52%	8.33%	37.86%
Medium Tech manufacturing	Sample	5.06%	6.27%	11.33%
	Population	11.95%	4.71%	16.67%
Material services	Sample	26.99%	7.95%	34.94%
	Population	25.12%	4.90%	30.02%
High-tech manufacturing	Sample	1.45%	1.20%	2.65%
	Population	2.39%	0.69%	3.08%
Information services	Sample	11.08%	5.30%	16.39%
	Population	9.82%	2.55%	12.37%
Total	Sample	65.78%	34.22%	100.00%
	Population	78.81%	21.19%	100.00%

Table 7 Sample composition - year 2010 (percentage of firms)

Industry type		Size [no. of employees] Small 1- 49	Medium 50-249	Total
Traditional manufacturing	Sample	18.50%	13.40%	31.90%
	Population	27.79%	8.70%	36.49%
Medium Tech manufacturing	Sample	6.97%	5.63%	12.60%
	Population	12.14%	4.83%	16.97%
Material services	Sample	25.74%	8.31%	34.05%
	Population	23.11%	4.52%	27.63%
High-tech manufacturing	Sample	1.61%	0.27%	1.88%
	Population	1.72%	0.53%	2.25%
Information services	Sample	15.55%	4.02%	19.57%
	Population	13.36%	3.30%	16.66%
Total	Sample	68.36%	31.64%	100.00%
	Population	78.12%	21.88%	100.00%

Table 8 Sample composition - year 2011 (percentage of firms)

5.5 Measures and Operationalization

In this section the variables operationalization is shown. Specifically, Figure 13 shows the conceptual framework enriched with the list of variables that have been considered in each context.

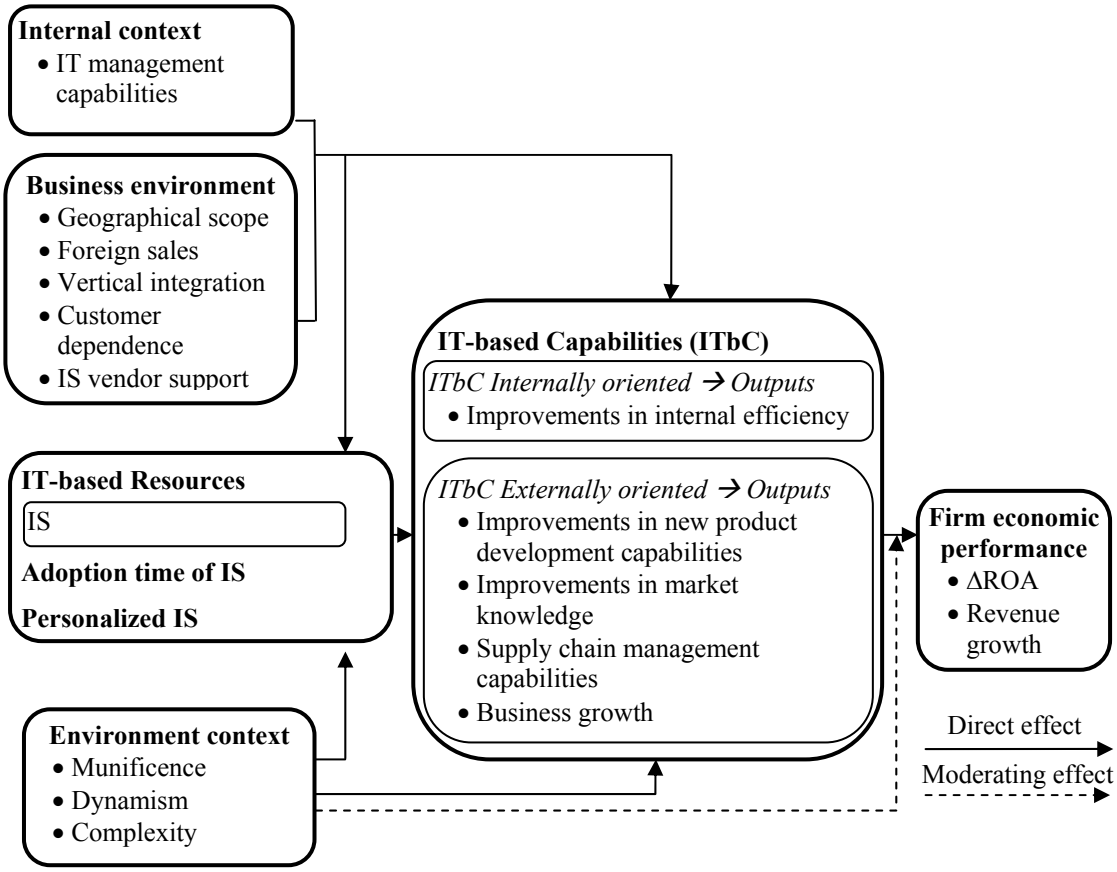


Figure 13 Conceptual framework enriched with the variables considered in each context

5.5.1 IT-based resources

5.5.1.1 Adoption time of IS

To operationalize the timing of adoption of each IS, respondents were required to indicate the year when each IS considered (ERP, CRM, SCM and PDM) was introduced. Then I selected the maximum value, since I wanted to identify the adoption timing of the first IS adopted in each firm. Finally, I computed the logarithmic value. The choice of such IS is a consequence of their broad overall functional coverage, as these technologies cover the main core and support activities of the value chain. ERP systems are typically used for production and inventory management and for administrative activities such as human resource management, financial and management accounting. CRM systems support the entire sales cycles from lead management to after-sales service. SCM technologies support the supply chain activities. PDM supports product development process and the creation and use of intellectual capital in this process (requirements, drawings, technical manuals, etc.).

5.5.1.2 Customized IS

The customized information systems used was operationalized by a dummy variable: if the company owns enterprise information systems developed according to their requirements or standard packages integrated with single modules internally developed, the variable is set to 1, otherwise it is 0.

5.5.2 IT-based capabilities

Following the definition of IT-based capabilities output previously defined, this construct was operationalised by using a five-point Likert scale with responses ranging from "strongly disagree" (-2) to "strongly agree" (+2), respondents had to evaluate whether IT led to a significant impact on a series of items related to the achievement of firm's IT-capabilities outputs (Table 9). To help respondents report objective evaluations, I asked them to base their assessments on impacts observed over the previous 4 years (between 2006 and 2009 for the survey delivered in 2010, and between 2007 and 2010 for the survey delivered in 2011). I have operationalized the IT-based capabilities development by looking at the outputs of such capabilities, since it was difficult to measure directly the existance of this type of capabilities in firms and therefore their outputs have been chosen as the way through which their development can be observed and modeled. Indeed, as explained by Dutta et al. (2005), the IT-based capabilities can be seen as an intermediate step between resources (inputs) and objectives (outputs) and can be measured only by inferring a firm's ability in converting IT resources into outputs, and therefore by observing their outputs, as I do in such research work. Specifically, when I mention the development of IT-based capabilities in this thesis, I mean the achievements of particular outputs accomplished thanks to the development of the IT-based capabilities that are difficult to be directly observed.

Item number	Item description
I1	Growth in the market share
I2	Entry in new market segments
I3	Market expansion/entry abroad
I4	Increased efficiency of administrative activities
I5	Reduction in the ratio costs of goods/services sold over sales revenues
I6	Growth in the number of new product/services developed
I7	A more timely and thorough management accounting system
I8	An improvement in inventory control
I9	A reduction in the order cycle time
I10	Improved quality controls on products/services
I11	Reduction in the failure risks of new products

I12	Reduction in time-to-market for new products
I13	Improved data management in the product development process
I14	Increased knowledge on customer needs and purchasing habits
I15	Increased control on sales, included sales agents
I16	Better support to sales employees
I17	Improved after-sales services
I18	Increased collaboration with suppliers involved in product design and engineering
I19	Increased efficiency in the purchasing activities
I20	Increased quality and/or raw material costs and/or components externally bought
I21	Identification of reliable or convenient suppliers

Table 9 Items that reflect firms' IT-based capabilities outputs (Data source: Surveys 2010 and 2011)

In order to define the items that will constitute factors that rapresent the IT-based capabilities, I considered several reserch studies that discuss the output of IT-based capabilities (Sohal et al., 2001; Nambisan, 2003; Pavlou and El Sawy, 2006; Ross, 1999; Sambamurthy et al., 2003; Lancioni et al., 2000; Keh et al., 2007; Shaw et al., 2001). However, given that none of the previous study provided a low level representation of these outputs and did not operazionalized the IT-based capabilities, as I refer to, as factors, I conducted first of all an Explorative Factor Analysis (EFA) and then a Confirmatory Factor Analysis (CFA) on data gathered with the survey conducted in 2010, and then I made again a CFA on data gathered with the survey conducted in 2011, in order to confirm factors found with data of the 2010.

The EFA with data gathered in 2010 was conducted in three steps. First of all, I checked for the factorability of the correlation matrix (i.e., how suitable is data for the factor analysis) by making the following computations:

1. I checked the values of the anti-image matrix on the main diagonal. These values have to be higher than the 0.5 thresholds. As can be seen in Table 10, all values are higher than 0.8 and therefore all variables have an acceptable anti-image value.
2. I checked for the measure of sampling adequacy (MSAs): the Bartlett's sphericity test (where null hypothesis is that no correlation is significantly > 0) is supported and the Kaiser-Mayer Olkin (KMO), whose value has to be more than 0.5, is also supported given that the value is equal to 0.907. Therefore, also these measures indicate that the factorability is possible with gathered data.

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I15	I16	I17	I18
I1	**.84**[a]																
I2	-.62	**.83**[a]															
I3	.01	-.43	**.91**[a]														
I4	-.07	-.05	-.15	**.84**[a]													
I5	.06	-.07	.00	-.49	**.84**[a]												
I6	-.03	-.12	.03	.15	-.34	**.92**[a]											
I7	-.18	.14	.07	-.10	-.31	-.04	**.90**[a]										
I8	.06	.06	-.08	-.10	.04	.05	-.42	**.90**[a]									
I9	.01	.06	-.12	.14	-.20	-.04	-.11	-.16	**.89**[a]								
I10	-.04	.03	.06	-.09	.08	-.10	-.02	-.06	-.53	**.90**[a]							
I11	.09	-.12	-.03	.11	-.10	.03	.11	-.11	.05	-.14	**.87**[a]						
I12	-.07	.02	-.16	-.04	.20	-.27	-.07	.06	-.05	-.06	-.55	**.87**[a]					
I13	-.08	.02	.01	.05	-.06	-.07	-.09	.08	-.15	-.03	-.07	-.16	**.96**[a]				
I14	-.06	-.05	.01	-.13	.11	-.12	-.07	-.02	-.03	.05	-.08	.05	.01	**.91**[a]			
I15	.25	-.23	-.01	.21	-.14	.10	-.04	-.13	.01	-.02	.12	-.13	.08	-.39	**.80**[a]		
I16	-.18	.12	.08	-.11	.06	-.05	.02	.05	.04	-.06	-.12	.05	-.10	-.19	-.52	**.86**[a]	
I17	.03	-.04	.01	-.24	.18	-.01	-.01	-.12	-.06	.05	-.11	.08	-.09	.10	-.07	-.24	**.87**[a]

a. Measures of Sampling Adequacy(MSA)

Table 10 Anti-image correlation (Data source: Survey 2010)

The second step of the EFA was to check for the total explained variance, in order to understand the number of factors that explain the most variance with the fewest factors. It was found that the 70.58% of variance was explained by 4 factors.

Third, conducting a Varimax rotation, I found the factor loadings of each item considered, then I match each item with one factor and finally I provided a name to each factor (Table 12). Specifically, in operationalising IT-based capabilities, I used four distinct composite variables to investigate the following areas of IT impact: 1) a firm's internal efficiency; 2) product/service development processes; 3) a firm's knowledge of customer behaviours and needs as a proxy for IT impact on a marketing capability; 4) business growth (Table 11). This approach constrains to deriving inferences on capabilities by looking at a series of outputs that are associated with the existence of these capabilities and are conditional on the use of IT resources (Molloy et al., 2011). This way of measuring capabilities implies that they are specified as latent constructs. The fact that capabilities are difficult to observe implies that they are also difficult to measure directly. In our econometric specifications, the factor scores of capabilities outputs were calculated as a weighted average of the items based on their factor loadings.

In Table 11 there are only 4 factors related to 4 IT-based capabilities. However, in the regression models shown in the next chapter, 5 IT-based capabilities are invetsigated. This happens because in the survey conducted in 2010 the items related

to the supply chain management IT-based capability were not included, but they were only included in the questionnaire delivered in 2011. Therefore, the first four IT-based capabilities were found conducting an EFA and then a CFA in 2010, and then a CFA in 2011, while the supply chain management capability was operationalized only with the factor analysis conducted with data gathered in 2011.

Item number	Name of the factor/item	F1	F2	F3	F4
Improvements in internal efficiency (IIE)					
I4	Increased efficiency of administrative activities	-0.048	**0.681**	0.191	0.482
I5	Reduction in the ratio costs of goods/services sold over sales revenues	0.195	**0.762**	0.095	0.349
I7	A more timely and thorough management accounting system	0.252	**0.797**	0.235	0.119
I8	An improvement in inventory control	0.242	**0.693**	0.335	-0.045
I9	A reduction in the order cycle time	0.584	**0.626**	0.146	0.051
I10	Improved quality controls on products/services	0.450	**0.689**	0.173	0.042
Improvements in new product development capabilities (NPD_CAP)					
I6	Growth in the number of new product/services developed	**0.576**	0.329	0.140	0.390
I11	Reduction in the failure risks of new products	**0.743**	0.010	0.279	0.297
I12	Reduction in time-to-market for new products	**0.782**	0.023	0.210	0.363
I13	Improved data management in the product development process	**0.637**	0.250	0.148	0.217
Improvements in market knowledge (MKT_CAP)					
I14	Increased knowledge on customer needs and purchasing habits	0.178	0.165	**0.750**	0.253
I15	Increased control on sales, included sales agents	0.185	0.145	**0.853**	0.099
I16	Better support to sales employees	0.231	0.141	**0.836**	0.149
I17	Improved after-sales services	0.091	0.226	**0.576**	0.102
Business growth (BG)					
I1	Growth in the market share	0.243	0.193	0.158	**0.794**
I2	Entry in new market segments	0.260	0.095	0.244	**0.851**
I3	Market expansion/entry abroad	0.301	0.165	0.128	**0.742**

Table 11 EFA on IT-based capabilities output (Data source: Survey 2010)

5.5.2.1 Method quality assessment

In case variables measured through Likert scales are used in the models, the psychometric properties of these scales have to be checked. They include the establishment of content validity, convergent validity, discriminant validity, and acceptable reliability.

Content validity was established through interviews with seven CIOs from different industries. This field-based validation served to ensure that the scale items were generalisable across the industries in the sample.

CFA was used to test convergent and discriminant validity, and reliability. The procedure used supported the convergent validity: all the estimates for the average variance extracted (AVE) were equal to or higher than 0.50 (Bagozzi and Yi, 1988). All scales exhibited also acceptable reliability, achieving Cronbach's alphas of at least equal to 0.70 and composite reliability (CR) more than 0.80.

Item number	Name of the factor/item	Loading
Improvements in internal efficiency (α = 0.866; CR = 0.909 ; AVE = 0.626)		
I4	Increased efficiency of administrative activities	0.721
I5	Reduction in the ratio costs of goods/services sold over sales revenues	0.811
I7	A more timely and thorough management accounting system	0.856
I8	An improvement in inventory control	0.771
I9	A reduction in the order cycle time	0.822
I10	Improved quality controls on products/services	0.760
Improvements in New Product development capabilities (α = 0.835 ; CR = 0.892 ; AVE = 0.674)		
I6	Growth in the number of new product/services developed	0.777
I11	Reduction in the failure risks of new products	0.844
I12	Reduction in time-to-market for new products	0.893
I13	Improved data management in the product development process	0.762
Improvements in market knowledge (α = 0.836; CR = 0.891; AVE = 0.676)		
I14	Increased knowledge on customer needs and purchasing habits	0.837
I15	Increased control on sales, included sales agents	0.890
I16	Better support to sales employees	0.898
I17	Improved after-sales services	0.637
Business growth (α = 0.874; CR = 0.923; AVE = 0.801)		
I1	Growth in the market share	0.888
I2	Entry in new market segments	0.943
I3	Market expansion/entry abroad	0.852

NOTE: α = Cronbach's; CR = composite reliability; AVE = average variance extracted.

Table 12 CFA on IT-based capabilities outputs (Data source: Survey 2010)

Discriminant validity was assessed through CFA by comparing the squared intercorrelations between two constructs that had to be less than the AVE estimates of the respective two constructs for all pairs of constructs (Fornell and Larcker, 1981). As can see by results shown in Table 13 this condition is respected.

F1	F2	correlation	correlation^2	AVE F1	AVE F2
IIE	NPD_CAP	0.601	0.361	0.626	0.674
IIE	MKT_CAP	0.489	0.239	0.626	0.676
IIE	BG	0.439	0.193	0.626	0.801
NPD_CAP	MKT_CAP	0.558	0.312	0.674	0.676
NPD_CAP	BG	0.570	0.325	0.674	0.923
MKT_CAP	BG	0.385	0.148	0.676	0.923

Table 13 Discriminant validity (Data source: Survey 2010)

Since data used in the models are based on the survey carried out in 2011, I also conducted a CFA of factors found with the survey of the 2010 on the data of the 2011. Specifically, Table 14 contains data that support the convergent validity and

the reliability of data gathered in 2011, whereas Table 15 shows data that support the discriminant validity of data gathered in 2011.

Item number	Name of the factor/item	Loading
Improvements in internal efficiency (α = .825; CR = .886 ; AVE = .566)		
I4	Increased efficiency of administrative activities	.744
I5	Reduction in the ratio costs of goods/services sold over sales revenues	.794
I7	A more timely and thorough management accounting system	.749
I8	An improvement in inventory control	.689
I9	A reduction in the order cycle time	.781
I10	Improved quality controls on products/services	.752
Improvements in New Product development capabilities (α = .848 ; CR = .896 ; AVE = .683)		
I6	Growth in the number of new product/services developed	.764
I11	Reduction in the failure risks of new products	.878
I12	Reduction in time-to-market for new products	.902
I13	Improved data management in the product development process	.752
Improvements in market knowledge (α = .852; CR = .916; AVE = .733)		
I14	Increased knowledge on customer needs and purchasing habits	.798
I15	Increased control on sales, included sales agents	.871
I16	Better support to sales employees	.918
I17	Improved after-sales services	.834
Business growth (α = .868; CR = .912; AVE = .777)		
I1	Growth in the market share	.856
I2	Entry in new market segments	.943
I3	Market expansion/entry abroad	.842
Improvements in supply chain management capabilities (SCM_CAP) (α = .907; CR = .905; AVE = .705)		
I18	Increased collaboration with suppliers involved in product design and engineering	.803
I19	Increased efficiency in the purchasing activities	.832
I20	Increased quality and/or raw material costs and/or components externally bought	.872
I21	Identification of reliable or convenient suppliers	.851

NOTE: α = Cronbach's; CR = composite reliability; AVE = average variance extracted.

Table 14 Confirmatory Factor Analysis on IT-based capabilities outputs (Data source: Survey 2011)

F1	F2	correlation	correlation^2	AVE F1	AVE F2
IIE	NPD_CAP	0.630	0.397	0.566	0.683
IIE	MKT_CAP	0.540	0.292	0.566	0.733
IIE	BG	0.490	0.240	0.566	0.777
IIE	SCM_CAP	0.600	0.360	0.566	0.724
NPD_CAP	MKT_CAP	0.550	0.303	0.683	0.733
NPD_CAP	BG	0.530	0.281	0.683	0.777
NPD_CAP	SCM_CAP	0.640	0.410	0.683	0.724
MKT_CAP	BG	0.370	0.137	0.733	0.777
MKT_CAP	SCM_CAP	0.570	0.325	0.733	0.724

Table 15 Discriminant validity (Data source: Survey 2011)

5.5.3 Internal contexts

The internal factor included as independent variables in this thesis is the IT management capabilities.

To operationalize the construct "**IT management capabilities**", we conducted a confirmatory factor analysis on four items taken from the questionnaire sent in 2011 (Table 16). Respondents rated these items on a five-point scale choosing a number that best reflected their opinion (strongly disagree = 1 to strongly agree = 5). This factor reflects an emphasis on the importance of managerial involvement in IT investments decisions, which may influence the IT assimilation in firms (Bharadway, 2000).

Construct	Loading
IT management capabilities (α = .756; CR = 855; AVE = .598)	
IT investments follow a medium-long term formal plan	.719
Benefits, costs and risks of IT investments are regularly observed	.829
The IT investments planning process involves managers of every functional area	.815
IT investments are aligned with all the operative and the strategic necessities of the firm	.723

NOTE: α = Cronbach's; CR = composite reliability; AVE = average variance extracted.

Table 16 Confirmatory Factor Analysis on the variable "IT management capabilities" (Data source: Survey 2011)

5.5.4 Business environment

The business environment takes into account SMEs': 1) vertical integration; 2) percentage of foreign sales; 3) geographical scope of their operating units; 4) customer dependence; 5) IS vendor support.

The level of "**Vertical integration"** was measured as the ratio between the value added and the total sales (Levy, 1985). I measured the "**Foreign sales**" as the ratio between the sales made abroad and the total firm sales (Reuber, 1997). Specifically, I asked whether the company made sales in Europe in 2010 considering three ranges (less than 5%; between 5% and 20%; more than 20%) and whether made sales in the rest of the world by considering other three ranges (0%; between 1 and 10%; more than 10%). After that, I centred both the values. Specifically, in case of sales made in Europe I centred the three ranges respectively with the values 2.5%, 12.5% and 30%, while in case of sales made in the rest of the world we centered respectively in 0%, 5% and 20%. Then, I summed these values and obtained the percentage of foreign sales made by each firm. Finally, the "**Geographical scope**" of their operating units was measured by the logarithmic form of the number of local units of each firm (Zhu et al., 2006).

Customer dependence was measured asking respondents the revenue percentage in 2010 gained by the three main customers, choosing among three

ranges: less than 30%, between 31% and 60%, and more that 60%. Then, I centred the answers respectively with the values 15%, 45% and 70%.

Finally, the **IS vendor support** was operationalized by a dummy variable equal to 1 in case each company consults IS vendors of medium size for taking their decisions, 0 otherwise.

5.5.5 Environmental conditions

To operationalize the environmental context, I combined some approaches that were inspired on Dess and Beard's (1984) work on the influence of environment factors on technology strategies and organization configurations. Specifically, dynamism and munificence of each industry were assessed using data from AIDA and Istat. To do so, I classified industries using ATECO classification at the three digit. I measured dynamism by considering turbulence in the distribution of revenues within each industry using firm-level data from AIDA about revenue concentration. Specifically, the dynamism of an industry of year t was calculated as the average of the absolute value of rank change of all firms in that industry from year t-1 to t. I used rank change instead of absolute change in revenues because it helps mitigate the impact of outliers on our results. Given this property, rank change has been used in a number of other studies to measure industry turbulence (e.g. Comin and Phillipon, 2005). To provide further validity for the use of this measure, I also operationalized dynamism as the variability in annual industry sales, following the approach used by Stoel and Muhanna (2009). To do so, for each sector the industry-level total sales for 5 years (from 2006 to 2010) were regressed on the year variable and dynamism was measured as the standard error of the regression slope coefficient of annual industry sales divided by the industry mean for the 5 year period. By using the same data on total industry sales revenues, munificence was measured as the growth rate in annual industry sales for 5 years, measured as the regression slope coefficient divided by the average industry sales.

Industry complexity was framed as the homogeneity-heterogeneity of inputs, and we used input/output concentration as a measure of industry complexity. The Istat input/output tables allowed us to calculate the complement to 1 of the concentration of each industry's inputs, measured as $Ci = \Sigma Ik^2/(\Sigma Ik)^2$, where Ik is the euro volume of inputs from industry k. The complement to 1 of concentration Ci

increases with the number of industries supplying the inputs and as they become more evenly distributed across the suppliers, capturing both the structural and distributive differences in complexity that may occur across industries.

For each industry characteristic, I split industries into two sets (high and low) based on the median value. This choice was motivated by the distribution of the three measures, which were found to be non-normal by a Shapiro-Wilks test. Each firm was assigned three dummy variables (munificence, dynamism and complexity). These dummies were assigned 1 for high-value and 0 for low-value data points.

5.5.6 Firm economic performance

Data related to firm performance were collecting by using the database AIDA Bureau van Dijk. The revenue growth and the delta ROA considered in this thesis have been widely used in the IT business value literature as measures of firm profitability (Cron and Sobol, 1983; Hitt and Brynjolfsson, 1996). The former is indicative of how effectively a firm can open up new markets or expand existing markets. The latter shows, instead, the consequent efficiency of its operation. Specifically, IT impact on performance was estimated by considering their changes over the 2007-2010 period.

For each year and each firm we considered the differences in ROA ratio respect to the median value in a peer group composed by all the Italian firms in the same industry segment (defined at a 3-digit level of ATECO code). This procedure allowed to assess whether in the period under analysis a firm has achieved a competitive edge (or disadvantage) or has bridged (or increased) a former competitive delay. This measure of profitability also controls indirectly for economic cycles (and thus the shift to a recession phase occurred in 2008) and other macroeconomic factors such as industry concentration. Specifically, the difference of the performance indicator for each firm (P_f) has been operationalized by subtracting the difference between the performance indicator of the firm in 2010 and of the median value in a peer group composed by all the Italian firms in the same industry segment P_{PG}, with the same difference referred to the year 2007. For computing the delta ROA, the following equation was solved:

$$Delta\ ROA = (ROA_f,2010 - ROA_{PG},2010) - (ROA_f,2007 - ROA_{PG},2007)$$

Second, to measure the impact of IT on the growth rates, I examined changes in the revenues between 2007 and 2010, deflating the nominal values to the year base 2000. The value added deflators estimated by Istat for each industry aggregation were used for this purpose. Specifically, the logarithmic form of the ratio between the deflected value of the revenues of 2010 and of the 2007 was computed in order to operationalize such variable.

It is worth noticing that I did not lag any performance indicator like in other studies on business value of IT (e.g. Brynjolfsson and Hitt, 2000), because my choice of measuring capabilities as the result of assimilation of IT in business processes postulates that we already controlled for the delay (i.e. the so-called "assimilation gap" in IS research) between adoption of the innovation and manifestation of its outcomes.

5.5.7 Control variables

Control variables are used to account for factors other than the theoretical constructs of interest, which could explain variance in the dependent variable. In this study, firm size, firm age, the business model adopted and the industry are used as control variables.

Firm size reflects past success and may influence current performance. It was operationalized as the logarithmic form of the number of employees in a company Fink and Neumann, 2007).

Firm age is perceived as an indication of external legitimacy of the existence of interfirm relationships, of the staying power, and of the pervasiveness of internal routines, all of which can affect current performance. On the other hand, young firms can be subject to the liability of newness, which can confound their performance. Firm age was measured by the logarithmic form of the actual existence of the firm since the starting year of its operations.

The potential payoff from using IT could vary across industries, which is reflected in the extent of IT use in the industry. Specifically, the industry was operationalized by five dummy variables: traditional low-tech manufacturing, medium-tech manufacturing, hi-tech manufacturing, material services and information services.

Finally, three dichotomous variables, that represent the way through which the company sells and thus the business model followed, were introduced in the models as control variables: firms that operate on-order, through catalogue of products/services and as sub supplier.

To sum up, Table 17 contains a summary of the variables used in the models, with the indication of the variable name, their description, the operationalization, the main reference and the data source.

Variable	Variable description	Main reference	Data source
Adoption time of IS	The logarithmic form of the maximum number of years since one of the 4 information systems considered has been adopted.	Caldeira and Ward, 2003	Survey
Customized IS	One dummy variable: if the company owns customized IS the variable is set to 1, otherwise it is 0.	Sanchez and Heene (2004)	Survey
Improvements in internal efficiency	Items constructed on a Likert scale (from -2 to +2): 1) Increased efficiency of administrative activities; 2) Reduction in the ratio costs of goods/services sold over sales revenues; 3) A more timely and thorough management accounting system; 4) An improvement in inventory control; 5) A reduction in the order cycle time; 6) Improved quality controls on products/services.	Sohal et al. (2001)	Survey
Improvements in new product development capabilities	Items constructed on a Likert scale (from -2 to +2): 1) Growth in the number of new product/services developed; 2) Reduction in the failure risks of new products; 3) Reduction in time-to-market for new products; 4) Improved data management in the product development process.	Nambisan (2003) Pavlou and El Sawy (2006) Ross (1999)	Survey
Improvements in market knowledge	Items constructed on a Likert scale (from -2 to +2): 1) Increased knowledge on customer needs and purchasing habits; 2) Increased control on sales, included sales agents; 3) Better support to sales employees; 4) Improved after-sales services.	Keh et al. (2007) Lancioni et al. (2000) Shaw et al. (2001)	Survey
Improvements in supply chain management capabilities	Items constructed on a Likert scale (from -2 to +2): 1) Increased collaboration with suppliers involved in product design and engineering; 2) Increased efficiency in the purchasing activities; 3) Increased quality and/or raw material costs and/or components externally bought; 4) Identification of reliable or convenient suppliers.	Tracey et al. (2005)	Survey
Business growth	Items constructed on a Likert scale (from -2 to +2): 1) Growth in the market share; 2) Entry in new market segments; 3) Market expansion/entry abroad.	Sambamurthy et al. (2003) Lancioni et al. (2000)	Survey
IT management capabilities	4 items base on a five point Likert scale: 1) IT investments follow a medium-long term formal plan; 2) Benefits, costs and risks of IT investments are regularly observed; 3) The IT investments planning process involves managers of every functional area; 4) IT investments are aligned with all the operative and the strategic necessities of the firm.	Bharadway, 2000	Survey

Size	Logarithmic form of the number of employees of each company.	Fink and Neumann (2007)	Survey
Vertical integration	Value added/total sales.	Levy (1985)	AIDA
Foreign sales	Sales made abroad/total firm sales.	Reuber and Fisher (1997)	Survey
Geographical scope	Logarithmic form of the number of local units of each firm.	Zhu et al. (2006)	Survey
Traditional manufacturing	Dummy variable equal to 1 in case a firm belongs to the TMAN industry, 0 otherwise.	Porat and Rubin (1977) Pavitt (1984)	AIDA
Medium-Tech manufacturing	Dummy variable equal to 1 in case a firm belongs to the MTECH industry, 0 otherwise.	Porat and Rubin (1977) Pavitt (1984)	AIDA
Hi-Tech manufacturing	Dummy variable equal to 1 in case a firm belongs to the HTECH industry, 0 otherwise.	Porat and Rubin (1977) Pavitt (1984)	AIDA
Material Services	Dummy variable equal to 1 in case a firm belongs to the MSERV industry, 0 otherwise.	Porat and Rubin (1977) Pavitt (1984)	AIDA
Information Services	Dummy variable equal to 1 in case a firm belongs to the ISERV industry, 0 otherwise.	Porat and Rubin (1977) Pavitt (1984)	AIDA
Munificence	Regression slope coefficient of annual industry sales divided by the industry sales mean for the 5-year period.	Stoel and Muhanna (2009) Dess and Beard (1984)	AIDA
Dynamism	Standard error of the regression slope coefficient of annual industry sales divided by the industry mean for the 5-year period.	Stoel and Muhanna (2009) Dess and Beard (1984)	AIDA
Complexity	$C_i = 1 - \frac{\sum I_k^2}{\left(\sum I_k\right)^2}$	Stoel and Muhanna (2009) Dess and Beard (1984)	AIDA
Customer dependence	The revenue percentage in 2010 gained by the three main customers, choosing among three ranges, has been considered: less than 30%, between 31% and 60%, and more that 60%. Then, the answers were centered respectively in the values 15%, 45% and 70%.	Premkumar and Roberts (1999)	Survey
IS vendor support	Dummy variable set to 1 in case the company has been support by IS vendors of medium size.	Thong (1999)	Survey
Delta ROA	$(ROA_{f,}2010\text{-}ROA_{PG,}2010) - (ROA_{f,}2007\text{-}ROA_{PG,}2007)$	Hitt and Brynjolfsson (1996)	AIDA
Revenue Growth	Logarithmic form of the ratio between the revenue 2010 deflated and the revenue 2007 deflated.	Hitt and Brynjolfsson (1996)	AIDA
Age	Logarithmic form of the actual existence of the firm since the starting year of its operations.	Caldeira and Ward, 2003	AIDA
On order sales	Dummy variable equal to 0 if the company adopts on order sales model, 0 otherwise.	Phan and Vogel (2010)	Survey
Catalogue sales	Dummy variable equal to 0 if the company adopts a catalogue sales model, 0 otherwise.	Phan and Vogel (2010)	Survey
Sub supplier	Dummy variable equal to 0 if the company is a sub supplier, 0 otherwise.	Tse and Tan (2011)	Survey

Table 17 Description and operationalization of the variables

Chapter 6

6. RESULTS AND DISCUSSION

This chapter shows the results found. It is divided in four main sections. First, the descriptive statistics of variables used in the models are shown. Second, the methodological choices taken for analyzing data are discussed and explained. Third, the analysis conducted and the decision taken in order to validate the trustworthiness of the research study are shown. Finally, the verification of the hypotheses and the results discussion are provided.

6.1 Descriptive statistics

This section has the aim of providing an overview of the adoption and assimilation levels of IT solutions among SMEs surveyed. Furthermore, a short prospective analysis on the new IT applications adopted by firms and software delivery models, such as the software as a service, is discussed.

6.1.1 Broadband availability and IT expenses

In the past years, the IT digital divide that characterizes the companies of smaller size has been mainly attributed to the lack of an adequate infrastructure for the Internet access. However, nowadays, this could be not anymore true. Indeed, as shown in Figure 14, around the 84% of the companies has a broadband Internet access. This result highlights that the digital divide is not anymore imputable to the available infrastructure. Indeed, only the 7% of companies surveyed have declared that there is not any broadband connection availability in the place where their companies are located. After this, only the 3% of companies has declared that does not need any broadband connection, while the 2% thinks that the costs of this technology is too high. They are usually companies of small size (number of employees very close to 10), where the latent demand of IT solution is almost absent.

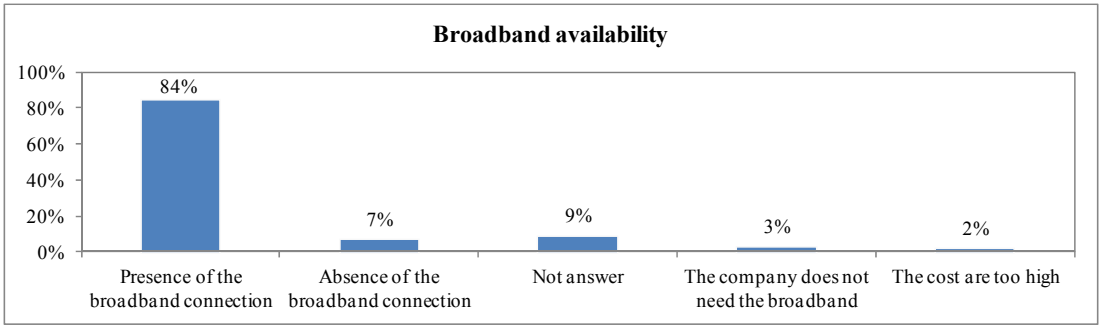


Figure 14 Broadband availability (Data source: survey 2011)

In addition, the expenses levels of IT solutions is evaluated in order to understand whether companies have a high propensity toward IT investments or not. As can be noticed in Figure 15, the importance that companies attribute to IT solutions is low since the IT investments (Operating Expenditure – OPEX – or Capital Expenditure - CAPEX) regard the revenues are very low. This result is consistent with the low diffusion among such companies of a CIO (Chief Information Officer), declared as formal rule only by the 22.5% of the companies surveyed. Specifically, the operating expenditure is on average the 1.77% of the revenues (they are usually expenses related to the Internet connectivity, labour costs and license fees for the use of software and other correlated services), while the capital expenditure is on average the 2.05% (these results are aligned with the national and international statistics - PricewaterhouseCoopers (2008)).

	OPEX regard revenues		CAPEX regard revenues		OPEX + CAPEX	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**
Value	1.77%	0.14%	2.05%	0.00%	2.06%	0.25%

Table 18 IT expenses (Data source: survey 2011)

However, such expenses levels depend on the sectoral specificities, since they are higher among companies that belong to the Information Service sector (capital expenditure is on average the 2.28% of the revenues and the capital expenditure is on average the 2.24%). Data gathered highlight also that in such sectors the IT management capabilities are higher than in the other sectors, confirming that the ability of seeing the IT as a strategic weapon and the ability of planning its adoption are both factors that explain the adoption rates within a firm (Figure 15).

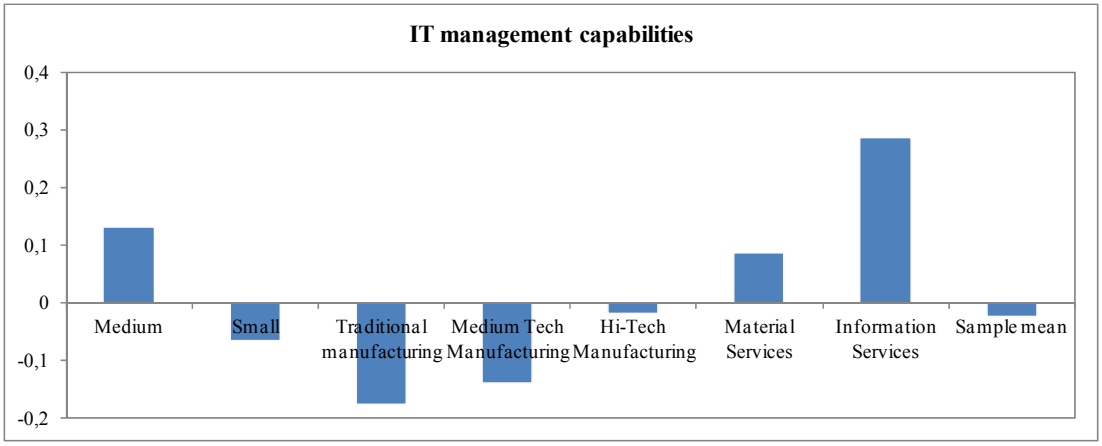


Figure 15 IT management capabilities (Data source: survey 2011)

6.1.2 Adoption rates of the IT-based resources and capabilities

Figure 16 highlights that ERP systems (adopted by 43% of the firms surveyed) are more diffuse than the IS that support firms' external orientation (CRM, SCM and PDM). The ERP systems are more diffused than the other IS also because they have been the first IS that were commercialized in "package" for the SMEs. Indeed, the 33% of small firms adopt such IS and the 65% of companies of medium size. Furthermore, its diffusion is higher in the manufacturing sector, coherently with the support that such technologies provide especially in the production and logistic functional areas.

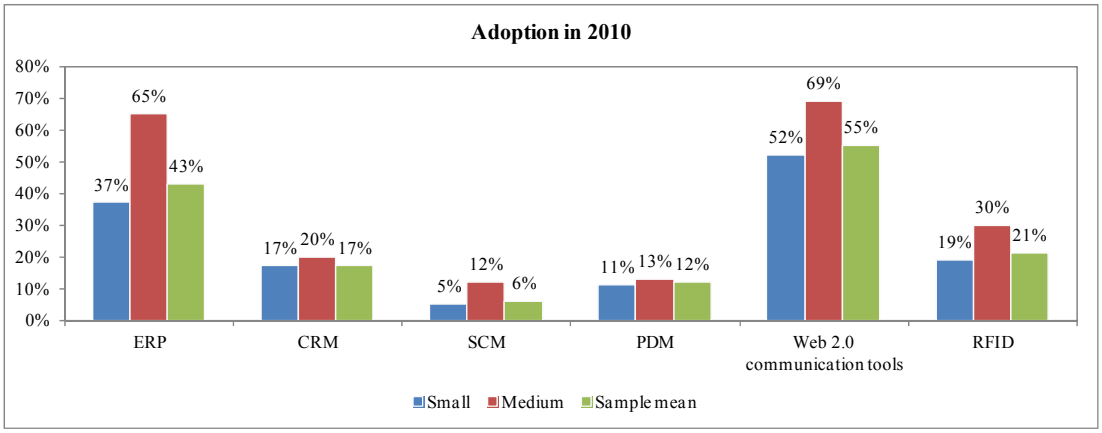


Figure 16 Adoption rates 2010 (Data source: survey 2011)

With regard to the use of IS in supporting firms' external orientation, SCM systems have a limited diffusion (6.0% of the firms). PDM packages have a 12% adoption rate and CRM has been adopted by the 17% of companies surveyed. Specifically, CRM systems are more diffused in the Information Service sector coherently with the fact that companies in this sector are faster in adopting IT

solutions and with the fact that usually the adoption of CRM systems comes after the adoption of ERP systems.

Similar to the adoption rates of IS, the impact of IS on the improvement of internal efficiency is more broadly experienced than the benefits produced in customer relationships management, product development activities, supply chain management and in business growth. The two least diffuse benefits of IT use are improvements in new product development capabilities and in business growth, as both the variable measuring these types of result exhibited a negative mean (respectively of -0.179 and -0.316).

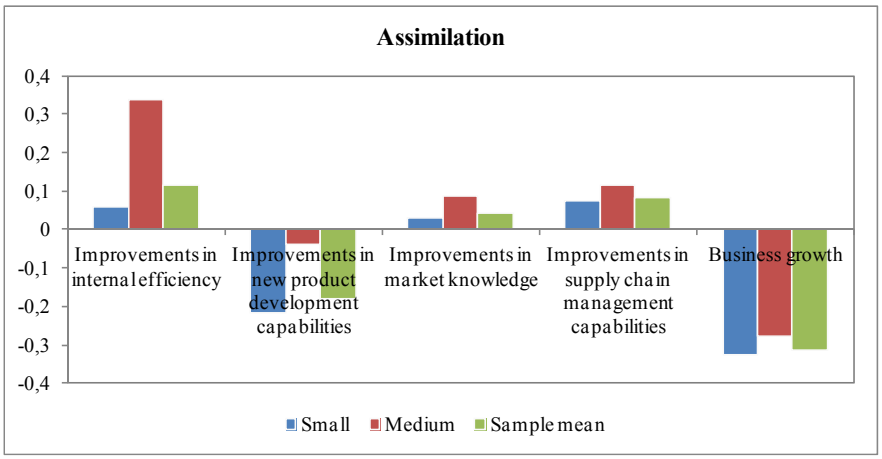


Figure 17 Assimilation rates (Data source: survey 2011)

Descriptives contained in Table 19 include also the mean value of each variable considered stratified by size and industry. Overall, these descriptives provide general evidence about the importance of industry and the differences in sample size in shaping the diffusion and use of IT.

Four main facts support the importance of industry effects in explaining the differences in IT use across firms. First, hi-tech manufacturing and information services sectors were the industry settings with the greatest diffusion of IT resources and more advanced IT-based capabilities. Specifically, in these two sectors, analysis of variance (ANOVA test) shows that in the information service sector there are the higher rate of adoption IS, customized according to the company requirements, and that companies in high-tech manufacturing sectors adopt previously IS. Second, statistics show that the assimilation of IT-based resources is higher in hi-tech manufacturing and information services sectors. Specifically, the improvements of

internal efficiencies and the new product development capabilities are higher in information services sectors, while improvements in market capabilities, supply chain management and business growth are higher in hi-tech manufacturing sector.

Third, statistics confirmed that sectors also differ in the inputs that are complementary to IT capital of firms. The preconditions related to the IT management capabilities in companies differed across industries, being more common in the information services sector. Fourth, with regard to the expected dual diffusion of IT, statistics highlight that some outcomes of firms' adoption of IT exhibited an uneven diffusion across sectors, whereas other outcomes exhibit a broad and rather uniform diffusion across industries.

The importance of size effects in explaining the differences in IT use across firms is provided by the higher values of all the variables considered in case of companies of medium size: they have higher adoption rates, they are more able to assimilate, also due to favouring organizational conditions, such as higher levels of human capital and higher levels of IT management capabilities.

Coherently with the previous findings, the Spearman correlation analyses (Appendix 6) show that the IT-based capabilities positively correlate with size and most of the technologies considered in this study.

Context	Variable	Min.	Max.	Size			Industry types						Sample mean
				Medium	Small	ANOVA	TMAN	MTECH	HTECH	MSERV	ISERV	ANOVA[15]	
IT adoption	Adoption of IS	0	4	1.110	0.690	0.000	0.770	0.950	0.690	0.700	0.780	0.042	0.780
	Customized IS	0	1	0.190	0.140	0.305	0.180	0.120	0.000	0.130	0.190	0.045	0.150
	Adoption time of IS	0	1.630	0.983	0.921	0.224	0.956	1.007	1.025	0.918	0.815	0.198	0.939
	ERP	0	1	0.650	0.370	0.000	0.470	0.560	0.380	0.340	0.370	0.054	0.430
	CRM	0	1	0.200	0.170	0.423	0.140	0.160	0.150	0.200	0.230	0.571	0.170
	SCM	0	1	0.120	0.050	0.008	0.060	0.010	0.150	0.090	0.040	0.156	0.060
	PDM	0	1	0.130	0.110	0.583	0.110	0.220	0.000	0.070	0.150	0.030	0.120
IT based capabilities	Improvements in internal efficiency	-2	2	0.337	0.057	0.002	0.052	0.200	0.119	0.112	0.214	0.591	0.116
	Improvements in new product development capabilities	-2	2	-0.039	-0.217	0.082	-0.260	-0.114	-0.033	-0.210	0.023	0.253	-0.179
	Improvements in market knowledge	-2	2	0.087	0.028	0.588	-0.051	-0.180	0.681	0.180	0.116	0.004	0.040
	Improvements in supply chain management capabilities	-2	2	0.116	0.073	0.665	0.060	0.245	0.369	-0.019	0.121	0.182	0.082
	Business growth	-2	2	-0.278	-0.326	0.699	-0.326	-0.356	0.028	-0.333	-0.279	0.807	-0.316
Environmental context	Munificence	0	1	0.658	0.676	0.753	0.578	0.892	0.309	0.644	0.827	0.000	0.672
	Dynamism	0	1	0.644	0.674	0.604	0.669	0.959	0.464	0.473	0.816	0.000	0.667
	Complexity	0	1	0.448	0.483	0.572	0.351	0.785	0.773	0.611	0.107	0.000	0.475
Business environment	Geographical scope	0	4.5	0.789	0.266	0.000	0.320	0.230	0.589	0.463	0.480	0.126	0.377
	Foreign sales	0	100	24.759	16.220	0.003	25.308	31.789	29.199	7.073	5.164	0.000	17.955
	Vertical integration	0.027	0.872	0.361	0.307	0.013	0.308	0.354	0.403	0.249	0.469	0.000	0.319
	Customer dependence	15	70	35.705	35.332	0.900	36.435	36.242	41.536	33.868	33.327	0.758	35.411
	IS vendor support	0	1	0.312	0.172	0.005	0.193	0.226	0.155	0.194	0.232	0.944	0.203
Internal context	IT management capabilities	-2	2	0.131	-0.067	0.049	-0.176	-0.139	-0.018	0.085	0.285	0.003	-0.024

Table 19 Descriptive statistics summary (Survey 2011)

[15] P-value. The null hypothesis is that all values are equal across the five industry types.

6.1.3 Perspective analysis of IT-based solutions

In a very diversified scenario where SMEs are usually late adopters, and where the IT investments are still high for some of these companies, the new IT paradigms, such as the cloud computing and the software delivered in an "as a service" modality, could increase the IT investments levels in these companies. This is the reason why their adoption behaviours towards ERP, CRM, SCM and PDM technologies in an "as a service" modality have been following analyzed (Table 20).

	ERP "as a service"	*ERP "as a service" within 2 years*	*CRM "as a service"*	*CRM "as a service" within 2 years*	*SCM "as a service"*	*SCM "as a service" within 2 years*	*PDM "as a service"*	*PDM "as a service" within 2 years*
Medium enterprises	5.80%	5.80%	3.50%	7.00%	1.20%	3.50%	4.70%	2.30%
Small enterprises	10.70%	4.70%	6.00%	2.50%	1.30%	0.90%	2.20%	1.60%
Traditional manufacturing	11.27%	3.06%	3.93%	3.06%	0.53%	1.05%	2.19%	3.32%
Medium Tech Manufacturing	10.71%	5.61%	1.30%	1.30%	0.00%	0.00%	9.72%	0.00%
Hi-Tech Manufacturing	22.65%	15.47%	15.47%	0.00%	15.47%	0.00%	0.00%	0.00%
Material Services	8.07%	5.82%	7.56%	3.25%	2.29%	2.49%	0.00%	1.25%
Information Services	8.95%	4.46%	9.08%	8.25%	1.19%	3.09%	4.17%	2.60%
Sample mean	10.20%	4.83%	5.66%	3.47%	1.49%	1.58%	2.87%	1.99%

Table 20 Adoption of "software as a service" solutions (Survey 2011)

These technologies have the advantage of enabling the enlargement of the IT portfolio, since they require a low initial investment. However, nowadays such technological solutions are still not widely diffused. On average, the 10% of companies adopt ERP solutions in an "as a service" modality. Especially, the hi-tech manufacturing and the information service sectors are the one where these technologies are more diffused. It is interesting that the "as a service" solutions are more diffused among smaller companies (the only exception is related to the adoption of PDM solutions). This can be explained by three main facts: 1) smaller companies are more financial constraints and therefore it is more likely that they would adopt less expensive IT solutions, such as the one delivered in an "as a service" modality; 2) smaller companies are more able to "shift" to the new technological paradigm, given the absence of previous investments in traditional IT solutions and therefore the absence of integration problems with the solutions already

adopted; 3) bigger companies are faster in the introduction of new IT solutions and, in case they have to adopt new IS, they choose the opportunities offered by the new IT paradigm. Coherently with the last point, within two years, the more recent IT solutions (CRM, SCM and PDM) will be more diffused among medium companies regards the smaller companies.

6.2 Data analysis: methodological choices

The analysis of quantitative data was performed using the statistical software STATA Version 9.0. This software package has the capability to analyze data using the statistical techniques required for achieving the purposes of the study.

Researchers have shown concerns regarding issues related to common method bias. Common method bias can occur when the same method is used to measure correlation between independent and dependent variables. According to Malhotra et al. (2006, p. 1865), common method bias refers to the "amount of spurious covariance shared because of the common methods used in the collecting data." There are several measures which can be taken to control for these effects. Researchers can control for method bias during the design phase of the study or through the use of statistical remedies (Podsakoff et al., 2003). In this study, the respondents have been allowed to keep their identities anonymous, which is likely to result in acquiring honest answers to questions as respondents do not feel pressure to produce answers which are socially desirable or otherwise biased.

During the design phase, the development of measurement items should be done in a way that ensures low levels of ambiguity. This issue was addressed in this study through the use of pre-existing scales and their modification based on the suggestions of CIOs. This helped to ensure that survey recipients were likely to understand the intended meaning of the questions. Finally, Tourangeau et al. (2000), proposes that acquiescence bias can be reduced by the use of bipolar numeric scales values (e.g. -2 to +2) and providing verbal labels for the midpoints of these scales. In this study, most scales use a similar approach to reduce acquiescence biases.

After data collection, specific statistical techniques can be used as another way to test for the impact of common method bias in the study. One of the most commonly used techniques is called Harman's single factor test. According to Podsakoff et al. (2003, p. 889), "researchers using this technique load all the

variables in their study into an exploratory factor analysis and examine the un-rotated factor solution to determine the number of factors that are necessary to account for the variance of the variables." Recently, researches have used factor analysis as a more developed test for the single factor test. In this study, the proposed variables formed different factors which lowers the possibility of common method bias. Indeed, no single factor emerged from the factor analysis, suggesting that common method bias is unlikely to affect the data.

6.2.1 Regression models

The study used ordinary least squares (OLS) regression and treatment-effects models to estimate the determinants of IT accumulation, IT assimilation and profitability levels achieved by firms. Treatment effects regression models allowed to account for endogeneity due to selectivity bias, as unobserved firm-specific factors may co-determine both the adoption of IS and the development of IT-based capabilities, and both the development of IT-based capabilities and firm performance. Such factors may be unobserved managerial conditions or supply chain relations that are only partly correlated with the observed conditions of the firm's organisational context. The treatment effects model is based on a two-steps estimator that solves the endogeneity problem by estimating conjointly the treatment effect on the dependent variable and the determinants of the treatment through a probit regression model. More specifically, the first treatment regression model[16] where the dependent variable is represented by the IT-based capabilities required the simultaneous estimation of the following specification:

$$\textit{IT-based capability}_{\,i} = b_{0,i} + \Sigma_{j=1,3} b_{j,i}[\textit{Environmental Context}] + \Sigma_{j=4,8} b_{j,i}[\textit{Business environment}] + \\ + b9_{,i}[\textit{Internal context}] + b_{10,i}[\textit{size x dynamism}] + b_{11,i}[\textit{complexity x vertical integration}] + \alpha_i TREAT_i \\ + \textit{control variables} + \varepsilon_i,\ i=1,2,3,\ 4,5 \text{ (Main equation)}$$

$$TREAT_i = \alpha_{0,i} + \Sigma_{j=1,3}\ \alpha_{j,i}\ [\textit{Environmental Context}] + \Sigma_{j=4,8}\ \alpha_{j,i}[\textit{Business environment}] + \ \alpha 9_{,i}[\textit{Internal} \\ \textit{Context}] + \textit{control variables} + u_i,\ i=1,\ 2,3,4,5 \text{ (Treatment equation)}$$

[16] The letter "i" indexes the IT-based capability type; the letter "j" indexes the variable considers for each context defined.

Whereas, the second treatment regression model[17] where the dependent variable is represented by each firm economic performance required the simultaneous estimation of the following specification:

$$Profitability\ index_{i,k} = b_{0,i,k} + \Sigma_{j=1,2} b_{j,i,k}[Environmental\ Context] + b_{3,i,k}[munificence\ x\ dynamism] + b4_{,i,k}[munificence\ x\ TREAT] + b5_{,i,k}[dynamism\ x\ TREAT] + \alpha_{i,k} TREAT_{i,k} + control\ variables + \varepsilon_i,\ i=1,2,3,\ 4,5,\ k=1,2$$ (Main equation)

$$TREAT_{i,k} = \alpha_{0,i,k} + \Sigma_{j=1,5}\ \alpha_{j,i,k}[Environmental\ Context] + \Sigma_{j=6,8}\ \alpha_{j,i,k}[Business\ environment] + \Sigma_{j=9,11}\ \alpha_{j,i,k}[Organisational\ Context] + \Sigma_{j=12,13}\ \alpha_{j,i,k}[IT\ adoption] + \alpha_{14,i,k}[size\ x\ dynamism] + \alpha_{15,i,k}[complexity\ x\ vertical\ integration] + control\ variables + u_i,\ i=1,\ 2,3,4,5,\ k=1,2$$ (Treatment equation)

6.2.2 Evaluation of the trustworthiness of the research study

Trustworthiness is a concept that reflects the overall quality of a research study. According to Newman (2003), four types of triangulation can enhance the trustworthiness of the research, in particular the triangulation of theory, method, measurement, and observers. Triangulation has been often used in social science as an important consideration for trustworthiness and it can be described as the use of different angles or perspectives to observe the phenomenon under study. Triangulation of theory is achieved when multiple theoretical perspectives are used during the planning stage and/or when interpreting data. The triangulation of method relates to the use of both qualitative and quantitative methods to address research goals. According to Newman (2003) this mixed approach can be followed either sequentially or simultaneously. In this study, triangulation of method has been achieved by alterning qualitative expert panels and quantitative surveys.

The triangulation of measurements is conceptualized as using multiple measures for the same phenomena. The adoption of this approach increases potential access to the most comprehensive information about the research questions (Newman, 2003). During the pre-study, interviews and documentation were used as different measurements, and during the survey, variables were measured with two or

[17] The letter "i" indexes the IT-based capability type; the letter "j" indexes the variable considers for each context defined; the letter "k" indexes the type of profitability measure considered.

more items. Finally, the triangulation of observers refers to the limitation of a study due to the involvement of single observer. The alternative is to integrate inputs from multiple observers, as they can add different perspectives and increase the likelihood of capturing a complete picture of the setting (Newman, 2003). This form of triangulation was achieved by planning, developing and writing the questionnaires with co-authors. Also, during the entire research process, inputs from supervisors and colleagues were incorporated.

6.3 Verification of the hypotheses and discussion

6.3.1 Effects on IT-based resources accumulation dynamics

To estimate the effect of the environmental and internal conditions, and of the features of the business environment, on the IT adoption process of IS, the hierarchical regression models (M1a - without the interaction terms - and M1b - with the interaction terms) were used (Table 21). Specifically, I tested directly the following hypotheses:

- H1: Firm internal context influences positively the earlier adoption of IS.
- H3: The complexity of the business environment influences positively an earlier adoption of IS.
- H7. The higher the environmental munificence (H7.a), the lower the environmental dynamism (H7.b) and the higher the environmental complexity (H7.c), the earlier is the adoption of IT resources in SMEs.

Influence of the internal context on the IT adoption

Hypothesis H1 had the aim of examining the contribution of the firm's internal context (defined in terms IT management capabilities) on the adoption of IS. As can be seen in Model 1b, the coefficient of the IT management capabilities was significant. This result can be explained by the fact that the IT adoption depends on the capability of planning successfully the systems required for managing the growth, because without the appropriate IT managerial capabilities SMEs cannot understand the value of IT solutions and can decide to not make any type of IT investment. Thus, hypothesis H1 was supported.

Influence of the complexity of the business environment on the IT adoption

In investigating the contribution of the complexity of the business environment on the adoption decisions, Hypothesis H3 was supported. Even though the contribution of the geographical scope and the level of vertical integration were not significant, the coefficient of the foreign sales was positive and significant. This evidence can suggest that the more SMEs export, the more they invest in IT solutions in order to manage the relationships with customer and process data related to their purchase behaviours. Indeed, IS are a way through which companies can achieve a good knowledge of customers requirements and manage the relationship with them. Under these conditions, SMEs decide to adopt to a greater extend IT solutions.

Influence of the environmental context on the IT adoption

I supposed that SMEs in munificent and complex environments would be more likely to adopt earlier IS, while later in dynamic environments. Specifically, I found that SMEs tend to adopt earlier in complex environments because in such environments SMEs have greater information processing requirements and are expected to have a greater need for IT resources. By contrast, in dynamic environments SMEs tend to adopt later IS since in these environments they could lose the flexibility that provide them a competitive advantage. Indeed, the environmental dynamism impacts on the adoption time of the IS, since SMEs in dynamic environments have a parsimonious use of IT resources. This may happen also because the more SMEs achieve business processes integration through standardized IS, the harder it is for them to reconfigure themselves around new "organisational architectures" to respond to environmental changes. Due to the high costs that are needed to change business processes once they have been formalized through the implementation of IS, SMEs may be discouraged by adopting early these IT resources. Therefore, hypothesis H7.b and H7.c were supported, while H7.a was not supported.

Ind. Var / Dep. Var	*M1a* Adoption time of IS	*M1b* Adoption time of IS
Environment context		
Complexity (C)	-0.004†	0.192†
Munificence	-0.026	-0.042
Dynamism	-0.121†	-0.109†
Business environment		
Geographical scope	0.005	-0.004
Foreign sales	0.002†	0.002†
Vertical Integration (VI)	-0.453*	-0.229
IS vendor support	0.002	0.014
Customer dependence	-0.001	0.006
Internal context		
IT management capabilities	0.079*	0.092**
IT adoption		
Customized IS	0.060	0.050
Interaction effects		
VIxC	...	0.781*
CD^2	...	-0.001
Control variables		
Size	-0.039	-0.019
Age	0.063†	0.068*
MSERV	-0.092	-0.110
ISERV	0.064	0.027
HTECH	-0.118	-0.113
MTECH	0.087	0.102
On order sales	-0.044	-0.022
Catalogue sales	0.007	0.006
Sub supplier	-0.128	-0.140†
Constant	0.546	0.839***
Fit indexes		
F Regression	2.76***	3.29***
R-Square	29.10%	29.56%

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 21 OLS models with the IS adoption measures as dependent variables (Data source: Survey 2011)

6.3.2 Effects on IT-based capabilities development

To estimate the effect of the environmental and internal conditions, and of the business environment features, on the IT-based capabilities development, five sets of models, one for each IT-based capability, were run. Specifically, treatment regression models were used in order to deal with endogeneity problems as previously specified. The dependent variable chosen in the first step of each treatment regression model was the existence of a customized IS, while the dependent variable of the second step of the treatment regression model was the

development of each IT-based capability. Specifically, in the first step of the treatment regression model, a probit regression model was run. Results of such model are shown in Table 22. One interesting result emerges: SMEs that adopt customized IS are more likely to operate in a dynamic environment, since thanks to the adoption of customized IS SMEs can try to lower the rigidity and the less flexibility that an IS introduces, especially in a turbulent environment that is characterized by continuous changes in customer needs. In such a way, SMEs are more flexible in responding timely to customers' requirements.

Ind. Var / Dep. Var	***M2*** **Customized IS**
Environment context	
Complexity	-0.144
Munificence	-0.459
Dynamism	0.779**
Business environment	
Geographical scope	0.017
Foreign sales	-0.009
Vertical Integration	-0.819
IS vendor support	-0.117
Customer dependence	-0.012*
Internal context	
IT management capabilities	0.143
Control variables	
Size	0.631†
Age	0.151
MSERV	0.070
ISERV	-0.074
HTECH	0.019
MTECH	0.065
On order sales	0.251
Catalogue sales	0.206
Sub supplier	0.153
Constant	-1.938
Fit indexes	
Wald chi square	21.30†
Pseudo R-Square	12.83%

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 22 First step of the treatment regression models – The dependent variable is "Customized IS" (Data source: Survey 2011)

Table 23 and Table 24 contain results of the second step of the treatment regression models, where I tested the following hypotheses:

- H2: SMEs internal context does not affect the development of internally-oriented IT-based capabilities (H2.a), whereas affects positively the development of externally-oriented IT-based capabilities (H2.b).
- H4: The complexity of the business environment increases the IT assimilation time.
- H5: The relationship between the strategic dependence on few customers and the development of IT-based capabilities is curvilinear (U-shaped), with the lower level at intermediate strategic customer dependence.
- H6. The degree of customization of IS (H6.a) and the support of IS vendors (H6.b) positively affect the development of IT-based capabilities.
- H8. Environmental conditions do not affect the extent to which firms develop internally-oriented IT-based capabilities.
- H9. In dynamic industries, the higher the size of the firm is, the more developed its externally-oriented IT-based capabilities will be.
- H10. Environmental munificence positively affects the development of externally-oriented IT-based capabilities.
- H11. SMEs that exhibit high levels of product complexity and vertical integration are more likely to develop externally-oriented IT-based capabilities.

Specifically, three models were run for each IT-based capability. The first was an OLS model (it was run in order to make a comparison with the treatment regression model, but it was not used for validate the hypotheses), the second contained results of the treatment regression model where all the independent variables were included (without the interaction variables), while the third model contained all variables (including also the interaction variables).

Dep. Var.	*M3a*	*M3b*	*M3c*	*M4a*	*M4b*	*M4c*	*M5a*	*M5b*	*M5c*
	Improvements in internal efficiency			**Improvements in NPD capabilities**			**Improvements in MKT knowledge**		
Ind. Var.	*OLS*	*Treat.*	*Treat.*	*OLS*	*Treat.*	*Treat.*	*OLS*	*Treat.*	*Treat.*
Environment context									
Complexity (C)	-0.085	0.174	-0.103	0.079	0.259*	0.155	-0.004	0.221*	-0.035
Munificence	0.139	0.125	0.183	0.062	0.102	0.126	0.177	0.221†	0.252*
Dynamism (D)	-0.182	-0.057	-0.049	-0.242	-0.063	-0.526	-0.578	-0.006	-0.707†
Business environment									
Geographical scope	0.120*	0.125†	0.127*	-0.027	-0.035	-0.036	0.126*	0.129*	0.131*
Foreign sales	0.003	0.005*	0.005*	0.001	0.001	0.001	0.005*	0.005*	0.005*
Vertical Integration (VI)	-0.694	-0.396	-0.658	-0.489	-0.317***	-2.981*	-0.093*	-0.707*	-1.005**
IS vendor support	0.206†	0.242*	0.236*	-0.109	-0.123	-0.148	-0.077	-0.062	-0.070
Customer dependence	-0.015	0.001	-0.013	-0.004	-0.002	-0.004	-0.022†	-0.001	-0.021†
Internal context									
IT management capabilities	0.247***	0.207**	0.205**	0.362***	0.388***	0.380***	0.282***	0.327***	0.313***
IT adoption									
Customized IS	0.227*	0.983***	1.045***	0.205†	1.094**	1.066**	0.239**	1.038***	1.107***
Moderating effects									
Size x D	0.095	...	0.091	0.203	...	0.439**	0.399	...	0.467†
C x VI	0.872	...	0.798	0.549	...	0.457	0.814	...	0.911†
Customer dependence^2	0.001	...	0.001	0.205	...	0.001	0.001†	...	0.001†
Control variables									
Size	-0.080	-0.145	-0.192	0.534†	-0.125	0.403	-0.429*	-0.344*	-0.637*
Age	0.072	0.045	0.053	0.025	0.026	0.018	-0.092	-0.127†	-0.133†
MSERV	0.006	-0.002	0.026	-0.006	-0.024	0.053	0.166	0.092	0.108
ISERV	0.304†	0.295†	0.349*	0.322†	0.295†	0.311†	0.173	0.025	0.073
HTECH	-0.111	-0.086	-0.077	0.096	0.113	0.109	0.658*	0.664*	0.665*
MTECH	0.085	0.125	0.091	0.058	0.092	-0.011	-0.275	-0.208	-0.293
On order sales	-0.041	-0.025	-0.041	-0.005	0.004	0.031	-0.012	-0.002	-0.015
Catalogue sales	0.171	0.144	0.142	0.051	0.064	0.074	0.041	0.053	0.052
Sub supplier	-0.152	-0.168	-0.158	-0.115	-0.170	-0.119	-0.047	-0.065	-0.058
Constant	-0.062	-0.281	0.054	0.021	-0.344	-1.038	1.192**	0.627†	1.447**
Fit indexes									
Log likelihood	n.a.	-273.929	-271.807	n.a.	-328.855	-323.276	n.a.	-330.241	-325.916
Wald Chi-Square	n.a.	72.15***	78.05***	n.a.	69.39***	84.07***	n.a.	69.59***	82.51***
Rho	n.a.	-0.681†	-0.677†	n.a.	-0.615†	-0.658†	n.a.	-0.615†	-0.683*
F Regression	3.68***	n.a.	n.a.	3.83***	n.a.	n.a.	3.41***	n.a.	n.a.
R-Square	27.52%	n.a.	n.a.	23.70%	n.a.	n.a.	26.63%	n.a.	n.a.

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10% (n.a. = not applicable)

Table 23 OLS and treatment regression models with the IT-based capabilities as dependent variables (part I) (Data source: Survey 2011)

	M6a	***M6b***	***M6c***	***M7a***	***M7b***	***M7c***
Dep. Var.	**Improvements in SCM capabilities**			**Business growth**		
Ind. Var.	*OLS*	*Treat.*	*Treat.*	*OLS*	*Treat.*	*Treat.*
Environment context						
Complexity (C)	0.060	0.259*	0.107	-0.301	0.085	-0.296
Munificence	0.160	0.278*	0.258*	0.301*	0.226†	0.298*
Dynamism (D)	0.299	-0.222†	-0.243	-0.166	-0.076	-0.197
Business environment						
Geographical scope	-0.001	-0.003	-0.006	0.131*	0.120†	0.133†
Foreign sales	-0.001	0.001	0.001	0.007*	0.008*	0.007*
Vertical Integration (VI)	-0.598	-0.325	-0.496	-1.080*	-0.707	-1.044*
IS vendor support	-0.049	-0.042	-0.063	0.121	0.089	0.122
Customer dependence	-0.017	0.002	-0.016	0.020	0.001	0.021
Internal context						
IT management capabilities	0.313***	0.297***	0.289***	0.314***	0.318***	0.310***
IT adoption						
Customized IS	0.226*	1.011***	0.981***	0.417**	0.885†	0.871†
Moderating effects						
Size x D	-0.242	...	-0.302	0.042	...	0.057
C x VI	0.587	...	0.518	1.240†	...	1.215†
Customer dependence^2	0.001†	...	0.001†	-0.001	...	-0.001
Control variables						
Size	0.022	-0.281†	-0.082	-0.426*	-0.452**	-0.518*
Age	0.028	-0.009	0.004	0.015	-0.005	0.005
MSERV	-0.249*	-0.338*	-0.312	0.001	-0.051	-0.022
ISERV	0.092	-0.012	0.069	0.146	0.168	0.131
HTECH	0.290	0.129	0.115	0.265	0.397	0.337
MTECH	0.066	0.052	0.062	-0.137	-0.083	-0.133
On order sales	-0.005	-0.033	-0.038	0.017	0.022	-0.007
Catalogue sales	-0.056	-0.040	-0.037	0.204	0.186	0.169
Sub supplier	0.153	0.112	0.143	-0.112	-0.126	-0.123
Constant	0.191	0.278	0.596	-0.006	0.062	0.026
Fit indexes						
Log likelihood	n.a.	-296.451	-303.386	n.a.	-381.519	-379.022
Wald Chi-Square	n.a.	66.57***	64.91***	n.a.	52.11***	58.30***
Rho	n.a.	-0.670**	-0.651**	n.a.	-0.332	-0.317
F Regression	2.85***	n.a.	n.a.	3.89***	n.a.	n.a.
R-Square	20.56%	n.a.	n.a.	22.28%	n.a.	n.a.

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 24 OLS and treatment regression models with the IT-based capabilities as dependent variables (part II) (Data source: Survey 2011)

In order to test hypotheses related to the assimilation process of IT solutions previously reminded, models 3c, 4c, 5c, 6c and 7c were taken into account.

Influence of the internal context on the IT assimilation process

Regard hypothesis H2, where I stated that "SMEs internal context does not affect the development of internally-oriented IT-based capabilities (H2.a), whereas affects positively the development of externally oriented IT-based capabilities (H2.b)", the coefficients of the IT management capabilities is positive in all the regression models run, and not only in the regression models related to the externally oriented IT-based capabilities. Therefore, SMEs with higher IT management capabilities are most able to increase their operational and strategic agility. This suggests that complementary investment to IT capital are necessary in order to develop IT-based capabilities. This finding also suggest that SMEs which lack in the IT managerial capabilities for exploiting new technologies are not able to successfully make planned and incremental IT investments. Indeed, the investments in organizational capital influence the pervasiveness of IT use in firm routines, the development of IT-based capabilities not only externally-oriented but also internally-oriented, and therefore the overall capacity of accumulate capabilities over the time. Specifically, SMEs with an appropriate internal context are more likely to accumulate all types of IT-based capabilities, also the internally-oriented. This happens because such companies incur into adjustment costs in their organization also in case efficiency levels have to be achieved. For example, SMEs can achieve a better use of IT in market relationships only once they have automated some back office activities which enable to manage the large amount of data about customers. Therefore, hypothesis H2a was not supported, while H2b was supported.

Influence of the business environment on the IT assimilation process

I stated in hypotheses 4 that "The complexity of the business environment negatively influence the IT assimilation". For finding support to such hypothesis, three variables were used for representing the business environment complexity: the geographical scope, the foreign sales and the levels of vertical integration. The geographical scope and the foreign sales exerted a positive and direct effect on the creation of internally-oriented IT-based capabilities and on the improvements in market knowledge and in business growth (see Models 3c, 5c and 7c). Whereas,

companies that are vertically integrated were less likely to improve their new product development capabilities, market knowledge and business growth. Therefore, the assimilation dynamics were more likely under some conditions of business environmental complexity. SMEs are able to assimilate under high level of complexity of the business environment, probably because the level of personalization of their IS are well-tailored to the specificities of the tasks that the sub-units of SMEs have to carry out. Thus, H4 was partially supported.

I found support for hypothesis H5 where I stated that the relationship between the strategic dependence on few customers and the development of IT-based capabilities is curvilinear (U-shaped), with the lower IT assimilation at an intermediate level of strategic customer dependence. Indeed, I found in models 5c and 6c a positive relationship between the squared value of the dependence on few customers by a firm and the improvements in market knowledge and in supply chain management capabilities. These results show that the customer dependence exercised a positive impact on the increase of the market knowledge and supply chain management capabilities. Indeed, SMEs have higher difficulties in developing such capability in case of "medium" dependence on few strategic customers. Specifically, high levels of dependence are beneficial in the routinization stage of technologies, since the experience of large customers may facilitate the organizational learning of small partners regarding innovation routinization (such firms are more likely to exploit their customers' desire for the integration of IS supporting marketing relationships).

In hypothesis H6, I stated that "The degree of customization of IS (H6.a) and the support of IS vendors (H6.b) positively affect the development of IT-based capabilities". Testing hypothesis H6.a, I found that SMEs that adopted customized IS had higher assimilation levels of the IT solutions adopted (the contribution of the adoption of customized IS on the development of IT-based capabilities was always significant). Therefore, hypothesis H6.a was supported. Looking at the contribution of IS vendors on the assimilation of IT based resources, I observed that it was only significant in case of internally-oriented IT-based capabilities (see model M3c). This evidence shows that the support of IS vendors lower the knowledge barriers and make easier for small businesses to adopt and achieve high efficiency levels. This

happens because the IS vendors try to fit the needs of SMEs in IT implementations though the enhancement of the degree of IS personalization that allows SMEs to respond in a more rapidly way. Indeed, the customization of IS enables to lower the rigidity and the less flexibility that an IS introduces, two aspects that are source of competitive advantage for SMEs. However, the support of IS vendors impact only on the development of internally-oriented IT-based capabilities, and has not any impact on the externally-oriented IT-based capabilities, because also IT managerial capabilities are needed (as found in hypothesis 2). Therefore, H6.b was partially supported.

Influence of the environmental conditions on the IT assimilation process

I found support to hypothesis H8 where I asserted that internally focused IT-based capabilities were uniformly distributed in relation to the environmental conditions. Model 3c highlighted that the environmental dummies did not exert any significant effect on the development of such capability. This is a result that confirms that the IT has the attributes of a GPT. Indeed, I found that the internally-focused IT-based capabilities exhibits a uniform diffusion across environments as the underlying technologies create few obstacles to their implementations and require little effort to adopt to environmental conditions. Consequently, it may be expected that firms' heterogeneity in some business processes decreases as the information technologies supporting these processes are subject to increasing standardization of their features an a progressive cost reduction.

By contrast, in hypotheses H9, H10 and H11 the influence of environmental conditions on the development of externally oriented IT-based capabilities were verified.

Specifically, the data supported hypothesis H9 where I stated that "In dynamic industries, the higher the size of the firm is, the more developed its externally-oriented IT-based capabilities will be". Results showed the moderating effect of the firm size on the relationship between environmental dynamism and the development of externally-focused IT-based capabilities (see models 4c and 5c). It was found that smaller businesses suffer more from their inability to adapt their IS efficiently and effectively to changing requirements in turbulent environments. Specifically, in dynamic environments, medium-sized enterprises were more likely than their smaller

counterparts to improve their market knowledge capabilities and their new product development capabilities (Figure 18).

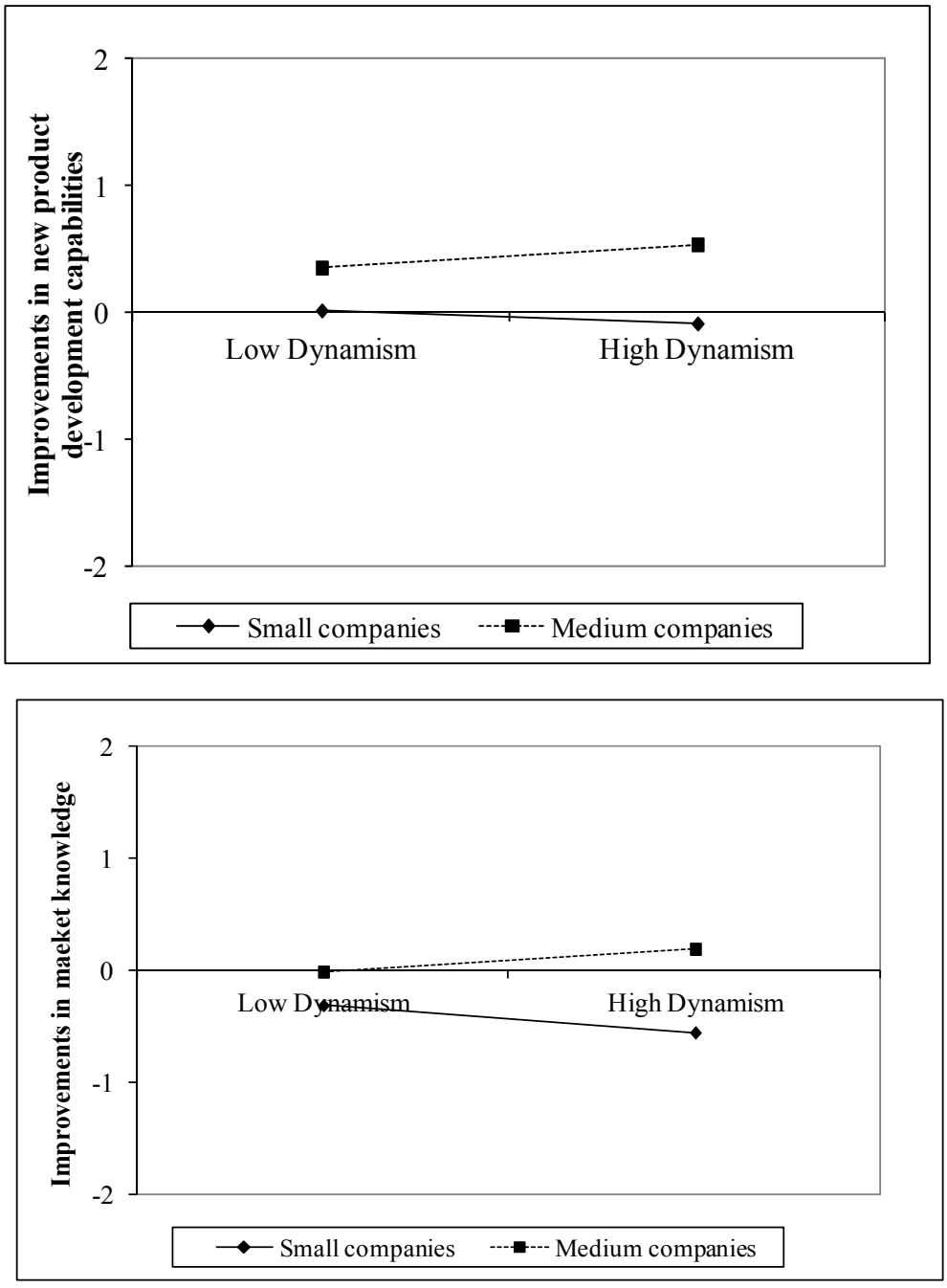
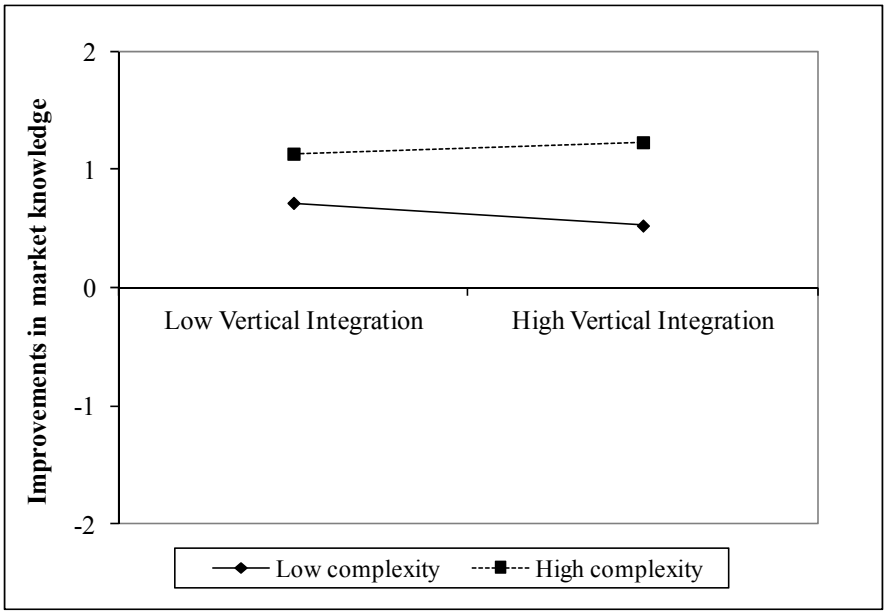


Figure 18 Two-way interaction effects: size and environmental dynamism on the development of IT-based capabilities (Data source: Survey 2011)

The data also supported H10 where I stated that "Environmental munificence positively affects the development of externally-oriented IT-based capabilities. Indeed, companies that operate in munificent environments were more likely to develop externally-oriented IT-based capabilities (see models 5c, 6c and 7c). Specifically, results showed that munificent environments offer SMEs to enter in

various markets segments, and offer more opportunities for collaboration with partners, customers and suppliers. The fact that the munificence is associated with superior externally-focused IT-based capabilities but not with the improvements of internal efficiency, confirms that the way through which SMEs use IT solutions adopted is constrained by some trade-offs at both the operational and strategic level (e.g. Chang and Hughes, 2011).

In hypothesis H11 I stated that "SMEs that exhibit high levels of product complexity and vertical integration are more likely to develop externally-oriented IT-based capabilities". Results showed that the companies with a complex product and that were vertically integrated were more likely to assimilate the IS adopted, since they had more information processing requirements which could be managed only through adopting and assimilating IT-based solutions. Given that the contribution this interaction variable was significant in models 5c and 7c, H11 was supported (Figure 19).



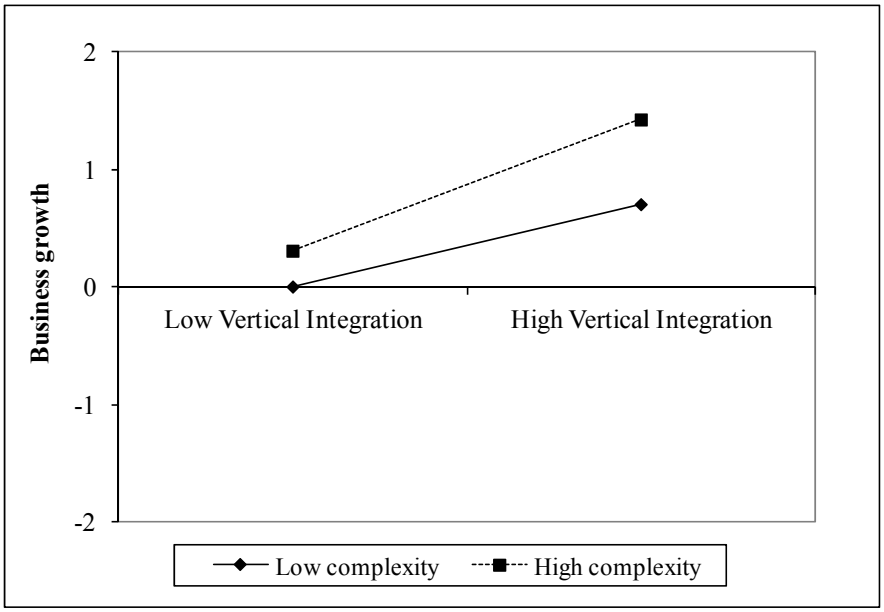


Figure 19 Two-way interaction effects: complexity and vertical integration on the development of IT-based capabilities (Data source: Survey 2011)

6.3.3 The moderating role of environmental context on firm economic performance

To estimate the effect of the moderating effect of the environmental conditions on the relationship between the development of IT-based capabilities and firm economic performance, 10 OLS (one for each combination of IT-based capability and performance indicator) and 20 treatment regression models (two for each combination of IT-based capability and performance indicator) were used in order to deal with endogeneity problems as previously specified. The dependent variable chosen in the first step of each treatment regression model was the dichotomized value of each IT-based capability, while the dependent variable of the second step of the treatment regression model was the ROA differential or the revenue growth. Table 25 contains the results of the first step of each treatment regression model, which is a probit regression model. Overall, results were consistent with those previously found.

Results of the OLS and of the second step of each treatment regression model were shown in Table 26, Table 27 and Table 28. Specifically, three models were run for each combination of IT-based capability and firm economic performance. The first model was an OLS model, whose aim was to compare results with the one of the treatment regression models, the second contained results of the treatment regression model where all the independent variables were included (without the interaction

variables), while the third model contained results of the treatment model with all the dependent variables (with also the interaction variables)[18].

	M8 **Improvements in internal efficiency**	***M9*** **Improvements in new product development capabilities**	***M10*** **Improvements in market knowledge**	***M11*** **Improvements in supply chain management capabilities**	***M12*** **Business growth**
Environment context					
Complexity (C)	0.561	0.619	0.754†	0.802†	-0.305
Munificence	0.272	0.072	-0.067	0.238	0.855***
Dynamism (D)	0.711	0.757	-0.578	0.950	-0.502
Business environment					
Geographical scope	0.101	0.054	0.289*	0.093	0.239†
Foreign sales	0.002	0.005	0.011†	0.001	0.009†
Vertical Integration (VI)	-0.399	-0.170	-0.030	-0.033	-1.064
IS vendor support	0.311	-0.287	-0.020	-0.268	0.242
Customer dependence	-0.008	0.017	-0.063*	-0.010	0.048†
Internal context					
IT management capabilities	0.552***	0.763***	0.360**	0.560***	0.347*
IT adoption					
Customized IS	0.356	0.177	0.293	0.238	0.203
Moderating effects					
Size x D	-0.474	-0.236	0.506	-0.592	0.169
C x VI	0.248	-0.612	-1.244	-1.071	0.528
Customer dependence^2	0.001	-0.001	0.001*	0.001	-0.001*
Control variables					
Size	0.761*	0.470	-0.246	0.410	-0.916†
Age	0.205†	0.261†	-0.199	-0.157	-0.029
MSERV	-0.205	0.405	0.377	-0.467	-0.243
ISERV	0.535	0.712†	0.394	-0.352	-0.149
HTECH	-0.160	0.902	1.307	0.586	1.475**
MTECH	-0.323	0.072	-0.528	-0.241	-0.072
On order sales	-0.070	0.352†	0.009	0.199	-0.233
Catalogue sales	0.427	0.068	0.206	-0.274	0.279
Sub supplier	-0.047	0.227	-0.055	0.127	0.197
Constant	-2.060	-2.159	0.786	0.438	1.830
Fit indexes					
Wald chi square	46.42**	56.35***	49.78**	35.77*	44.09**
Pseudo R-Square	16.53%	20.66%	16.63%	11.48%	15.97%

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 25 First step of the treatment regression model – Dichotomized IT-based capabilities as dependent variable (Data source: Survey 2011)

[18] For brevity the control variables related everyone related to each industry defined at two digit level of the ATECO code were omitted in the tables that contain models' results.

Ind. Var./Dep. Var.	M 13a ΔROA *OLS*	M 13b ΔROA *Treat.*	M 13c ΔROA *Treat.*	M 14a RG *OLS*	M 14b RG *Treat.*	M 14c RG *Treat.*	M 15a ΔROA *OLS*	M 15b ΔROA *Treat.*	M 15c ΔROA *Treat.*	M 16a RG *OLS*	M 16b RG *Treat.*	M 16c RG *Treat.*
IT-based capabilities												
CAP considered	**Improvements in internal efficiency**						**Improvements in new product development capabilities**					
CAP coefficient	0.086	7.345***	7.947***	0.002	0.327**	0.384**	0.305	6.993***	7.620***	0.078	0.503***	0.518***
Environmental context												
DYN	-0.598	-0.525	-1.337	-0.070	-0.062	0.018	-0.141	-0.461	0.142	-0.061	-0.078	-0.022
MUN	-0.591	0.465	1.684	0.041	0.126†	0.130	-1.080	-0.956	-0.994	0.115	0.132†	0.110
Moderating effects												
DYN x CAP	0.495	…	1.429	0.018	...	-0.136†	-1.161	...	-1.673†	0.012	...	-0.125†
MUN x CAP	0.116	...	-1.908†	0.065	…	-0.014	0.380	…	0.412	0.085	…	0.064
Control variables												
Y_2007[19]	-0.395***	-0.404***	-0.405***	0.001	0.001	0.001	-0.404	-0.455***	-0.457***	0.001	0.001	0.001
Size	0.875	-0.830	-0.753	0.110	-0.045	-0.040	0.554	-0.992	-0.965	0.134*	0.005	0.005
Fit indexes												
Log likelihood	n.a.	-786.912	-784.785	n.a.	-185.843	-184.541	n.a.	-943.882	-942.660	n.a.	-160.254	-158.539
Wald Chi-Square	n.a.	161.94***	175.62***	n.a.	83.29***	86.72***	n.a.	143.10***	146.20***	n.a.	89.34***	88.83***
Rho	n.a.	-0.820**	-0.844***	n.a.	-0.612*	-0.587*	n.a.	-0.812†	-0.815†	n.a.	-0.929**	-0.925**
F Regression	63.12***	n.a.	n.a.	33.12***	n.a.	n.a.	65.15***	n.a.	n.a.	4.82***	n.a.	n.a.
Adj R-Square	27.15%	n.a.	n.a.	20.08%	n.a.	n.a.	26.13%	n.a.	n.a.	18.84%	n.a.	n.a.

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 26 Determinants of firm profitability: treatment regression models (Part I) (Data source: Survey 2011)

[19] It refers to the value of the economic performance in year 2007.

Ind. Var./Dep. Var.	**M 17a ΔROA** *OLS*	**M 17b ΔROA** *Treat.*	**M 17c ΔROA** *Treat.*	**M 18a RG** *OLS*	**M 18b RG** *Treat.*	**M 18c RG** *Treat.*	**M 19a ΔROA** *OLS*	**M 19b ΔROA** *Treat.*	**M 19c ΔROA** *Treat.*	**M 20a RG** *OLS*	**M 20b RG** *Treat.*	**M 20c RG** *Treat.*
IT-based capabilities												
CAP considered		**Improvements in market knowledge**						**Improvements in supply chain management capabilities**				
CAP coefficient	1.158	4.467†	5.807**	0.125	0.613***	0.460***	1.814†	9.329***	7.871***	0.118	0.512***	0.379**
Environmental context												
DYN	0.195	0.187	1.016	-0.145†	-0.053	-0.145†	-0.600	0.447	-0.200	-0.107	-0.038	-0.059
MUN	0.313	-0.851	-0.428	0.100	0.130†	0.056	-1.606*	-0.367	-1.140	0.004	0.078	-0.019
Moderating effects												
DYN x CAP	-1.445	…	-2.191	0.175	…	0.201	1.150	…	1.221	0.083	…	0.044
MUN x CAP	-0.963	…	-0.712	0.094	...	0.181†	1.162	…	1.607	0.142	...	0.213*
Control variables												
Y_2007	-0.410***	-0.494***	-0.488***	-0.001†	-0.001*	-0.02†	-0.409***	-0.452***	-0.449***	-0.001†	-0.001	-0.001
Size	0.752	0.525	0.556	0.118†	0.035	0.025	0.572	-0.147	-0.122	0.107†	0.073	0.078
Fit indexes												
Log likelihood	n.a.	-748.355	-746.347	n.a.	-222.482	-219.772	n.a.	-944.539	-943.466	n.a.	-252.264	-249.641
Wald Chi-Square	n.a.	81.02***	84.99***	n.a.	91.79***	95.89***	n.a.	234.93***	252.09***	n.a.	75.64***	82.72***
Rho	n.a.	-0.581†	-0.579†	n.a.	-0.862***	-0.894***	n.a.	-0.914***	-0.917***	n.a.	-0.783***	-0.794***
F Regression	7.20***	n.a.	n.a.	7.32***	n.a.	n.a.	6.24***	n.a.	n.a.	11.49***	n.a.	n.a.
Adj R-Square	21.71%	n.a.	n.a.	22.64%	n.a.	n.a.	28.74%	n.a.	n.a.	19.27%	n.a.	n.a.

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 27 Determinants of firm profitability: treatment regression models (Part II) (Data source: Survey 2011)

Ind. Var./Dep. Var.	**M 21a ΔROA** *OLS*	**M 21b ΔROA** *Treat.*	**M 21c ΔROA** *Treat.*	**M 22a RG** *OLS*	**M 22b RG** *Treat.*	**M 22c RG** *Treat.*
IT-based capabilities						
CAP considered			**Business growth**			
CAP coefficient	2.318†	4.006†	6.397*	0.195†	0.747***	0.815***
Environmental context						
DYN	-0.400	-0.067	0.058	-0.011	-0.040	-0.011
MUN	0.099	-0.514	-0.412	0.185**	0.191***	0.187**
Moderating effects						
DYN x CAP	-1.941	...	-3.207†	-0.122	…	-0.105
MUN x CAP	1.137	…	0.522	0.090	…	0.023
Control variables						
Y_2007	-0.411***	-0.441***	-0.434***	-0.001	-0.001	-0.001
Size	1.438	1.357	1.625†	0.126†	0.103†	0.102†
Fit indexes						
Log likelihood	n.a.	-994.354	-992.691	n.a.	-189.710	-189.058
Wald Chi-Square	n.a.	94.17***	99.12***	n.a.	189.49***	198.29***
Rho	n.a.	-0.387†	-0.407†	n.a.	-0.939***	-0.935***
F Regression	5.11***	n.a.	n.a.	21.81***	n.a.	n.a.
Adj R-Square	23.34%	n.a.	n.a.	18.96%	n.a.	n.a.

***p-value < 0.1%; ** p < 1%; * p < 5%; †<10%

Table 28 Determinants of firm profitability: treatment regression models (Part III) (Data source: Survey 2011)

Overall, in all the models, the IT-based capability development had a positive and significant contribution on the achievement of higher economic performance, confirming findings of previous studies (e.g. Tambe et al., 2012).

In hypothesis H12, I stated that "The lower the environmental dynamism (H12.a) and munificence (H12.b), the higher is the impact of internally-oriented capabilities on firm economic performance". In run models 13c and 14c for testing this hypothesis. Results showed that the impact of the internally-oriented IT-based capabilities was lower in dynamic and munificent environments (Figure 20). Indeed, such capabilities might have a more critical importance on a firm's competitiveness in more mature and stable environments, since these environments forgive less the operational inefficiency of firms. Therefore, I found support of hypothesis H12.

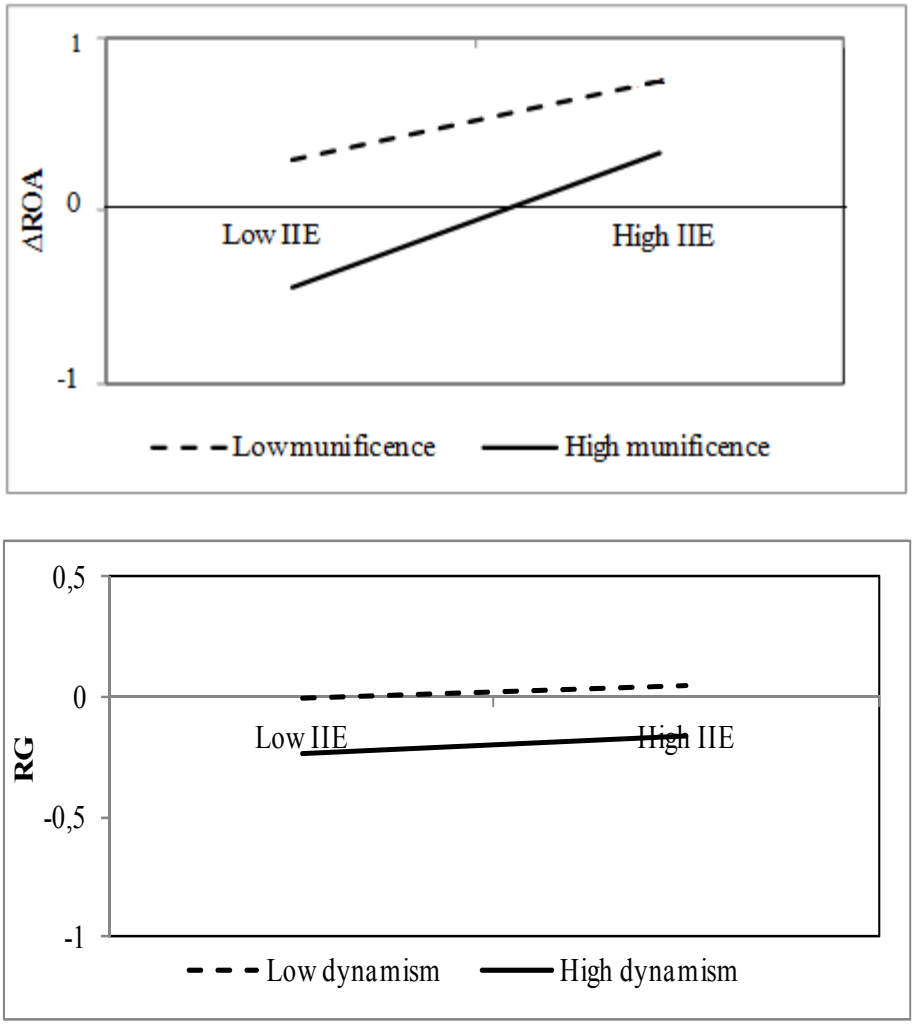
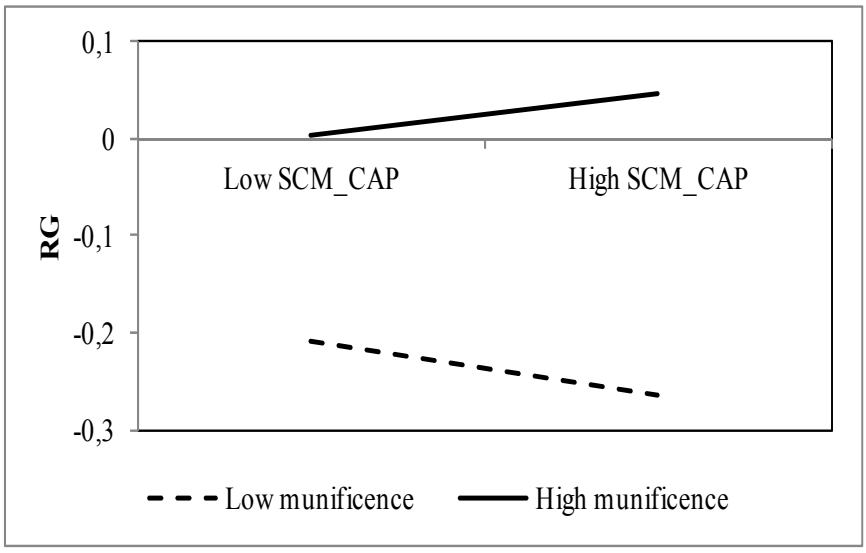


Figure 20 Two-way interaction effects: internally-oriented IT-based capabilities and environmental dynamism on firm economic performance (Data source: Survey 2011)

In the models related to the development of externally-oriented IT-based capabilities (models 15c, 16c, 17c, 18c, 19c, 20c, 21c and 22c), I tested the hypotheses H13 where I stated that "The higher the environmental munificence, the higher is the impact of externally-oriented IT-based capabilities on firm economic performance" and H14 where I stated that "The higher the dynamism, the lower is the impact of a firm's IT-based capabilities on its profitability differentials respect to competitors". Specifically, since the moderating effect of the environmental dynamism on the relationship between the development of externally-oriented IT-based capabilities and the firm economic performance were negative, and since the moderating effect of the environmental munificence was positive, I found support for both the hypotheses.

These findings provide some degree of support to arguments from RBV and to contingency approaches to management of IS. Indeed, consistently with contingency theory, I found evidence supporting that in more munificent industries returns from IT investments are higher when firms use IT and for supporting its relationships with customers and suppliers (Figure 21).



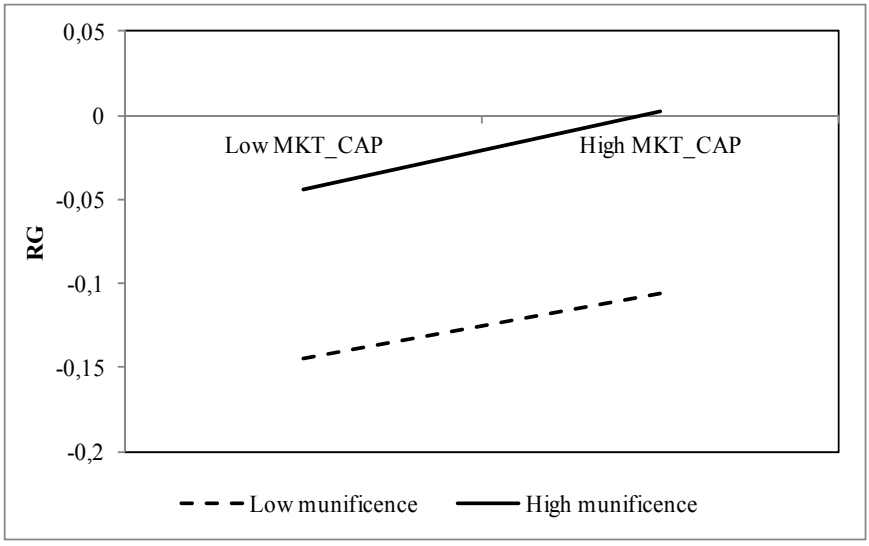
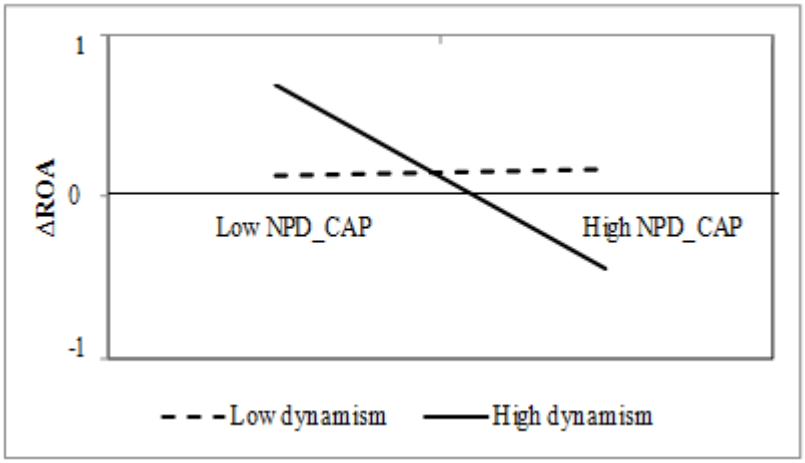


Figure 21 Two-way interaction effects: externally-oriented IT-based capabilities and environmental munificence on firm economic performance (Data source: Survey 2011)

However, results also confuted in part contingency theory, by showing that in more dynamic industries, capabilities that support a firm's external orientation have a lower strategic value. Instead, according to contingency theory, these capabilities would be more valuable in dynamic environments due to the importance of market responsiveness to deal with discontinuity (Figure 22).



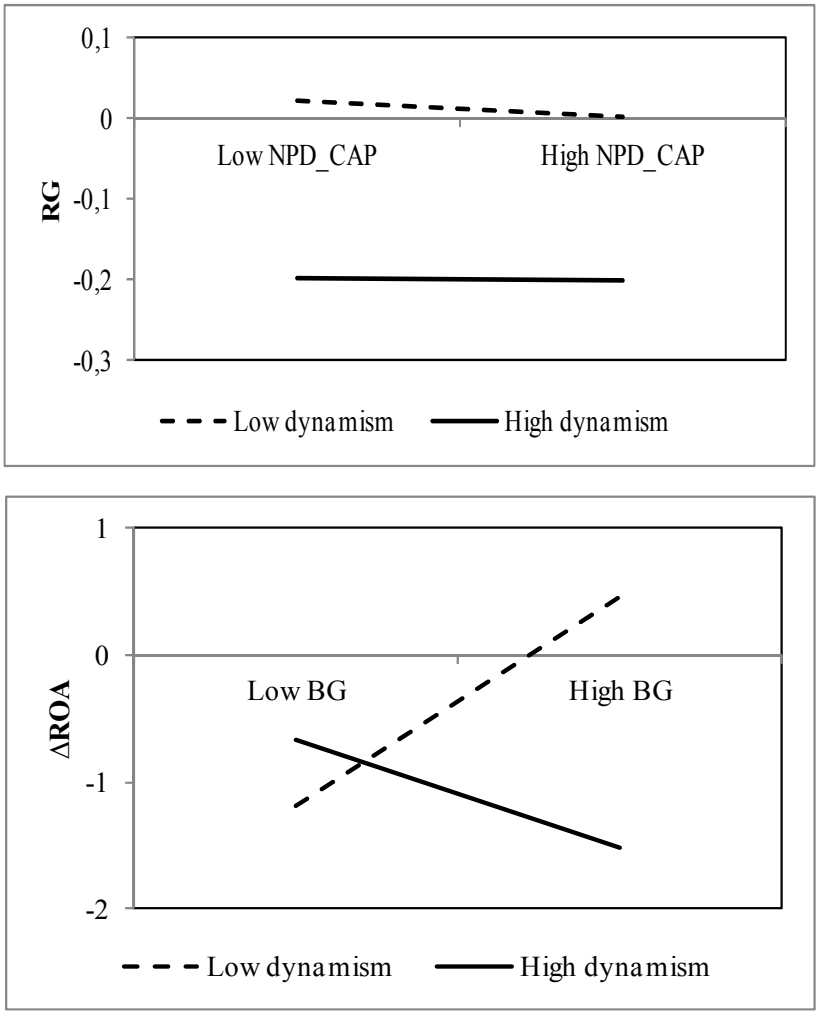


Figure 22 Two-way interaction effects: externally-oriented IT-based capabilities and environmental dynamism on firm economic performance (Data source: Survey 2011)

A reason for this result may lie in a classical RBV argument. Indeed, in industries exhibiting less discontinuities, firms are more likely to sustain superior economic returns when they differentiate their competencies base respect to competitors in a way where IT is used to execute "proactive" strategies based on enhancing their products development processes. In stable environments, this choice may be more successful in generating competitive advantages respect to "defensive" strategies focused exclusively on efficiency improvements.

Another argument for explaining the lower returns from IT investments in turbulent industries may lie in SME's particularities and in the inherent nature of information systems. Despite IS research (e.g. Sambamurthy et al., 2003) emphasizes that in turbulent environments IT potentially allows firms to improve their strategic flexibility and to undertake a greater number of competitive actions, in SMEs' IS

may decrease their operational and strategic agility. Indeed, the more firms have achieved business processes integration through IT, the harder is to reconfigure their structure around new "organizational architectures" to respond to environmental changes (Brandyberry et al. 1999). Reconfigurations of organizational structures based on intensive use of IT may imply complex adjustments dynamics, especially in smaller firms where IT investments generate critical sunk costs. This argument appears consistent with recent evidence (Giuri et al., 2008) showing weak complementarities in SMEs in combining IT expenditures with investments in human capital and in organizational transformations. Given the simplicity of SMEs' organizational structures, it appears that an intensive use of IT associated with skilled people and new organizational practices may unnecessarily overburden the educated employees. In other words, following the discussion above, we can posit that when SMEs deploy IS in their organizational routines, the rigidity of such technologies may impede them to fully grasp their benefits. This occurs as under high environmental turbulence SMEs have to sustain considerable adjustment costs to reconfigure their IT solutions and the associated routines. By contrast, when firms have to reconfigure frequently their routines, informal coordination channels and "labour intensive" control heuristics may result more flexible than IS.

To sum up, Table 29 contains the hypotheses validation summary, and Table 30 the summary of the main findings related to each hypothesis.

Hypothesis		Supported?
H1	Firm internal context influences positively the earlier adoption of IS.	Supported
H2	SMEs internal context does not affect the development of internally-oriented IT-based capabilities (H2.a), whereas affects positively the development of externally oriented IT-based capabilities (H2.b).	H2.a not supported, H2.b supported
H3	The complexity of the business environment influences positively an earlier adoption of IS.	Supported
H4	The business environment complexity negatively influence the IT assimilation.	Partially supported.
H5	The relationship between the strategic dependence on few customers and the development of IT-based capabilities is curvilinear (U-shaped), with the lower level at intermediate strategic customer dependence.	Supported
H6	The degree of customization of IS (H6.a) and the support of IS vendors (H6.b) positively affect the development of IT-based capabilities.	Supported
H7	The higher the environmental munificence (H7.a), the lower the environmental dynamism (H7.b) and the higher the environmental complexity (H7.c), the earlier is the adoption of IT resources in SMEs.	H7.a not supported, H7.b and H7.c supported.
H8	Environmental conditions do not affect the extent to which firms develop internally-oriented IT-based capabilities.	Supported
H9	In dynamic industries, the higher the size of the firm is, the more developed its externally-oriented IT-based capabilities will be.	Supported
H10	Environmental munificence positively affects the development of externally-oriented IT-based capabilities.	Supported
H11	SMEs that exhibit high levels of product complexity and vertical integration are more likely to develop externally-oriented IT-based capabilities.	Supported
H12	The lower the environmental dynamism (H12.a) and munificence (H12.b), the higher is the impact of internally-oriented capabilities on firm economic performance.	Supported
H13	The higher the environmental munificence, the higher is the impact of externally-oriented IT-based capabilities on firm economic performance.	Supported
H14	The higher the dynamism, the lower is the impact of a firm's IT-based capabilities on its profitability differentials respect to competitors.	Supported

Table 29 Hypotheses validation summary

Ind. Var. / Dep. Var.	Adoption of IS	Improvements in internal efficiency	Improvements in new product development capabilities	Improvements in market knowledge	Improvements in supply chain management capabilities	Business growth
Environmental context						
Complexity	H7. In dynamic environments, IS are adopted later, while earlier in complex environments.	H8. Internally-oriented IT-based capabilities development is not influenced by environmental conditions.	H9. Medium sized companies under high levels of environmental dynamism are more likely to increase their new product development capabilities and their market knowledge.			
Munificence		H12. SMEs have higher economic performance from the development of internally-oriented IT-based capabilities under low levels of dynamism and munificence.	H10. SMEs in munificent environments are more likely to develop the externally-oriented IT-based capabilities: improvements in market knowledge, improvements in supply chain management capabilities and business growth.			
Dynamism			H13 and H14. SMEs have higher economic performance from the development of externally-oriented IT-based capabilities under low levels of dynamism, but high levels of munificence.			
			H11. SMEs that exhibit high levels of product complexity and vertical integration are more likely to increase their market capabilities and to have higher rates of business growth.			
Business environment						
Geographical scope Foreign sales Vertical Integration	H3. SMEs that sell abroad are more likely to adopt earlier IS.	H4. SMEs with a high geographical scope and that sale abroad assimilate to a greater extent IT solutions.				
IS vendor support		H6a. SMEs that have the support of IS vendors are more able to develop internally-oriented IT-based capabilities.				
Customer dependence		H5. SMEs that are highly dependent by very few customers or by a large number of customers are more likely to improve their market knowledge and supply chain management capabilities.				
Internal context						
IT management capabilities	H1. SMEs are more likely to adopt IS in case they have developed IT managerial capabilities.	H2. IT management capabilities affects positively both the development of externally-oriented IT-based capabilities and of internally-oriented IT-based capabilities.				
Customized IS		H6b. SMEs that adopt customized IS are more likely to assimilate IT solutions.				

Table 30 Summary of the main findings

Chapter 7

7. CONCLUSION AND IMPLICATIONS

This chapter shows the conclusion of this research work and the practical implications for small firm managers and policy-makers. The final section presents limitations and suggestions for future studies.

7.1 Contributions for theory

This study was initiated with the purpose of advancing the knowledge about factors that influence the IT accumulation, assimilation and competitiveness in SMEs. In particular, I proposed an integrated model for evaluating the role of IT-based resources, the role of both internally-oriented and externally-oriented IT-based capabilities, on the process that starts from the decision of investing in information technologies to the achievement of high economic performance in SMEs. The specific aim was to overcome the narrow view of the studies conducted until now, that have analyzed such phenomena at a high level of aggregation choosing as unit of analysis mainly the large companies (e.g. Drnevich and Kriauciunas, 2011). Indeed, most studies in the domain of the RBV have mainly focused on the effect of a single resource and/or of a single capability on performance of large companies. Therefore, based on the statement of Wade and Hulland (2004), which underlined that the literature has not widely applied the RBV to the IS studies, this research thesis tries to accomplish such request by applying the RBV and the contingency perspective at the SMEs case.

In this study, two central research questions were theorized and examined: 1) *What conditions (in terms of environmental, internal and business environment contexts) influence IT accumulation and IT-based capabilities development?* 2) *Under what environmental conditions are IT-based capabilities more or less likely to contribute to firm economic performance?* Fourteen hypotheses to explore the effects

of environmental and internal conditions, and of the business environment where companies act, have been explored, and the pattern through which SMEs can achieve higher firm economic performance have been investigated, by looking also at the moderating influence of environmental dynamism and munificence.

By considering the conditions under which IT investments contribute to improve firm economic performance, I provided theoretical contributions to three different literature streams: the innovation diffusion literature, the Information Systems literature and the strategic management literature.

First, concerning the *innovation diffusion literature*, by showing that medium sized enterprises are more likely to develop their externally-oriented IT-based capabilities in dynamic environments, whereas small firms were less able, the study supports the idea that that despite IT costs are falling and the commoditization is increasing, IT still generates competitive divides among small and medium sized companies.

Second, concerning the *Information Systems literature*, the study provides additional evidence on the application of the RBV theory in this stream of literature and comes up with two interesting results:

- The environmental dynamism impacts on the adoption time of IS. In such environment SMEs have a more parsimonious use of the IT solutions, due to the rigidity that IT solutions can introduce in their processes, and therefore the adoption choice is delayed. By contrast, in complex environments SMEs adopt earlier the IS given their higher needs of information processing.
- Under high levels of environmental dynamism customized IT solutions are more likely to be adopted, since in such environments only customized IS can allow companies to rapidly respond to environmental changes and to the rise of new customer needs. In such a way, they can reconfigure easily the IS adopted according to what happens in the market where they operate, being prompt in replying to the turbulence levels that they have to face.

Furthermore, I found that internally-oriented IT-based capabilities are diffused uniformly across industries, as the technologies create few obstacles to their implementation and require little effort to adopt to environmental conditions. However, the development of the externally-oriented IT-based capabilities depends

on the environmental conditions. Indeed, such capabilities are more developed under higher level of munificence and complexity, since these environments offer SMEs the opportunity to enter and penetrate various segment markets and this tends to enhance their demand and assimilation of IS in support to the collaboration with suppliers and partners. Moreover, I found that IT is driving the modularization and atomization of business processes and enabling their combination and recombination to create new business processes in SMEs.

Results also confutes the arguments that IT potentially allows firms to improve their strategic flexibility and thus to undertake a greater number of competitive actions to deal successfully with a dynamic competitive environment (Sambamurthy et al. 2003). My evidence is in line with studies showing that the rigidity of integrated IS may decrease the organizational flexibility (e.g. Raymond et al., 2009). Such limits of IT highlight that many small firms may be reluctant to adopt IS because they fear a reduction of productivity in the short term due to the low "malleability" of such systems and their fixed costs. It is plausible that under environmental turbulence small firms do not use IT to support their product development processes and customer relationships as they prefer to deal with dynamism using mutual adjustment and informal channels. Indeed, flat organizational hierarchies may facilitate the preference towards these coordination mechanism with respect to IT. In addition, other two reasons may contribute to explain the detrimental effect of dynamism on the development of IT-based capabilities in smaller firms. In turbulent environments, firms may be less likely to undergo a gradual learning-by-doing process in routinizing technologies that support market and supply chain relationships because of frequent discontinuities in technological and market conditions (Zhu et al., 2006). Second, the more firms achieve business process integration though IT, the harder is for them to reconfigure themselves around new "organizational architectures" to respond to environmental changes (Brandyberry et al., 1999). This reconfiguration may be particularly complicated in SMEs given their peculiarities.

Furthermore, this study demonstrates that the process from the adoption of IT based solutions to the achievement of high economic performance is highly influenced by SMEs' internal conditions, and by the features of the business

environment. Indeed, IS do not exist in a vacuum, but instead they are embedded in a particular internal context, that influence the adoption and assimilation rates. Only companies with adequate IT management capabilities are able to develop internally-oriented and externally-oriented IT-based capabilities, because complementary investments in organizational capital influence the pervasiveness of IT use in firm routines. However, the IS vendor support impact on the IT assimilation process only in case the internally-focused IT-based capabilities are considered, since for developing the externally-oriented IT-based capabilities SMEs have to dispose of adequate IT management capabilities. Furthermore, SMEs that operate in environments characterized by high structural complexity adopt and assimilate earlier than the other firms.

Last, but not least, SMEs adopt to a greater extent internally-focused IT-based capabilities rather that externally-focused. This evidence underlines their difficulties in using IT investments for external and strategizing purposes, since their main focus is circumscribed to improve their internal operations and activities, without understanding the importance of using IT for increasing the effectiveness of the relationships with suppliers and customers, and for reaching new market segments.

Third, concerning the *strategic management literature*, the novel contribution of this study concerns in the explanation of how the environmental conditions impact on the economic returns of IT investments in SMEs. Specifically, this study demonstrates that given differences in the competitive environment, in the speed and timing of technology diffusion, the economic value generated by the development of IT-based capabilities is different. Indeed, it depends on the environmental conditions, with firms in turbulent environments exhibit lower returns of both internally and externally-oriented IT-based capabilities, while firms in munificent environments exhibit lower returns of the internally-oriented IT-based capabilities, but higher returns of the externally-oriented IT-based capabilities. Based on this evidence, the study suggests that in dynamic environments isolating mechanisms and barriers to imitate IT resources may be weaker and that in high-munificent industries growth in the demand and in the existence of greater market opportunities make firms with greater product development capabilities, superior market knowledge, superior supply chain management capabilities and business growth.

Overall, my findings suggested that SMEs should consider their unique industry conditions before making the case for and adopting technology. Improved understanding of these environmental conditions could allow firms determine which parts of the business stands to benefit the most from investment in IT. As such, we are now closer to understand the main ways in which IT investments can contribute to competitive advantage in SMEs, and look forward for advancing the analysis on such topic.

7.2 Implications for practice

In addition to the theoretical contributions, several findings from this research study hold practical implications for managers and policy-makers. First, practical implications from the perspective of the SMEs and then implications for policy-makers will be discussed.

7.2.1 Implications for managers

- **Externally-oriented IT-based capabilities can allow SMEs to achieve a competitive advantage**. SMEs managers are encouraged to focus their attention on developing externally-oriented IT based capabilities rather than focus their attention on improving their internal efficiency. When developed, the externally-oriented IT-based capabilities facilitate small firms to access external resources, competences, and knowledge, build new relationships with prospective partners, which reduce their internal resource limitations.
- **Externally-oriented IT-based capabilities are necessary for SMEs that operate under particular environmental conditions.** Externally-oriented IT-based capabilities were observed to be rather high in the technology-based industry and in munificent industries for most of the SMEs. This means that, in general, SMEs in a high-tech industry and in munificent environments are sophisticated users of IT and they are expected to maintain high levels of externally-oriented IT-based capabilities. If lacking such capabilities, a SME would suffer and fall behind competitors. Thus, it is suggested that SMEs managers should view these capabilities as a necessity for sustaining their business operations. Furthermore, this result stresses the importance for many SMEs in mature industries of a strategic repositioning in market segments with greater business growth opportunities.

- **Managers of SMEs that operate in dynamic environments should see the new IS delivery models as an opportunity.** The fact that SMEs exhibit slower dynamics of adoption of IS in dynamic environments emphasizes that IS vendors should enhance the flexibility of IS. The evolution of IT towards Service-Oriented Architecture and "Software as a Service" delivery models for IS points in this direction and may eventually favour a greater diffusion of IS in SMEs.
- **Managers of SMEs that operate in dynamic environments should see customized IT solutions as an opportunity.** Given that customized IT solutions are characterized by a greater flexibility, SMEs in dynamic environments should adopt to a greater extent these solutions, in order to rapidly reconfigure their IT infrastructure and to accomplish unexpected customers' needs and requests.
- **It is risky to adopt IT solutions without the complementary organizational investments.** The complementary organizational investments in practices, organizational routines and business processes that managers have to carry out before the introduction of new IS may be crucial for the successful assimilation of the IT-based resources adopted. Therefore, in order to successfully deal with the assimilation process of the IT-based capabilities, SMEs necessitate to accumulate over time other types of intangible assets, such as managerial IT expertise, qualified human capital for IT use and planning skills. Furthermore, they have to interact with IS vendors in order to successfully routinize the IT solutions.
- **Managers of SMEs should leverage more on the customers' knowledge.** SMEs whose sales revenues mostly stems from few customers are usually strategic suppliers of large firms, and therefore they should learn to profit from these customers' learning in using IT for inter-firm collaboration and supply chain management activities.

7.2.2 Implications for policy makers

- **Develop programs for promoting the development of IT-based capabilities in SMEs.** SMEs are an important part of the economy as they contribute to employment and growth. Governmental bodies in Europe

should understand their critical role and should made several policy implications that support their competitiveness. Thus, it is suggested that the policy-makers should provide financial support for programs aimed to develop externally oriented capabilities in SMEs, and IT adoption in sectors with lower adoption dynamics, as this may be the key to how IT initiatives actually lead to SMEs competitiveness.

- **Demand oriented policies.** Since small firms have difficulties in assessing costs and benefits of IT, demand for IT must be stimulated. In such a way, smaller companies could be able to better understand the benefits of IT solutions and the divide of IT investments between SMEs and larger companies could be reduced. Policy makers should stimulate exchange of experiences and promote transactional cooperation activities.

7.3 Limitations and Suggestions for Future Studies

Besides these issues, the paper presents stimuli for further studies, which mainly originate in some weaknesses of this research. In this regard, it may be useful to highlight some weaknesses which may raise some concerns.

First, the results were derived from a sample of a single Italian region. Studies with comparative samples of firms from other countries should be used to test and extend the generalizability of our findings. Some concerns can be raised on how much our results can be generalized given our focus on Italian SMEs, and on the Piedmont region, in particular. With this regard, some particularities of the regional industrial system (e.g. a high specialization on automotive, the lack of large firms pushing their small suppliers towards an integration of information systems for supply chain management) may make our sample biased in terms of IT adoption respect to the population of firms localized in other European regions (e.g. the Lombardy area in Italy) with a high economic development and a considerable presence of large enterprises. An extension of the survey to SMEs in other regions could overcome this limitation.

Second, SMEs could be isolated by the environmental conditions occurring in their industry as they may be positioned in market niches that are “protected” by the competitive forces occurring at the industry level. To overcome this problem, future studies could check measures of dynamism and munificence at the macro-economic

level with managers' perceptions about the environmental forces occurring at the firm level.

Third, the data were collected from a single respondent, rather than observed directly through field-based study. This is currently the standard methodology in strategy research, but it has certain drawbacks. We tried to correct these drawbacks through our selection of respondents who were sufficiently knowledgeable about the business. However, in SMEs this approach may present lower drawbacks respect to larger enterprises, as in SMEs CEOs and other managers are usually more generalists and may be thus more knowledgeable about IT-related issues.

Fourth, future studies could mainly focus on making a deeper distinction on the different adoption and assimilation behaviours between small and medium companies, and how contextual conditions may influence such patterns. Furthermore, if under high levels of dynamism the divide in market share between small and medium enterprises is increased over the years could be interesting to be evaluated.

Finally, it could be investigated if companies that adopt Software as a Service would be able to accumulate capabilities even in absence of high levels of ISs customization. Indeed, the rise of the cloud computing paradigm promises dramatic reductions in the cost of the IT which could determine an acceleration in the IT solutions adopted by SMEs.

Notwithstanding these limitations, my study has produced important suggestions for future studies that could be focus on understanding the business value of the new IT delivery models and on making distinctions between companies of small and medium sizes.

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APPENDIX

Appendix 1: Papers where hypotheses have been investigated

Hypothesis		Paper	Input-output stage		
			IT accumulation	IT assimilation	Profiting from IT
H1	Firm internal context influences positively the earlier adoption of IS.	Paper A	X		
H2	SMEs internal context does not affect the development of internally-oriented IT-based capabilities (H2.a), whereas affects positively the development of externally oriented IT-based capabilities (H2.b).	Paper C		X	
H3	The complexity of the business environment influences positively an earlier adoption of IS.	Paper A	X		
H4	The business environment complexity negatively influence the IT assimilation.	Paper A		X	
H5	The relationship between the strategic dependence on few customers and the development of IT-based capabilities is curvilinear (U-shaped), with the lower level at intermediate strategic customer dependence.	Paper A		X	
H6	The degree of customization of IS (H6.a) and the support of IS vendors (H6.b) positively affect the development of IT-based capabilities.	Paper A		X	
H7	The higher the environmental munificence (H7.a), the lower the environmental dynamism (H7.b) and the higher the environmental complexity (H7.c), the earlier is the adoption of IT resources in SMEs.	Paper A	X		
H8	Environmental conditions do not affect the extent to which firms develop internally-oriented IT-based capabilities.	Paper C		X	
H9	In dynamic industries, the higher the size of the firm is, the more developed its externally-oriented IT-based capabilities will be.	Paper C		X	
H10	Environmental munificence positively affects the development of externally-oriented IT-based capabilities.	Paper C		X	
H11	SMEs that exhibit high levels of product complexity and vertical integration are more likely to develop externally-oriented IT-based capabilities.	Paper A	X		
H12	The lower the environmental dynamism (H12.a) and munificence (H12.b), the higher is the impact of internally-oriented capabilities on firm economic performance.	Paper B			X
H13	The higher the environmental munificence, the higher is the impact of externally-oriented IT-based capabilities on firm economic performance.	Paper B			X
H14	The higher the dynamism, the lower is the impact of a firm's IT-based capabilities on its profitability differentials respect to competitors.	Paper B			X

Table A 1 Papers where hypothesis have been investigated

Appendix 2: Research Based studies in IS research

Source/Title	Paper Type	Findings	Comments on the RBV
Sustaining it Advantage: The Role of Structural Differences (Clemons and Row 1991)	Conceptual	Argues that IT cannot, in and of itself, lead to SCA, but may assist other resources in doing so. Referred to as the strategic necessity hypothesis.	Very good conceptual work. Only loosely based on the RBV.
Information Technology and Sustained Competitive Advantage: A Resource-based Analysis Advantage (Mata et al. 1995)	Conceptual	Considers whether four IS resources lead to SCA under the resource-based view. The resources are access to capital, proprietary technology, technical IT skills, and managerial IT skills. Using logical RBV arguments, finds that managerial IT skills are the only resource that leads to SCA.	Good conceptual development. Logical rather than empirical arguments made for appropriateness of resources. Resource list not justified.
Organizational Learning and Core Capabilities Development: The Role of it (Andreu and Ciborra 1996)	Conceptual	Looks at the role IT plays in developing capabilities and competencies within the firm. Describes the role of IT within the context of organizational learning.	RBV not measured.
Develop Long-Term Competitiveness Through IT Assets (Ross et al. 1996)	Conceptual	Defines three IT assets: IT human resources asset, technology asset, and relationship asset. These assets in combination with IT processes lead to SCA.	Loosely based on the RBV. RBV not actually measured. No empirical work.
Information Technology as Competitive Advantage: The Role of Human, Business, and Technology Resources (Powell and Dent-Micallef 1997)	Empirical (retail industry survey)	Supports the strategic necessity hypothesis. Finds that IT alone cannot produce SCA, but that IT can leverage other intangible, complementary human and business resources to gain SCA.	Strong empirical content although RBV not measured directly.
Catching the Wave: Alertness, Responsiveness, and Market Influence in Global Electronic Networks (Zaheer and Zaheer 1997)	Empirical	Uses an RBV framework to show that alertness and responsiveness lead to market influence in the global finance industry.	Strong empirical work. SCA is not the main dependent variable. RBV not measured.
Resource-Based Theory and a Structural Perspective of Strategy Applied to the Provision of Internet Services (Lopes and Galletta 1997)	Conceptual	Uses RBV and structural perspective of strategy to develop a series of propositions about online information services. Divides resources into knowledge- based and property-based types.	Draws on Miller and Shamsie (1996) for conceptual grounding. Hypothesizes that knowledge-based resources are more valuable in online setting. No testing of hypotheses.
IT Capabilities: Theoretical Perspectives and Empirical Operationalization (Bharadwaj et al. 1998)	Empirical	Describes the formation of an IT capability construct with six elements: IT business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT	Does not test the link between capability construct and performance or SCA.

		infrastructure.	
Core IS Capabilities for Exploiting Information Technology (Feeny and Willcocks 1998)	Conceptual	Nine core IS capabilities are identified which are organized into four categories: business and IT vision, delivery of IS services, design of IT architecture, and core IS capabilities. Capabilities are mapped onto skills and values.	Interesting conceptual work. Practitioner focus. Not directly linked to RBV theory. Non empirical.
An Information Company in Mexico: Extending the RBV to a Developing Country Context (Jarvenpaa and Leidner 1998)	Empirical (case study)	Mixed support for the RBV found in emerging country context.	RBV not measured directly. Resource attributes considered.
Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures (Armstrong and Sambamurthy 1999)	Empirical (survey)	Looks at the influences of quality of senior leadership, sophistication of IT infrastructures and organizational size on IT assimilation.	Conceptual model only loosely based on the RBV. RBV not actually measured.
Strategic Context and Patterns of IT Infrastructure Capability (Broadbent, Weill and Neo 1999)	Empirical (survey)	More extensive IT infrastructure capability found in firms where products changed quickly and the implementation of long-term strategies was tracked over time.	
Resource View Theory Analysis of SAP as a Source of Competitive Advantage for Firms (Pereira 1999)	Conceptual	Explores whether SAP could be considered a determinant of SCA in the RBV sense. Determines that it could, if managed properly.	Non-empirical. Loosely based on the RBV. Some attributes justified with logical arguments.
Building Competitive Advantage Through Information Systems: The Organizational Information Quotient (Service and Maddux 1999)	Conceptual	Develops a series of success components through which IT can lead to SCA. Evaluation of these components leads to an organizational information quotient.	RBV logic indirectly applied.
A Resource-Based Perspective on Information Technology Capability and Firm Technology Capability and Firm Performance: An Empirical Investigation (Bharadwaj 2000)	Empirical (archival data, matched pairs)	Performance of firms which are rated to have superior IT capability in magazine survey compared to firms which do not. Performance of superior IT capability firms found to be higher.	Strong conceptual development of IT capability construct. Construct measures not used, however, in empirical analysis.
Capabilities, Business Processes, and Competitive Advantage: The Impact of Information Technology on Customer Satisfaction in the North American Insurance	Empirical (survey)	Study finds that managerial IT knowledge and service climate positively affect customer service performance.	Supportive of the RBV. Argues that RBV works at the level of business processes as well as at the firm level.

Industry (Ray et al. 2001)			
Information Technology and Competitive Advantage: A Process Oriented Assessment (Ray et al. 2001)	Empirical (survey)	Study finds that managerial IT knowledge leads to enhanced customer service performance but flexibility of IT infrastructure, IT technical skills, and IT applications do not.	Supportive of the RBV.
Sustaining Strategic it Advantage in the Information Age: How Strategy Paradigms Differ by Speed (Hidding 2001)	Conceptual	Argues for a strategic model that differentiates among IT types. IS strategy should depend on the length of the product cycle (ecologies).	Attempts to extend the RBV to make it more useful in quantifying sustainability of competitive advantage.
Information Technology, Core Competencies, and Sustained Competitive Advantage (Byrd 2001)	Conceptual	Argues that IT infrastructure flexibility yields sustained competitive advantage as an enabler of firm-specific core competencies.	Loosely based on RBV arguments.
Beyond Sabre: An Empirical Test of Expertise Exploitation in Electronic Channels (Christianse and Venkatraman 2002)	Empirical	Finds that RBV is more effective than Transaction Cost Economics at explaining the creation of expertise. Finds technology lock in not effective.	Constructs not explicitly operationalized as resources.
Membership Size, Communication Activity, Sustainability: A Resource-Based Model of Online Social Structures (Butler 2001)	Empirical	Uses RBV to look at online social structures. Finds complex relationships between membership size, communication activity, and online structure sustainability.	Uses resource-based logic to frame conceptual arguments. Develops notion of sustainability. Does not operationalize resources using resource attributes.
Impact of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective (Ravichandran and Lertwongsatien 2002)	Empirical	Examines complementarity from a resource-based perspective. Finds preliminary support for the relationship between IT and non-IT firm capabilities in achieving superior firm performance.	IT capability measures (unspecified) used in analysis. Link made to firms performance, not SCA.
Diversification and Performance of Japanese IT Subsidiaries: A Resource-Based View (Wade and Gravill 2003)	Empirical	Finds that Japanese IT firms that diversify internationally based on resource strengths outperform those with unrelated portfolios.	Uses the RBV as a guiding conceptual framework. Does not operationalize resources or test resource attributes directly.
Issues in Linking Information Technology Capability to Firm Performance (Santhanam and Hartono 2003)	Empirical	Extends and confirms Bharadwaj (2000). Finds that firms with superior IT capability also exhibit superior firm performance.	IT capability not operationalized, resource attributes not used in analysis. Multidimensional dependent construct used. Calls on continued use of RBV

			in IS research.
Types of Information Technology Capabilities and Their Role in Competitive Advantage: An Empirical Study (Bhatt and Grover, 2005)	Empirical	While the quality of the IT infrastructure is hypothesized as a value capability and expectedly did not have any significant effect on competitive advantage, the quality of IT business expertise and the relationship infrastructure (competitive capabilities) did. The results of the study also indicate that the intensity of organizational learning (dynamic capability) was significantly related to all of the capabilities.	IT capabilities as source of competitive advantage.
Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance (Rivard, Raymond and Verreault, 2006)	Empirical	The model encapsulates the effects of both IT support for business strategy and IT support for firm assets on firm performance.	The model developed evaluate the impact of IT on firm performance.
Understanding the influence of information systems competencies on process innovation: A resource-based view (Tarafdar and Gordon, 2007)	Empirical	The findings illustrate how six IS competencies - Knowledge Management, Collaboration, Project Management, Ambidexterity, IT/Innovation Governance, Business-IS Linkages - can differentially affect the conception, development and implementation of process innovations.	A RBV perspective of process innovation.
IT capabilities and firm performance: A contingency analysis of the role of industry and IT capability type (Dale Stoel and Muhanna, 2009)	Empirical	Using publicly available rankings as proxies for two types of IT capabilities (internally and externally focused), the authors empirically examined the degree to which three industry characteristics (dynamism, munificence, and complexity) influenced the impact of each type of IT capability on measures of financial performance.	IT capability impact on firm performance

Table A 2 Resource Based studies in the IS research (Wade and Hulland, 2004)

Appendix 3: Questionnaire 2011

SECTION 1 - COMPANY PROFILE

1.1. Provide a brief company description.

_____

1.2. Specify the number of employees.

Number: _____	
☐	I do not know

1.3. Specify the foundation year of your company.

_____	
☐	I do not know

1.4. Specify areas of your company.

Logistics supply	☐
Production	☐
Distribution supply	☐
Sales, marketing and post sales services	☐
Administration, personnel management, control management	☐
Design and product development	☐

1.5. Is your company part of an industrial group?

☐	No
☐	Yes, of an Italian group
☐	Yes, of a not Italian group
☐	I do not know

1.6. Specify the local units[20] of your company.

Number: _____ → *Go to the question 1.7 if number = 1*	
☐	I do not know → *Go to the question 0*

1.6.1. *Between the local units declared above, how many are located in Piedmont?*

Number: _____	
☐	All
☐	I do not know

1.7. Your company is located:

☐	In area when productive activities are conducted
☐	Closer to communication places (airports, train stations, …)
☐	In an urban centre
☐	In a peripheral area
Other: _____	
☐	I do not know

1.8. The company sells:

☐	To individuals/families
☐	To other companies
☐	Products
☐	Services
☐	On demand
☐	By using catalogues of products/services
☐	As sub distributor

1.9. Specify the revenues percentage in 2010 that comes from your three main customers:

☐	Less than 30%
☐	Between 31% and 60%
☐	More than 60%
☐	I do not know

1.10. Specify your revenues in 2010.

Revenues: _____ €	
☐	I do not know

1.11. In 2010, has your company exported products/services in foreign markets?

☐	Yes
☐	Not
☐	I do not know

1.12. Specify the revenues percentage that your company has realized in 2010 in:

Piedmont	☐ <30%	☐ 30%-60%	☐ >60%	☐ Do not know
Rest of Italy	☐ <30%	☐ 30%-50%	☐ >50%	☐ Do not know
Europe	☐ <5%	☐ 5-20%	☐ >20%	☐ Do not know
Rest of the world	☐ 0%	☐ 1-10%	☐ >10%	☐ Do not know

1.13. Specify how many suppliers and strategic partners are localized in:

	none	**low**	**medium**	**High**
Piedmont	☐	☐	☐	☐

[20] LOCAL UNIT: it is the single location where the company conduct its economic activities, it is in a defined geographical location with an address and a civic number.

Rest of Italy	☐	☐	☐	☐
Abroad	☐	☐	☐	☐

1.14. Which was the trend of the following indicators between 2009 and 2010?

-2 = significantly worst
-1 = worst
0 = constant
+1 = better
+2 = significantly better

	-2	-1	0	+1	+2
Number of customers (all)	☐	☐	☐	☐	☐
Number of customers abroad	☐	☐	☐	☐	☐
Number of employees	☐	☐	☐	☐	☐
Number of suppliers	☐	☐	☐	☐	☐
Revenues from new products introduced in the last three years	☐	☐	☐	☐	☐
R&D investments	☐	☐	☐	☐	☐
Operative productivity[21]	☐	☐	☐	☐	☐

SECTION 2 – INTERNAL ORGANIZATION OF THE COMPANY

2.1 Is there a CIO in your company?

☐	Yes
☐	Not
☐	I do not know

2.2 Specify the employees percentage involved in the management and maintenance of IT systems, of application and information network.

_____ %
☐ In the company there is nota n IT area
☐ I do not know

2.3 In your company, which person takes decision about IT investments?

☐	CEO
☐	General director
☐	Production manager
☐	Sales manager
☐	IT manager
☐	External consultant
☐	Other, specify ……..

2.4 (if 2.1=yes) **Which is the involvement level of the IT manager in the following activities?** (1= null, 5= very high)

	1	2	3	4	5
Definition of the technical and functional prerequisites related to the introduction of new information systems	☐	☐	☐	☐	☐
Monitoring projects related to the implementation of new information systems	☐	☐	☐	☐	☐
Selection of new suppliers of technologies and of consultant compagnie specialized in their implementation	☐	☐	☐	☐	☐

2.5 Specify which of the following coordination activities with customers and suppliers are conducted by using information systems

	With customers	With suppliers
Sharing of industrial production plans	☐	☐
Involvement in the new product development	☐	☐
Orders contorl	☐	☐

SECTION 3 – IT ADOPTION

3.1 Are your local units in Piedmont connected to the Internet?

☐	Yes → *Go to the question 3.2*
☐	Not → *Go to the question* 12

3.2 Specify which of the following connection typologies are used in your company.

☐	Traditional modem
☐	ISDN line
☐	DSL
☐	Wireless
☐	HyperLAN / WiMAX
☐	Optical fibre
☐	I do not know → *Go to the question 3.2.5*

3.2.1 *(in case the company has not a traditional modem or an ISDN line)* **Specify the connection speed.**

☐	Less than 2 Mbps
☐	Between 2 and 20 Mbps
☐	More than 20 Mbps
☐	I do not know → *Go to the question 3.2.5*

[21] ROS, ROA, MOL/Sales.

3.2.2 *(in case the company has not a traditional modem or an ISDN line)* ***Specify the nominal speed of download and upload:***

	Nominal speed*
Download	..... Mbps
Upload	.....Mbps

* it is the speed declared by the connectivity provider

3.2.3 *(if the speed is higher than 2Mbps)* **Specify the year in which your company has introduced a connection higher than 2Mbps**

Year	.....

3.2.4 *(in case the speed is > 2Mbps and if 3.2.2=1 and if 3.2= only modem or ISDN)* ***Why does your company not use a connection more than 2 Mbit/s?***

☐	The cost is high
☐	It is not available in the area where our company is located
☐	We do not need
☐	We are planning the adoption in the next 12 months
☐	I do not know

3.2.5 *(if 3.1=yes)* **Specify the agreement/disagreement of the following sentences** *(-2: strong disagreement; +2: strong agreement)*

	-2	**-1**	**0**	**1**	**2**
The connection speed of the Internet is usually lower than the nominal speed guaranteed	☐	☐	☐	☐	☐
We usually have disconnections in the Internet	☐	☐	☐	☐	☐

3.3 Specify the connection technologies used in your company.

☐	LAN
☐	Wireless LAN

3.4 Specify if in your company the VOIP technology for calling is used.

☐	Yes
☐	Not
☐	I do not know

3.5 Specify which of the following systems are used in your company.

☐	Intranet
☐	Extranet

3.6 Specify which of the following IS are adopted by your company and the introduction year.

	IS	**Introduction year**
☐	ERP	_____
☐	CRM	_____
☐	SCM	_____
☐	PDM or PLM	_____

3.7 Specify which IS are used in an "as a service" modality or whether you have decided to adopt the following IS in the following 2 years.

	Currrently in an "as a service" modality	Within the next two years in an "as a service" modality
ERP	☐	☐
CRM	☐	☐
SCM	☐	☐
PDM or PLM	☐	☐

3.8 In your company, the IS mentioned in 3.6 are mainly:

☐	Standardized packages with low personalization (go to the question 3.10)
☐	Standardized package, but personalized according to the internal processes (g to the question 3.9)
☐	Applications developed in based to the company requirements (go to the question 3.9)
☐	Several standard packages integrated with single modules internally developed (go to the question 3.10)
☐	I do not know (go to the question 3.10)

3.9 In case your company uses personalized packages, has your IT personnel done software personalization?

☐	Yes
☐	Not
☐	I do not know

3.10 Does your company use infrastructural services in an "as a service" modality?

☐	Elastic cloud computing)
☐	Storage and data backup services
☐	Information security systems
☐	Online payment services
Other: _____	

3.11 Which of the following barriers to the adoption of "as a service" solutions are seen by your company?

☐	Low knowledge of these solutions
☐	Integration problems with company solutions already adepte
☐	Perception of a low data security
☐	Problems related to the Internet connectivity
☐	Insufficient personalization and lack of differentiation
Other: _____	

3.12 Specify if your company uses RFID technologies in the following cases (MAA):

☐	Presence and accesses control of employees in the company
☐	Inventory management
☐	Supply or distribution logistics (support to traceability)
☐	Assistance and maintenance of production systems
☐	Revelation of environmental parameters (temperature, humidity, …) in warehouses and along the supply chain
☐	Other (specify _____)

3.13 Does your company use the outsourcing for managing activities connected to the IT?

☐	Yes
☐	Not
☐	I do not know

3.13.1 (if 3.13 = yes) **Specify the supplier typologies that you refer to for managing these activities.**

☐	Little companies and/or local individual companies
☐	Medium-big consultancy and IT services national companies

3.13.2 (if 3.13 = yes) **Specify which of the following activities was outsources to a foreign supplier**.

☐	Systematic management of LAN and servers
☐	Personalization and maintenance of IS
☐	Help desk services for users of information technologies
☐	IS integration
☐	Other

SECTION 4 – USAGE OF IT BY EMPLOYEES

4.1 Have some employees participate to IT training courses in 2010?

☐	Yes
☐	Not
☐	I do not know

4.1.1 *(if 4.1 = yes)* **Specify the employees percentage that have followed these training courses.**

_____ %	
☐	I do not know

4.2 Has your company used *e-learning* systems for the employees training (not only related to the IT)?

☐	Yes
☐	Not
☐	I do not know

4.3 Specify which of the following communication modalities are regularly used in your company.

	Customers	Suppliers	Other employees	Other companies
Chat and video systems (for instance Skype)	☐	☐	☐	☐
Blog	☐	☐	☐	☐
Social networking instruments	☐	☐	☐	☐
Wiki	☐	☐	☐	☐
Podcast	☐	☐	☐	☐
RSS	☐	☐	☐	☐
Newsletter	☐	☐	☐	☐

4.4 Does your company employ dispersed workers that work in different sites from the main site of the company accessing to the Internet to the IS of the company?[22]

☐	Yes → *Go to the question 4.4.1*
☐	*Not* → *Go to the question 4.5*
☐	*I do not know* → *Go to the question*

[22] It is not included employees that access simply to the email, distributors and transport employees, and employees that work in other company sites.

	4.5

4.4.1 (if 4.4 = yes) **Where is the remote work conducted?**

☐	At home
☐	In dedicated centers
☐	At the customer site
☐	By any site
Other: …..	
☐	I do not know

4.4.2 (if 4.4 = yes) **Do the remote working forms include telework forms defined in the working contracts signed?**

☐	Yes
☐	Not
☐	I do not know

4.4.3 (if 4.4 = yes) **Which percentage of workers defined in 4.4 work remotely?**

_____ %	
☐	I do not know

4.4.4 (if 4.4 = yes) **In which of the following areas remote work is used?**

☐	Logistics supply
☐	Production
☐	Distribution supply
☐	Sales, marketing and post sales services
☐	Administration, personnel management, control management
☐	Design and product development
☐	Logistics supply
	Other, specify _____

4.4.5 (if 4.4 = yes) **Specify which of the following connection to the Internet are used by employees that work remotely.**

☐	Mobile connection through mobile phone/Internet key (GSM, GPRS, UMTS)
☐	Wireless connection
☐	Fixed connection at the customer, supplier site, …

4.4.6 (if 4.4 = yes) **Which of the following motivations have allowed your company to adopt remote working forms?**

☐	For reaching employees without any geographical limit and benefit of the salary differences between countries
☐	For reducing transport costs of employees
☐	For reducing the fixed costs
☐	Due to employees' requests
☐	For managing sales and post-sales activities
☐	For operative continuity necessities related to the management/maintenance of machineries
☐	For accessing to competences difficult to be reached by employing people that work in the company

4.4.7 (if 4.4 = yes) **Indicate the frequency with which employees work outside the physical boundaries of the firm:**

☐	Always
☐	2-3 days a week
☐	Once a week
☐	Occasionally, according to company needs
☐	Occasionally, according to employee's needs
☐	I do not know

4.5 Which are the main obstacles that you see in your company in adopting dispersed workers? (defined in 4.4)? (MAA[23])

☐	Limited knowledge of norms on telework adoption
☐	The job features do not allow it
☐	Problems related to data security of electronic data
☐	Resistance to the organizational change
☐	Difficulties in updating employees' technical and operational knowledge
☐	Problems in programming and coordinating employees' activities
☐	Problems in checking activities results
☐	Difficulties for the company in appropriating the experience of the employees
Othe: …….	

[23] Multiple Answers Admitted: it means that the respondent can provide as answer more than one choice.

SECTION 5 – DELIVERY OF ONLINE SERVICES

5.1 Has your company a web site?

☐	Yes → *Go to the question 5.1.1*
☐	Not → *Go to the question 5.2*
☐	I do not know → *Go to the question 5.1.1* **Errore. L'origine riferimento non è stata trovata.**

5.1.1 **Does your web-site include information in foreign languages?**

☐	Yes
☐	Not
☐	I do not know

5.1.2 **On your web site, customers can:**

☐	Search information on products and services of the company
☐	Consult a catalogue and/or check the state of the delivery
☐	Require post sales services and/or make complaints
☐	Enroll to the company newsletter or to feed RSS
☐	Participate to a discussion forum
☐	Make researches of workplace and/or making job applications
☐	Make commercial transactions (buying company products)
☐	Identify distributors and leaders location

5.2 Does your company sell products or services online?

☐	Yes → *Go to the question 5.2*
☐	Not → *Go to the question 5.2.4*
☐	I do not know → *Go to the question 5.2.4*

5.2.1 **Has your company agreements with societies that manage e-marketplaces for selling products online?**

☐	Yes
☐	Not
☐	I do not know

5.2.2 **In 2010, which revenues percentage comes from online sales?**

%	
☐	I do not know

5.2.3 **The customers that your company has reached with online sales are mainly localized in:**

☐	In Piedmont
☐	In the rest of Italy
☐	Abroad
☐	I do not know

5.2.4 **In your opinion, which are the barriers for the online sales of your products/services online?**

☐	Features of products/services
☐	Low capacity of customers of buying online
☐	High costs for the development and maintenance of an electronic commerce system
☐	Our security problems in the payments
☐	Problems in the logistics
☐	Importance of the personal relationship
Other: _____	

SECTION 6 – USAGE OF ONLINE SERVICES

6.1. Does your company buy products/services in the Internet?

☐	Yes → *Go to the question 6.1.1*
☐	Not → *Go to the question 6.2*
☐	I do not know → *Go to the question 6.2*

6.1.1. *(if 6.1 = yes)* **Which of the following products/services are bought on the Internet?**

☐	Services (fly billing, hotel, Energy, other services)
☐	Direct materials
☐	Indirect goods (PC, printers, mobile phones, etc.)

6.1.2. *(if 6.1 = yes)* **For online purchases, which modality have you followed until now? (MAA)**

☐	We have directly bought on the supplier web-site
☐	We have signed contract with e-marketplaces societies
☐	Our IT systems are integrated with the suppliers' systems for the order definition
Other: _____	
☐	I do not know

6.1.3. *(if 6.1 = yes)* **Which of the following benefits has your**

company reached by the on-line purchases? *(MAA)*

☐	Access to a higher suppliers' number
☐	Higher speed in the buy process
☐	Reduction of the administrative costs
☐	Price reduction
☐	Inventory levels reduction
☐	We have bought a product/service available only on-line
Other: _____	
☐	I do not know

6.1.4. *(se 6.1= yes)* **Suppliers reached through online purchases are mainly localized in:**

☐	Piedmont
☐	Rest of Italy
☐	Abroad
☐	I do not know

6.2. Which of the following obstacles are related to online purchases? (MAA)

☐	Products and services cannot be bought online
☐	Difficulty of integrating the business accounting
☐	Delivery costs are too high
☐	Importance of the personal relationships
☐	Suppliers able to receive online orders are low
☐	Online prices are higher than prices in the traditional market
☐	Logistic problems
☐	Security problems of payments
Other: _____	
☐	I do not know

6.3. Does your company use online banking?

☐	Yes
☐	Not
☐	I do not know

6.4. In the last 12 months, has your company use the Internet for interacting with the Public Administration?

☐	Yes → *Go to the question 6.4.1*
☐	Not → *Go to the question 6.5*
☐	I do not know → *Go to the question 6.5*

6.4.1. For which goal does your company use the Internet for interacting with the Public Administration? (MAA)

☐	Read/receive information
☐	Download modules
☐	Send compiled modules
☐	Terminate online transactions
☐	I do not know

6.4.2. Are you satisfied of the services used?

☐	Yes → *Go to the question 6.4.4*
☐	Not → *Go to the question 6.4.3*
☐	I do not know → *Go to the question 6.4.4*

6.4.3. Specify the reason why you are unsatisfied about the use of on-line services of the Public Administration (MAA).

☐	Incomplete information
☐	Difficulty in accessing to the service
☐	Lack of interesting services
☐	Long time service
Other: _____	
☐	I do not know

6.4.4. Your confidence level with the Public Administration and of information regard norms, rules, opportunities is grown with the ise of the Internet?

☐	Yes
☐	Not
☐	I do not know

6.5. Does your company know the web-site www.dati.piemonte.it, from which is possible to download data of Regione Piemonte?

☐	Yes → *Go to the question 6.5.1*
☐	Not → *Go to the question 6.5.2*
☐	I do not know → *Go to the question 6.5.2*

6.5.1. (if 6.5 = *yes)* **Have you ever download data from this web-site?**

☐	Yes
☐	Not
☐	I do not know

6.5.2. Do you believe that data available on this web site could be useful for your company?

☐	Yes
☐	Not
☐	I do not know

6.5.3. Which data type would you like to find in this web-site?

_____

SECTION 7 – IT AND ENERGY SAIVINGS

7.1. Does your company adopt technologies that support sustainable practices[24]?

☐	Yes → Go to the question 7.3
☐	Not → Go to the question 7.2
☐	I do not know → Go to the question 7.3

7.2. *(if 7.1 = not)* **Indicate the reason why these technologies are adopted**

☐	We do not know such technologies
☐	We know these practices, but we do not think they are applicable in our company
☐	We are planning to introduce them in the next two years
☐	I do not know

→ *(if 7.1 = not, go to the section 8)*

7.3. Which of the following solutions does your company utilize for monitoring and/or reduce Energy consumptions and reduce the environmental impact of its activities?

☐	New servers with lower energy consumptions
☐	Sensors and technologies for monitoring energy consumptions of the productivity processes
☐	Sensors and technologies for the lighting and cooling systems
Other: _____	

7.4. *(if 7.1 = yes)* **Why does your company use such technologies? (MAA)**

☐	For monitoring the Energy consumption and reducing energy costs
☐	For reducing the environmental impact of the productivity activities
☐	As answer to customers needs
☐	For reducing the environmental impact of the administrative activities
☐	For monitoring and reducing the environmental impact of the logistic activities
☐	For respecting norms and standards related to the environmental/energy sustainability (ex. ISO 14001)
Other: _____	

SECTION 8 – IT INVESTMENTS

8.1 Has your company in 2010 made investments in IT?

☐	Yes
☐	Not

8.2 8.1 Considering the 2010, specify the following IT costs:

(if 8.1 = yes) New investments	____ 000 €	☐ Do not know
OPEX	____ 000 €	☐ Do not know

8.2.1 Regard 2009, in 2010 investments and costs in IT are:

☐	Decresed
☐	Stabele
☐	Increased
☐	I do not know

8.3 Has your company a budgeting process for costs and investments in IT?

☐	Yes
☐	Yes, but it is not systematic and continuous among the years
☐	Not
☐	I do not know

8.1 Which is the role that the CEO provide to the IT?

☐	A marginal role
☐	An instrument for automating the administrative and control activities with high level of routine work
☐	A strategic role for increasing the quality of the information management in the key activities (product development, production, distribution, sales, etc…)
☐	A strategic role oriented to develop new products and services based on innovative IT (e.g. web-based services for customers, RFID usage for the traceability and identification of fashion counterfeit vesture)
☐	There is not a clear and shared vision on the IT role in the company strategy
☐	I do not know

[24] Adoption of solutions for reducing the environmental impact and the energy consumptions.

8.4 ***Specify the importance that the following factors have assumed in pushing your company in making IT investments in the last three years (1: no importance; 5: very high importance)***

	1	*2*	*3*	*4*	*5*
The opportunity to improve our business processes envisioned by some consulting firms	☐	☐	☐	☐	☐
The opportunity to improve our business processes envisioned by some consulting firms	☐	☐	☐	☐	☐
The availability of technologies suited to our specific business processes and our specificities	☐	☐	☐	☐	☐
The opportunities for improvement outlined by technical journals, professional associations, experts within the IT trade fairs and conferences	☐	☐	☐	☐	☐
A change in company management	☐	☐	☐	☐	☐
The necessity of compliance with new regulations (e.g. Basel II) or special certifications	☐	☐	☐	☐	☐
Requests of certain strategic customers	☐	☐	☐	☐	☐
Demands of the industrial group to which our company belongs	☐	☐	☐	☐	☐
Requests for new investors in the social capital of the company	☐	☐	☐	☐	☐
The desire to obtain or defend a strategic advantage over our competitors	☐	☐	☐	☐	☐
The need to keep up with direct competitors	☐	☐	☐	☐	☐
The necessity of providing greater integration of our processes with those of our suppliers	☐	☐	☐	☐	☐

8.5 How do you evaluate the use of the IT in the following areas regard competitors?

(1: in a lower way regard the existent potentialities; 7: aligned to the companies that in your own industry used the IT successfully)

	1	*2*	*3*	*4*	*5*	*Non so*
Supply logistics	☐	☐	☐	☐	☐	☐
Production	☐	☐	☐	☐	☐	☐
Distribution logistics	☐	☐	☐	☐	☐	☐
Sales, marketing and post-sales services	☐	☐	☐	☐	☐	☐
Administration, personnel management, management control	☐	☐	☐	☐	☐	☐
Design and product development	☐	☐	☐	☐	☐	☐

8.6 Do you think that in the following areas new IT investments could lead benefits to your competitiveness? (1: not at all; 5: significantly)

	1	*2*	*3*	*4*	*5*	*Non so*
Supply logistics	☐	☐	☐	☐	☐	☐
Production	☐	☐	☐	☐	☐	☐
Distribution logistics	☐	☐	☐	☐	☐	☐
Sales, marketing and post-sales services	☐	☐	☐	☐	☐	☐
Administration, personnel management, management control	☐	☐	☐	☐	☐	☐
Design and product development	☐	☐	☐	☐	☐	☐

8.7 State your level of agreement / disagreement with the following statements (-2: strong disagreement; 2: strong agreement):

	-2	*-1*	*0*	*1*	*2*
The financial resources available for investment in IT is appropriate to current needs	☐	☐	☐	☐	☐
The technical skills of our specialists in IT are adequate to operate and manage the technologies adopted	☐	☐	☐	☐	☐
The information skills of our employees are appropriate for adequately use the adopted technologies	☐	☐	☐	☐	☐
We have appropriate skills and information channels in order for identifying reliable suppliers and IT	☐	☐	☐	☐	☐
There are technologies on the market suited to our operational and strategic specificities	☐	☐	☐	☐	☐
New investments in IT are	☐	☐	☐	☐	☐

hampered by the limited scalability and flexibility of our IT infrastructure (e.g. servers, databases, storage capacity, etc...)					
Our investment in IT follow a formal medium-term plan	☐	☐	☐	☐	☐
We regularly monitor the benefits, costs and risks of investment in IT	☐	☐	☐	☐	☐
The planning of investment in IT involves the heads of all departments	☐	☐	☐	☐	☐
Investments in IT are fully aligned to strategic and operational needs of the company	☐	☐	☐	☐	☐
New investments in IT are hampered by the difficulty of introducing / managing the organizational changes needed to exploit the potentialities of new technologies	☐	☐	☐	☐	☐
We regularly monitor investment in IT made by our competitors	☐	☐	☐	☐	☐
The IT investments made in the past fully cover our needs related to these technologies	☐	☐	☐	☐	☐
We use the sample consultancy firms for the implementation of the I	☐	☐	☐	☐	☐
Our consultants/suppliers of IT services are able to provide IT solutions suitable to our operative needs	☐	☐	☐	☐	☐
Our consultants/suppliers of IT services analyze efficiently needs in order to personalize the solutions bought	☐	☐	☐	☐	☐

8.8 Provide your level of agreement/disagreement with the following statements (-2: strong disagreement; 2: strong agreement):

In the last 3 years, investments in IT have favoured:	***-2***	***-1***	***0***	***1***	***2***
Growth in the market share	☐	☐	☐	☐	☐
Entry in new market segments	☐	☐	☐	☐	☐
Market expansion/entry abroad	☐	☐	☐	☐	☐
Increased efficiency of administrative activities	☐	☐	☐	☐	☐
Reduction in the ratio costs of goods/services sold over sales revenues	☐	☐	☐	☐	☐
Growth in the number of new product/services developed	☐	☐	☐	☐	☐
A more timely and thorough management accounting system	☐	☐	☐	☐	☐
An improvement in inventory control	☐	☐	☐	☐	☐
A reduction in the order cycle time	☐	☐	☐	☐	☐
Improved quality controls on products/services	☐	☐	☐	☐	☐
Reduction in the failure risks of new products	☐	☐	☐	☐	☐
Reduction in time-to-market for new products	☐	☐	☐	☐	☐
Improved data management in the product development process	☐	☐	☐	☐	☐
Increased knowledge on customer needs and purchasing habits	☐	☐	☐	☐	☐
Increased control on sales, included sales agents	☐	☐	☐	☐	☐
Better support to sales employees	☐	☐	☐	☐	☐
Improved after-sales services	☐	☐	☐	☐	☐
Increased collaboration with suppliers involved in product design and engineering	☐	☐	☐	☐	☐
Increased efficiency in the purchasing activities	☐	☐	☐	☐	☐
Increased quality and/or raw material costs and/or components externally bought	☐	☐	☐	☐	☐
Identification of reliable or convenient suppliers	☐	☐	☐	☐	☐

Thank you for the collaboration!

Appendix 4: ATECO-OECD technological intensity classification

ATECO 2002	Sector description	Sector
150	Food and beverage industry	TMAN
151	Production, processing and storage of meat and meat products, except the activity of butcher	TMAN
152	Processing and storage of fish and fish products	TMAN
153	Processing and storage of fruit and vegetables	TMAN
154	Production of animal and vegetable oils and fats	TMAN
155	Dairy industry and ice cream	TMAN
156	Grain processing and starch products	TMAN
157	Production of animal feed	TMAN
158	Manufacture of food products	TMAN
159	Beverage industry	TMAN
160	Tobacco industry	TMAN
170	Textile industry	TMAN
171	Preparation and spinning of textile	TMAN
172	Weaving	TMAN
173	Finishing of textile and articles of clothing	TMAN
174	Packaging of textile articles, excluding articles of clothing	TMAN
175	Other textile industries	TMAN
176	Manufacture of knitted and crocheted fabrics	TMAN
177	Manufacture of articles of footwear, except underwear	TMAN
180	Manufacture of clothing, preparation, packaging and dyeing of fur	TMAN
181	Pack of leather and semi leather clothing	TMAN
182	Pack of clothing and accessories in fabric, not the clothing and leather coat	TMAN
183	Dressing and dyeing of fur; manufacture of fur	TMAN
190	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear leather and similar material	TMAN
191	Tanning and dressing of leather; manufacture of semi leather	TMAN
192	Manufacture of luggage, handbags, saddler and leather seats and similar material	TMAN
193	Manufacture of shoes	TMAN
200	Manufacture of wood and of products of wood and cork, except furniture, manufacture of materials from straw	TMAN
201	Cutting, and treatment of wood planning	TMAN
202	Manufacture of veneer sheets, plywood and wood (laminated, of chipboard, fibre and wood)	TMAN
203	Manufacture of wood in carpentry and joinery building	TMAN
204	Manufacture of wood packaging	TMAN
205	Manufacture of other products of wood, cork and materials plaiting	TMAN
210	Manufacture of pulp, paper and cardboard and paper products	TMAN
211	Manufacture of pulp, paper and cardboard	TMAN
220	Publishing, printing and reproduction of recorded media	TMAN
221	Publishing	ISERV
222	Printing and related services to the press	TMAN
223	Reproduction of recorded media from original	ISERV
230	Manufacture of coke, refined petroleum products and nuclear fuel	TMAN
231	Manufacture of coke oven products	TMAN
232	Manufacture of refined petroleum products	TMAN
233	Nuclear fuel treatment	TMAN
240	Manufacture of chemicals and synthetic fibres and artificial	MTECH
241	Manufacture of basic chemicals	MTECH

242	Manufacture of chemicals for agriculture (other than fertilizers) and insecticides, rat poison and similar products	MTECH
243	Manufacture of paints, varnishes and, printing ink, adhesive, solvent-based and thinner and inorganic and organic products strippers	MTECH
244	Manufacture of pharmaceutical products and chemicals and botanical uses for medicines	HTECH
245	Manufacture of soaps, detergents and cleaning of products for cleaning and polishing of perfumes and cosmetics	MTECH
246	Manufacture of chemicals	MTECH
247	Manufacture of artificial and synthetic fibres	MTECH
250	Manufacture of rubber and plastic products	TMAN
251	Manufacture of rubber	TMAN
252	Manufacture of plastic products	TMAN
260	Manufacture of other non-metallic mineral processing	TMAN
261	Manufacture of glass and glass products	TMAN
262	Manufacture of non-refractory ceramic than for construction purposes, and refractory ceramic products	TMAN
263	Manufacture of non-refractory ceramic wall and floor, including the decoration and glazing	TMAN
264	Manufacture of bricks, tiles and other products for the building not in clay refractory	TMAN
265	Production of cement, lime and plaster	TMAN
266	Manufacture of concrete, cement, plaster and artificial stone; asphalt	TMAN
267	Cutting, and wax finishing of stone and marble, stones and crushing of minerals	TMAN
268	Manufacture of other non-metallic mineral products	TMAN
270	Metallurgy	TMAN
271	Steel industry	TMAN
272	Manufacture of pipes and fittings of iron, steel and cast steel	TMAN
273	Other activities 'of first transformation of iron and steel cold	TMAN
274	Production of non-ferrous metal base, including semi-finished goods	TMAN
275	Foundries	TMAN
280	Manufacture of fabricated metal products, except machinery and equipment	TMAN
281	Manufacture of metal construction	TMAN
282	Manufacture, installation and repair of tanks, reservoirs and containers of metal capacity 'exceeding 300 litres, and manufacture of boilers radiators for central heating	TMAN
283	Manufacture, installation and repair of steam generators, boilers, except for the central heating	TMAN
284	Forging, pressing and forming of metals, metallurgy of dust	TMAN
285	Treatment and coating of metals, general mechanical engineering	TMAN
286	Manufacture of articles of cutlery, tools, and related locks	TMAN
287	Manufacture of other metal products	TMAN
290	Manufacture, installation, maintenance and repair of machinery and equipment	MTECH
291	Manufacture, installation, maintenance and repair of machinery and equipment for the production and use energy mechanics, except for the motor vehicles and road transport aircraft	MTECH
292	Manufacture, installation, repair and maintenance of other equipment for general use	MTECH
293	Manufacture, installation, maintenance and repair of machines for agriculture and forestry	MTECH
294	Manufacture, installation, repair and maintenance of machine tools and accessories, except parts interchangeable	MTECH
295	Manufacture, installation, repair and maintenance of other equipment for special uses, including parts and accessories	MTECH
296	Manufacture, installation, repair and maintenance of arms, ammunition and weapons systems, including parts and accessories	MTECH

297	Manufacture of household equipment including parts and accessories, except l 'installation, repair and maintenance	MTECH
300	Manufacture of office machinery and computers of accessories including, excluding installation, repair and maintenance	HTECH
310	Manufacture, installation, maintenance and repair of machinery and electric apparatus	MTECH
311	Manufacture, installation, maintenance and repair of engines, generators and electrical transformers	MTECH
312	Manufacture, installation, repair and maintenance of equipment for the electricity distribution and electricity control	MTECH
313	Manufacture of insulated wire and cable	MTECH
314	Manufacture of electric batteries and battery	MTECH
315	Manufacture of lighting devices (not even type of electric), for electric lamps and bulbs	MTECH
316	Manufacture of other electrical equipment	MTECH
320	Manufacture of radio, television and communication equipment	HTECH
321	Manufacture of pipes and valves and other electronic components electronic	HTECH
322	Manufacture of radio transmitters for broadcasting and television and telecommunications equipment	HTECH
323	Receivers for the manufacture of radio and television broadcasting of apparatus for recording and reproduction of sound and image and related products, except repair	HTECH
330	Manufacture of medical, precision and optical instruments, watches	HTECH
331	Manufacture, repair and maintenance of medical and surgical and orthopaedic devices	HTECH
332	Construction, maintenance and repair of instruments and apparatus for measuring, monitoring, testing, navigation and the like, except industrial process control equipment	HTECH
333	Manufacture, repair and maintenance of equipment for the control of industrial processes	HTECH
334	Construction, maintenance and repair of optical instruments and equipment photographic	HTECH
335	Manufacture of watches	HTECH
340	Manufacture of motor vehicles and their engines, engines of motorcycles, trailers and semitrailers	MTECH
341	Manufacture of motor vehicles and their engines, engines motorcycles	MTECH
342	Manufacture of bodies for motor vehicles, trailers and semi-trailers for manufacture of motor vehicles	MTECH
343	Manufacture of parts and accessories for motor vehicles (except those in wood) and their engines	MTECH
350	Manufacture of other transport	MTECH
351	Shipbuilding industry: shipbuilding and repair of ships and boats, including activities of plant	MTECH
352	Construction, maintenance and repair of locomotive, even to operate, and rolling stock tramway, including activities of plant	MTECH
353	Construction, maintenance and repair of aircraft and space vehicles, including activities of plant	HTECH
354	Manufacture and installation of motorcycles, bicycles and moped, including parts and accessories	MTECH
355	Manufacture of other transport, including parts and accessories	TMAN
360	Manufacture of furniture; other manufacturing	TMAN
361	Construction and repair of furniture	TMAN
362	Jewelry and goldsmith	TMAN
363	Construction and repair of musical instruments	TMAN
364	Manufacture of sporting equipment repair and maintenance of the type used in sport gym, gyms and similar centers	TMAN
365	Manufacture of games and toys	TMAN

366	Other manufacturing industries	TMAN
370	Preparing for the recovery and recycling	TMAN
371	Preparing for the recovery and recycling of waste and scrap metal, building demolition of naval	TMAN
372	Preparing for the recovery and recycling of waste and scrap not metal	TMAN
500	Sale, maintenance and repair of motor vehicles and motorcycles, retail sale of automotive fuel	MSERV
501	Sale of motor vehicles	MSERV
502	Maintenance and repair of motor vehicles	MSERV
503	Sale of motor vehicle parts and accessories	MSERV
504	Sale, maintenance and repair of motorcycles and mopeds, accessories and spare parts	MSERV
505	Retail sale of automotive fuel for boats and planes	MSERV
510	Wholesale trade and commission trade, except of motor vehicles and motorcycles	MSERV
511	Trade brokerage	MSERV
512	Wholesale trade of agricultural materials and live animals	MSERV
513	Wholesale of food, beverages and tobacco-based products	MSERV
514	Wholesale of other consumer goods final	MSERV
515	Wholesale of non-agricultural products intermediates, and recycling of waste	MSERV
518	Wholesale of machinery and equipment	MSERV
519	Wholesale of other products, wholesale unskilled	MSERV
520	Wholesale trade and commission trade, except of motor vehicles and motorcycles	MSERV
521	Retail trade in non-specialized	MSERV
522	Retail specialist in years of food, beverages and tobacco	MSERV
523	Retail trade of pharmaceuticals, medical devices and health products and orthopedic, cosmetics, perfume and articles of personal hygiene; herbalist	MSERV
524	Retail trade of other non-food products, except those of second hand	MSERV
525	Retail trade of articles of second hand, except for sale by auction houses, furniture and objects of antique, including old books	MSERV
526	Retail stores outside of shops	MSERV
527	Repair of consumer goods and personal to the house	MSERV
550	Hotels and restaurants	MSERV
551	Hotels, hotels, pensions and similar	MSERV
552	Youth hostels, mountain retreats, camps and other lodging for short stays	MSERV
553	Catering	MSERV
554	Bars and cafes, bars, pubs, wine and other related exercises without kitchen	MSERV
555	Restaurants, catering and banqueting	MSERV
600	Land transport, transport by pipelines	MSERV
601	Rail transport	MSERV
602	Other inland	MSERV
603	Pipeline transport	MSERV
610	Shipping and waterways	MSERV
611	Shipping and coastal	MSERV
612	Transport for internal water ways, including transportation lagoon	MSERV
620	Aviation	MSERV
621	Transport planes except charter flights	MSERV
622	Non-scheduled air transport; charter (and not in line of line)	MSERV
623	Space transportation, to launch satellites	MSERV
630	Activity of supporting and auxiliary transport travel agents	MSERV
631	Ods handling, storage and housing (for third parties)	MSERV
632	Other activities 'in relation to transport	MSERV
633	Travel agencies and other agents of tourism, travel operators (tour operator) travel service, tour guide and accompanying	MSERV
634	Transportation agencies	MSERV
640	Post and telecommunications	MSERV

641	Post national courier postal orders from other national agencies address at home	MSERV
642	Telecommunications	ISERV
700	Activity estate	ISERV
701	Activity real estate on own property	ISERV
702	Lease of real estate and its sub-lease, rental companies, their management of shopping centres	ISERV
703	Work for real estate contract	ISERV
710	Renting of machinery and equipment without operator and of personal and household goods	MSERV
711	Rental without driver of vehicle, including light vans	MSERV
712	Hire without operator of other means of transportation	MSERV
713	Hire without operator of other equipment	MSERV
714	Rental of personal and household goods	MSERV
720	Computer and activities connected	ISERV
721	Consultancy for the installation of hardware systems	ISERV
722	Implementation of software, software consulting	ISERV
723	Electronic data processing and registration (for third parties)	ISERV
724	Management of databases and web portals	ISERV
725	Installation, maintenance and repair of office machinery and computer equipment	ISERV
726	Activity related to the processing	ISERV
730	Research and development	ISERV
731	Experimental research and development in the field of natural sciences and engineering	ISERV
732	Experimental research and development in the field of social sciences and humanities	ISERV
740	Professional and business services	ISERV
741	Business legal, accounting', tax and consulting company, and market studies of opinion polls, and consulting business management, operational holding	ISERV
742	Studies of architecture, engineering and other activities technical	ISERV
743	Testing and analysis techniques	ISERV
744	Advertising	ISERV
745	Services research, selection and delivery of personnel	ISERV
746	Surveillance and investigation services	ISERV
747	Services for cleaning, disinfection and disinfection	MSERV
748	Other business and professional services	MSERV

Table A 3 ATECO-OECD classification

Appendix 5: Environmental measures (2011) according to ATECO classification

ATECO 2002	Munificence	Munificence dummy	Dynamism	Dynamism dummy	Complexity	Complexity dummy
150	0.039	0	0.019	1	0.148	0
151	0.066	0	0.003	0	0.148	0
152	0.040	0	0.022	1	0.148	0
153	0.112	1	0.028	1	0.148	0
154	-0.031	0	0.042	1	0.148	0
155	0.111	1	0.011	0	0.148	0
156	0.118	1	0.032	1	0.148	0
157	0.125	1	0.021	1	0.148	0
158	0.085	1	0.011	0	0.148	0
159	0.050	0	0.011	0	0.148	0
160	0.023	0	0.008	0	0.003	0
170	0.054	0	0.013	0	0.209	1
171	0.036	0	0.018	1	0.209	1
172	0.014	0	0.015	1	0.209	1
173	0.018	0	0.007	0	0.209	1
174	0.044	0	0.019	1	0.209	1
175	0.051	0	0.016	1	0.209	1
176	0.028	0	0.018	1	0.209	1
177	0.068	0	0.012	0	0.209	1
180	0.027	0	0.022	1	0.300	1
181	0.094	1	0.010	0	0.300	1
182	0.096	1	0.008	0	0.300	1
183	0.102	1	0.019	1	0.300	1
190	0.113	1	0.022	1	0.149	0
191	0.052	0	0.020	1	0.149	0
192	0.126	1	0.023	1	0.149	0
193	0.082	0	0.009	0	0.149	0
200	0.026	0	0.014	0	0.109	0
201	0.075	0	0.018	1	0.109	0
202	0.062	0	0.024	1	0.109	0
203	0.103	1	0.008	0	0.109	0
204	0.129	1	0.019	1	0.109	0
205	0.057	0	0.009	0	0.109	0
210	0.052	0	0.003	0	0.394	1
211	0.078	0	0.010	0	0.394	1
212	0.088	1	0.013	0	0.394	1
220	0.016	0	0.015	1	0.214	1
221	0.024	0	0.004	0	0.214	1
222	0.043	0	0.014	0	0.214	1
223	0.043	0	0.014	0	0.214	1
230	0.172	1	0.010	0	0.030	0
231	0.394	1	0.112	1	0.030	0
232	0.100	1	0.019	1	0.030	0
233	0.091	1	0.055	1	0.030	0
240	0.042	0	0.087	1	0.106	0
241	0.077	0	0.010	0	0.106	0
242	0.122	1	0.070	1	0.106	0
243	0.053	0	0.010	0	0.106	0
244	0.028	0	0.009	0	0.106	0
245	0.063	0	0.026	1	0.106	0

246	0.063	0	0.005	0	0.106	0
247	-0.006	0	0.050	1	0.106	0
250	0.079	0	0.014	0	0.159	0
251	0.066	0	0.015	0	0.159	0
252	0.080	0	0.012	0	0.159	0
260	0.050	0	0.023	1	0.210	1
261	0.060	0	0.004	0	0.210	1
262	0.084	0	0.009	0	0.210	1
263	0.046	0	0.014	0	0.210	1
264	0.010	0	0.022	1	0.210	1
265	0.054	0	0.016	1	0.210	1
266	0.057	0	0.005	0	0.210	1
267	0.065	0	0.012	0	0.210	1
268	0.061	0	0.010	0	0.210	1
270	0.135	1	0.076	1	0.246	1
271	-0.138	0	0.007	0	0.246	1
272	0.136	1	0.020	1	0.246	1
273	0.128	1	0.015	1	0.246	1
274	0.126	1	0.047	1	0.246	1
275	0.124	1	0.022	1	0.246	1
280	0.081	0	0.010	0	0.137	0
281	0.139	1	0.012	0	0.137	0
282	0.076	0	0.013	0	0.137	0
283	0.140	1	0.067	1	0.137	0
284	0.146	1	0.016	1	0.137	0
285	0.122	1	0.011	0	0.137	0
286	0.089	1	0.014	0	0.137	0
287	0.085	1	0.013	0	0.137	0
290	0.093	1	0.010	0	0.233	1
291	0.132	1	0.017	1	0.233	1
292	0.116	1	0.010	0	0.233	1
293	0.093	1	0.013	0	0.233	1
294	0.086	1	0.009	0	0.233	1
295	0.124	1	0.012	0	0.233	1
296	0.044	0	0.023	1	0.233	1
297	0.039	0	0.013	0	0.233	1
300	0.001	0	0.011	0	0.666	1
310	0.004	0	0.047	1	0.182	1
311	0.174	1	0.015	1	0.182	1
312	0.094	1	0.007	0	0.182	1
313	0.150	1	0.037	1	0.182	1
314	-0.012	0	0.019	1	0.182	1
315	0.058	0	0.014	0	0.182	1
316	0.069	0	0.004	0	0.182	1
320	0.015	0	0.031	1	0.279	1
321	0.038	0	0.004	0	0.279	1
322	0.106	1	0.015	1	0.279	1
323	0.011	0	0.028	1	0.279	1
330	0.081	0	0.023	1	0.248	1
331	0.088	1	0.009	0	0.248	1
332	0.073	0	0.011	0	0.248	1
333	0.133	1	0.011	0	0.248	1
334	0.122	1	0.028	1	0.248	1
335	0.083	0	0.071	1	0.248	1
340	0.021	0	0.021	1	0.098	0
341	0.089	1	0.021	1	0.098	0
342	0.115	1	0.019	1	0.098	0

343	0.088	1	0.015	0	0.098	0
350	0.173	1	0.046	1	0.131	0
351	0.165	1	0.014	0	0.131	0
352	0.038	0	0.030	1	0.131	0
353	0.109	1	0.044	1	0.131	0
354	0.044	0	0.015	1	0.131	0
355	0.036	0	0.021	1	0.131	0
360	0.057	0	0.015	1	0.275	1
361	0.080	0	0.010	0	0.275	1
362	0.044	0	0.017	1	0.275	1
363	-0.157	0	0.030	1	0.275	1
364	0.009	0	0.023	1	0.275	1
365	0.100	1	0.032	1	0.275	1
366	0.084	0	0.007	0	0.275	1
370	0.146	1	0.021	1	0.406	1
371	0.181	1	0.024	1	0.406	1
372	0.147	1	0.008	0	0.406	1
500	0.052	0	0.032	1	0.108	0
501	0.039	0	0.025	1	0.108	0
502	0.067	0	0.017	1	0.108	0
503	0.057	0	0.005	0	0.108	0
504	0.054	0	0.021	1	0.108	0
505	0.224	1	0.017	1	0.108	0
510	0.089	1	0.007	0	0.217	1
511	0.123	1	0.013	0	0.217	1
512	0.127	1	0.022	1	0.217	1
513	0.092	1	0.004	0	0.217	1
514	0.072	0	0.006	0	0.217	1
515	0.176	1	0.022	1	0.217	1
518	0.078	0	0.012	0	0.217	1
519	0.068	0	0.007	0	0.217	1
520	0.090	1	0.005	0	0.325	1
521	0.081	0	0.003	0	0.325	1
522	0.101	1	0.003	0	0.325	1
523	0.116	1	0.009	0	0.325	1
524	0.085	1	0.010	0	0.325	1
525	0.128	1	0.018	1	0.325	1
526	0.094	1	0.004	0	0.325	1
527	0.136	1	0.013	0	0.325	1
550	0.096	1	0.118	1	0.128	0
551	0.102	1	0.009	0	0.128	0
552	0.114	1	0.010	0	0.128	0
553	0.121	1	0.009	0	0.128	0
554	0.107	1	0.006	0	0.128	0
555	0.071	0	0.015	1	0.128	0
600	0.094	1	0.021	1	0.181	0
601	0.049	0	0.019	1	0.181	0
602	0.105	1	0.008	0	0.181	0
603	-0.025	0	0.012	0	0.181	0
610	0.074	0	0.021	1	0.049	0
611	0.102	1	0.009	0	0.049	0
612	0.063	0	0.004	0	0.049	0
620	0.067	0	0.040	1	0.016	0
621	0.160	1	0.019	1	0.016	0
622	0.173	1	0.012	0	0.016	0
623	0.103	1	0.017	1	0.016	0
630	0.092	1	0.004	0	0.312	1

631	0.118	1	0.018	1	0.312	1
632	0.060	0	0.017	1	0.312	1
633	0.064	0	0.010	0	0.312	1
634	0.091	1	0.005	0	0.312	1
640	-0.337	0	0.110	1	0.039	0
641	0.035	0	0.004	0	0.039	0
642	0.114	1	0.028	1	0.039	0
700	0.004	0	0.076	1	0.047	0
701	0.156	1	0.005	0	0.047	0
702	0.095	1	0.019	1	0.047	0
703	0.127	1	0.045	1	0.047	0
710	-0.027	0	0.021	1	0.760	1
711	0.145	1	0.021	1	0.760	1
712	0.057	0	0.052	1	0.760	1
713	0.157	1	0.012	0	0.760	1
714	0.064	0	0.003	0	0.760	1
720	-0.026	0	0.028	1	0.155	0
721	0.209	1	0.011	0	0.155	0
722	0.091	1	0.008	0	0.155	0
723	0.150	1	0.033	1	0.155	0
724	0.184	1	0.042	1	0.155	0
725	0.068	0	0.011	0	0.155	0
726	0.121	1	0.004	0	0.155	0
731	0.121	1	0.015	1	0.616	1
732	0.069	0	0.010	0	0.616	1
740	0.133	1	0.054	1	0.137	0
741	0.114	1	0.028	1	0.137	0
742	0.147	1	0.020	1	0.137	0
743	0.122	1	0.018	1	0.137	0
744	0.063	0	0.003	0	0.137	0
745	0.134	1	0.012	0	0.137	0
746	0.116	1	0.012	0	0.137	0
747	0.116	1	0.008	0	0.137	0
748	0.197	1	0.019	1	0.137	0

Table A 4 Environmental measures (2011)

Appendix 6: Spearman Correlation Matrix (2011)

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Adoption of IS	1.000												
2	Customized IS	.383**	1.000											
3	Adoption time	.155*	.060	1.000										
4	IIE	.290**	.175**	.119	1.000									
5	NPD_CAP	.181**	.179**	.190*	.599**	1.000								
6	MKT_CAP	.168**	.131*	.030	.511**	.498**	1.000							
7	SCM_CAP	.176**	.088	.084	.577**	.611**	.535**	1.000						
8	BG	.138*	.151**	.148	.475**	.527**	.362**	.411**	1.000					
9	Complexity	-.099	-.036	-.034	.033	.034	.113*	.053	.023	1.000				
10	Munificence	-.100	-.117*	-.122	-.006	.002	.090	-.008	-.009	-.053	1.000			
11	Dynamism	.000	.065	.022	.044	.043	-.072	.037	.085	.008	-.370**	1.000		
12	Customer dependence	-.049	-.109	-.133	-.064	-.127*	-.222**	-.029	-.093	-.170**	-.047	.061	1.000	
13	Geographical scope	.139**	.104	-.050	.100	.017	.158**	-.003	.034	.042	.119*	-.028	-.058	1.000
14	Foreign sales	.215**	.036	.138	.044	-.010	-.005	.017	.176**	.024	-.331**	.208**	-.067	-.075
15	Vertical integration	.004	.021	-.195*	-.045	.016	-.228**	-.010	-.084	-.212**	-.123*	.052	.281**	-.043
16	IT management capabilities	.197**	.022	.169*	.337**	.401**	.277**	.302**	.252**	-.062	.085	-.066	-.033	.077
17	Δ ROA	-.009	-.034	-.033	.076	.015	-.030	-.002	.097	.052	-.044	.030	-.053	.001
18	RG	.003	-.061	.009	.177**	.073	.180**	.030	.217**	-.047	.362**	-.256**	.000	.197**
29	IS vendor support	.270**	.029	.041	.153**	.053	.049	.026	.082	-.058	-.123*	.034	-.003	.084
20	Size	.285**	.128*	.044	.206**	.100	.005	-.006	.016	-.047	-.128*	.017	.036	.348**
21	Age	.072	.089	.271**	.052	.049	-.057	-.015	.028	.050	-.233**	.155**	-.159**	-.083
22	Traditional manufacturing	.020	.036	.085	-.040	-.065	-.093	-.015	-.010	-.118*	-.483**	.180**	.021	-.055
23	Material Services	-.096	-.051	-.015	-.035	-.064	.088	-.083	-.033	.205**	.488**	-.366**	-.078	.049
24	Information Services	.034	.068	-.187*	.050	.095	.064	.030	-.008	-.323**	.219**	-.087	.022	.058
25	Hi-Tech manufacturing	-.032	-.062	.024	-.039	.011	.105	.041	.066	.069	.003	-.019	.033	.048

26	Medium-Tech manufacturing	.081	-.034	.100	.063	.066	-.109	.084	.041	.230**	-.282**	.381**	.040	-.079		
27	On order sales	.012	.042	-.085	-.017	-.024	-.125*	.043	-.004	.016	-.190**	.091	.004	-.121*		
28	Catalogue sales	.159**	.086	.100	.073	.041	.032	.026	.068	-.002	-.134**	.164**	-.176**	-.022		
29	Sub supplier	.048	.037	-.112	-.027	-.042	-.101	.014	-.07	-.133**	-.067	.084	.055	-.047		

		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
14	Foreign sales	1.000															
15	Vertical integration	.051	1.000														
16	IT management capabilities	-.121*	-.060	1.000													
17	Δ ROA	.011	-.079	.001	1.000												
18	RG	-.172**	-.157**	.135*	.188**	1.000											
29	IS vendor support	.109*	-.020	.125*	-.021	.055	1.000										
20	Size	.241**	.227**	.141**	.014	.051	.167**	1.000									
21	Age	.229**	.046	-.023	-.012	-.216**	.016	.199**	1.000								
22	Traditional manufacturing	.349**	.064	-.134*	-.015	-.166**	-.007	.134**	.277**	1.000							
23	Material Services	-.339**	-.393**	.047	.013	.227**	-.031	-.108*	-.142**	-.492**	1.000						
24	Information Services	-.264**	.278**	.154**	.001	.111*	.012	-.101	-.249**	-.338**	-.354**	1.000					
25	Hi-Tech manufacturing	.053	.087	-.026	-.069	-.023	-.026	-.026	.026	-.095	-.099	-.068	1.000				
26	Medium-Tech manufacturing	.301**	.118*	-.052	.028	-.197**	.049	.096	.099	-.260**	-.273**	-.187**	-.053	1.000			
27	On order sales	.153**	.203**	-.082	.016	-.145**	.052	-.005	.072	.173**	-.248**	.007	-.043	.122*	1.000		
28	Catalogue sales	.225**	-.055	-.089	-.037	-.132*	.060	.006	.050	.065	-.106*	-.084	-.064	.188**	.152**	1.000	
29	Sub supplier	0.033	0.137*	-0.088	0.007	-0.105	0.049	0.019	-0.024	0.076	-0.095	0.003	-0.045	0.044	0.228**	0.216**	1

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table A 5 Spearman Correlation Matrix (2011)