



**DOTTORATO IN SISTEMI INFORMATIVI AZIENDALI  
CICLO XX**

**IT INVESTMENTS AND FIRM PERFORMANCE**  
**An Analytic and Empirical investigation**

**CANDIDATO: Maria Federica Izzo**

**TUTOR: Prof. G. Fiori**

*Ai miei Genitori*

---

*Forse la parte più difficile..*

*Ma necessaria,*

*dopo tre lunghi anni che sono passati in un battito di ciglia...*

*Grazie alla mia famiglia, sempre presente, soprattutto in quei brevissimi fine settimana pieni di profumi, plaid, "sandwich" e piaceri di caffè.*

*Grazie ai miei punti di riferimento. Quei pochi a cui chiedo e posso chiedere. Sempre.*

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*To Amit and his jokes, to Nurah and her love for theatres (the right and the wrong ones...)*

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## **I. Abstract**

We drawn on the Resource based view theory (Penrose, 1959; Barney 1986, 1991; Grant, 1991; Wernerfelt, 1984) to examine how investments in information technology (IT) affect firm performance.

Moreover, we want to understand through which paths this effect works.

The results of past studies are inconclusive. Some of these studies have found little or negative impacts of IT on firm performance, measured as productivity, financial performance, consumer value, etc. (Barua et al., 1995; Weill, 1992; Barua et al., 1995; Dos Santos et. al.,1993; etc.); while others have identified significant positive impacts (i.e. Bharadwaj et al., 1999; Thatcher and Pingry, 2004, etc.).

We assume that IT investments have not a direct impact on firm performance, but coherently with the resources complementarity argument (Clemons, 1988; Floyd and Wooldridge, 1990), we propose a model that interrelates IT decisions, IT changes, in Inside-out and Outside-in Capabilities of the firm, process performance and, only in the last step, firm performance.

In this frame, our thesis is that in an enterprise, trying to detect and measure the effects (if any) of IT investments, the fist focus must be the process changes caused by the IT implementation, and only then the study con move toward financial indicators.

The model is empirically tested using organizational and process data collected from a survey analysis (questionnaires about key factors that enable companies to maximize the return on IT investments) and also using financial data collected from two of the mayor data bank of Bureau van Dijk Electronic Publishing (Osiris and Amadeus).

The results provide strong support for the research model and lead to different conclusions:

- (a) the direct link between IT investments (measured by IT Penetration) and Firm Performance (measured by ROA) has not a statistical relevance and doesn't explain the variation in firm performance;



- (b) Process Performance recovers a moderator role in the relationship between IT Penetration (or IT investments in the Model 4) and Financial Performance;
- (c) the positive impact of IT Decisions on Process Performance is mediated by changes in Inside-out and Outside-in Capabilities;
- (d) firm size, introduced in our model as a control variable, has no effect in the relationships tested.

These results, from a managerial perspective, may be useful to understand how investments in IT affect not only the final results of a firm but firstly the bottom line, caused changes in internal and external firm capabilities at organizational and process level.

Furthermore, managers need to have a better understanding of the impact of IS on the organisational infrastructure and performance. Such understanding can help an organisation better utilise resources and improve its competitive position.

On the other hand, failure of such understanding may have disastrous consequences such as inappropriate resource allocation and result in a competitive disadvantage.

The present work is organized as follows.

The next sections (par. 1 and par. 2) review relevant literature to propose an approach for conceptualizing and measuring IT value, and hypothesize its impact on financial performance (par. 3).

Subsequent sections outline the methodology of the study (par. 4 and par. 5), present the results (par. 6), and discuss implications (par. 7) as well as a path for future research (par. 8).

## 1. Introduction

As managers experience more volatile marketplaces, global competition, shortened product life cycles, customer pressures for tailored offerings and tighter performance standards, they increasingly depend on new information systems (IS).

The IS components in business solutions must be constructed rapidly and effectively despite the massive changes in IT product capability, a restructured supply industry, potential shifts in system development approaches, and new ambiguities in terms of what should be regarded as a business-side versus a technical specialist task (Feeny and Willcocks, 1998).

Thus, we expect that the impact of IT on a firm's performance cannot be measured directly, but can only be quantified by examining the indirect effect on some organizational change (e.g., organizational learning, restructuring of process, introduction of different routines, etc.).

In particular we expect that the IT investment can have an impact on firm financial performance only through two intermediate and correlated steps:

- (a) changes in capabilities;
- (b) changes in process performance.

Support for our claim that the relationship between IT investments and firm performance is partially mediated by organizational changes stems directly from the resource-based perspective.

The Resource based view (RBV) argues that durable competitive advantage emerges from unique combinations of resources (Grant, 1991) that are economically valuable, scarce and difficult to imitate and substitute (Barney, 1991). As these resources are imperfectly mobile across firms boundaries and because firms pursue different strategies in deploying these resources, they are likely to be heterogeneously distributed across firms. Firm resources are insulated from competitive imitation by path dependencies, embeddedness, causal ambiguity and time diseconomies of imitation (Barney, 1991; Mata et al., 1995).

These heterogeneously distributed and difficult to imitate resources in part drive differences in firm performance.

According to this scenario, the question is if IT investments can represent a source of competitive advantage for firms and if they can lead to differences in firm performance.

The literature is not unique on this point.

While some firms have realized positive benefits, in fact, many other firms have fallen victim to the productivity paradox (Lucas, 1999) and have actually experienced negative returns from investing in IT.

The natural conclusion is that IT, by itself, may not hold the answer to enhanced performance, but rather must be incorporated into the firm and combined with other firm capabilities to produce positive effects (Tippins and Sohi, 2003).

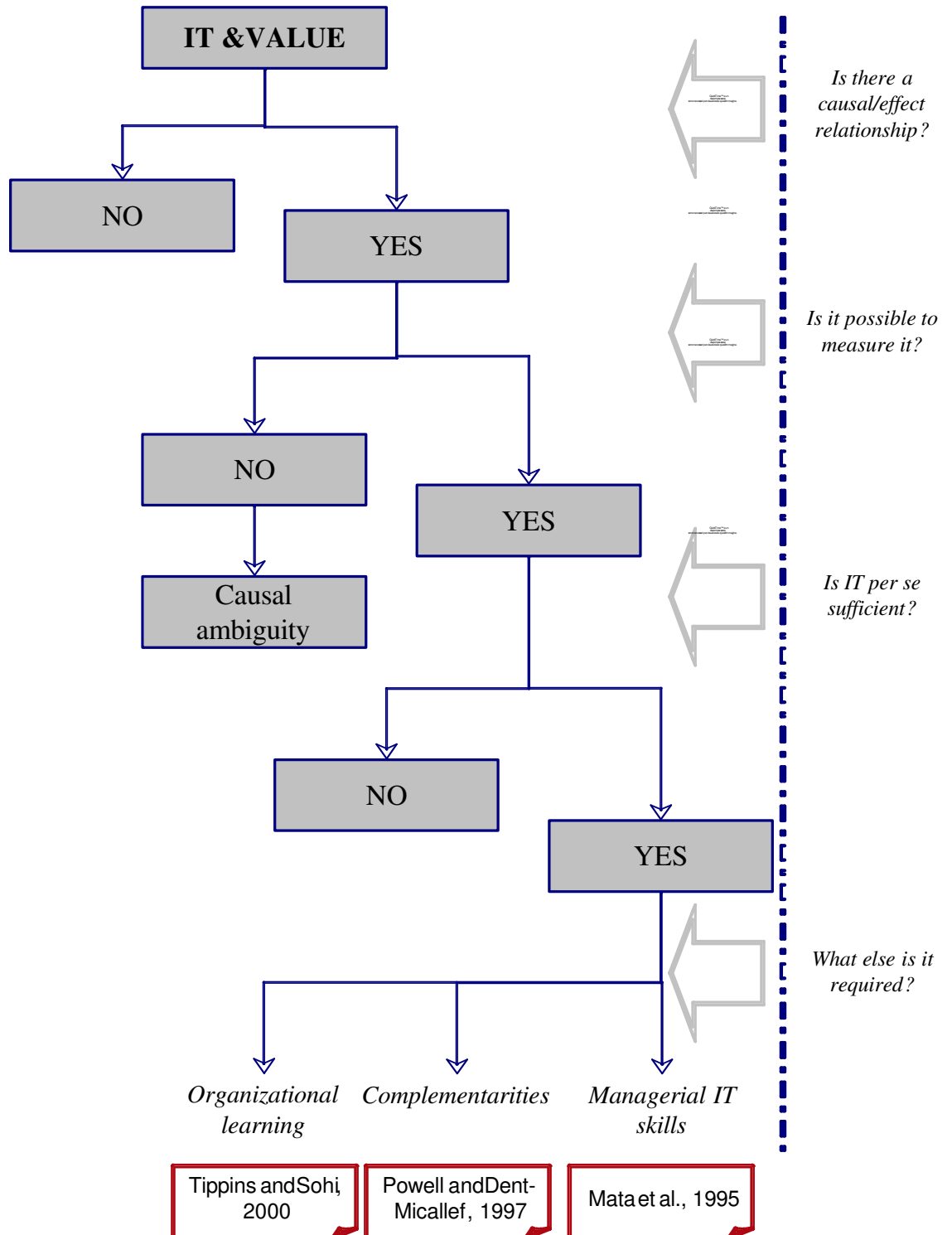
Given the wide range of benefits realized by different firms with regard to IT investment, simple ownership of IT by an organization does not support the thesis that IT will positively impact critical outcome measures.

The focus, so, is not simply about the availability and control on IT resources, but on its use and embeddedness within the firm.

Regarding the long lasting debate on IT value, we can say that the business value of computers is limited less by computational capability and more by the ability of managers to invent new processes, procedures and organizational structures that leverage this capability.

The theoretical path applied in our work is presented in the next figure and it shows the articulation of our IT evaluation process approach.

**Table 1: The conceptual path**



### ***1.1. The very first problem. Defying IT and Performance***

As sometimes occurs, especially referring to topics that are largely studied, the first problem we encountered approaching the study of IT effects on firm performance, regards the definition itself of IT investments and firm Performance.

These two elements, in fact, represent two correlated and huge worlds academics and practitioners have puzzled about.

Moreover, before we can discuss how to improve performance, it's necessary to define what performance is. This isn't as simple as it sounds. Despite the frequent use of the word "performance", its precise meaning is rarely clearly explicated

Information technology (IT), as defined by the Information Technology Association of America (ITAA), is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware".

IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information, securely.

For what concerns Performance, in a very broad way, it has to do with what firms do that generates revenues in excess of costs. In this sense, Performance is the sum of all processes that will lead the managers to take appropriate actions, in the present, that will create a performing organization in the future (e.g. one that is effective and efficient).

Performance is a complex concept because indicators could be contradictory. Many concepts are not normally captured in accounting and control system (competence, awareness of brand value, existing structure of negotiation, relationship with both partners and suppliers, and organizational responsibility structure, etc) and for this reason, an effective performance system has to be developed, maintained and controlled.

According to Neely (1998), a performance system "enables informed decisions to be made and actions to be taken because it quantifies the efficiency and

effectiveness of past actions through acquisition, collation, sorting, analysis, interpretation and dissemination of appropriate data”. The nexus with the first advantage of IS appears clear, and the same with all the potentialities of IT systems.

In this sense, so, IT and performance are indissolubly linked and, as we are going to demonstrate in this work, changes in the first one may cause changes (improvements) in the second one.

## **2. Information systems in the firm system**

### ***2.1. The Challenge of IT***

The business environment of the new millennium is responsive, dynamic and competitive, and it is in a constant state of customer-centred change.

This change has been largely initiated by innovations in information and communication technologies, which have led to the creation of the information-based economy. Consequently, many organizations have become reliant upon Information Technology and Information Systems to support their business processes.

Information systems and information technologies are often inextricably linked and sometimes it appears difficult to study one without the other. Moreover, also because it has become conventional to do so, in this work we will refer to them jointly as information technology.

Due to the relevance of IT in firm life and the growing amount of resources invested in it, there is an exponential interest of researcher and practitioners about the efficiency and effectiveness of these investments.

According to McKay and Marshall (2001), there appears to be a dichotomy with respect to the question of investment in IT. On the one hand, the notion of an information-based economy and the arrival of an e-business domain have led to considerable faith being placed in IT to deliver performance improvements. On the other hand, there is concern that IT/IS is not delivering what it promises by vendors and project champions.

In the next paragraphs we will try to outline the main literature's position about this dichotomy, with the respective hypothesis, explanations and solutions (or further questions).

### ***2.2. IT and organization.***

Within the new social and economic context, characterised by mobility and

interdependence, an enterprise that wishes to become competitive must rethink its organisation, mobilise its human competences and redefine its strategies, and in these sense is technology that determines organization.

IT promotes collaboration and information sharing both inside and across organizational boundaries, it can exert the inventories management, the control processes, the management efficiencies and all the decision support mechanisms.

Moreover, at the higher level, it concerns the process of managing the uncertainty and risk surrounding the transactions necessary to convert inputs in output (Thompson, 1967).

In other words IT is completely unbounded in any activities of the firm.

Obviously, due to this condition IT can represent, at the same time, a resource or a constraint for the firm, or, by the way, a source of risk, underevaluation or, worst, misevaluation.

As the present work aims at focusing on, most organizations take considerable care in quantifying the direct financial implications such as the costs for hardware and software, installation and configuration costs, overhead, and training costs, and maintenance costs.

However, these are primarily front-end costs, which, over time, bear increasingly little resemblance to the real operating costs that can exceed by orders of magnitude the up-front expenditure. The full costs of IT implementation, often referred to as the total cost of ownership, include both the direct cost that can be attributed to the implementation and operation of new technology, as well as indirect human and organizational costs<sup>1</sup>.

### ***2.3. IT and strategy. How to reach more.***

The idea of creating value through IT, for a long time, was used as a synonymous of competitive advantage.

Competitive advantage is normally defined as the firm ability to earn return on investment persistently above the average for the industry (Porter, 1985). In

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<sup>1</sup> On the point see the work of Epstein and Reja, 2005



other words, competitive advantage leads to abnormal returns and to a virtuous value creation path in comparison to competitors.

The ability to effectively manage information within the firm has become critically important because it may provide a basis for gaining a competitive advantage. Seen by many as a source of value creation instead of a cost (Sampller, 1998), information has become an invisible asset that, when managed properly, can be used to leverage other firm resources.

Strategy has been defined as “the match an organization makes between its internal resources and skills... and the opportunity and risks created by its external environment” (Charles and Dan Schendel, 1978).

In that definition we recognize elements from the Resource Based View (RBV) and its attention to the firm internal resources and capabilities and from the Micheal Porter’s analysis of industry structure and competitive positioning of the firms.

Porter and Millar (1985) related IT to the value chain, concluding that the main strategic purpose of IT is to coordinate activities in the chain; Rackoff et al. (1985) concluded that IT should support competitive thrusts such as cost leadership, differentiation, innovation, growth, and external alliances; and Rockart and Short (1989) argued that IT investments serve primarily to 'manage organizational interdependence,' i.e., to solve coordination problems among departments and strategic business units. A number of researchers examined the conditions under which IT creates sustainable advantages.

Porter (1985), for example, focused on first-mover advantages, arguing that technological advantage arises when first-mover advantages (such as preempting customers through switching costs) outweigh first-mover disadvantages (such as development costs and learning curves).

Moreover, information is not only a way to face the competitive environment, but it’s itself an element that continuously changes the competitive scenario.

According to Porter (1985) this change occurs in three vital ways:

- it changes industry structure and, in so doing, alters the rules of competition;
- it creates competitive advantage by giving companies new ways to outperform their rivals;
- it spawns whole new business, often form within a company's existing operations.

As the field of strategic management has expanded, strategy researchers and practitioners have showed increasing interest in the role of information technology (IT) in strategy formulation and implementation, and in its impacts on financial performance (Powell and Dent-Micallef, 1996).

In that background, we are witness of a shift from the external focus to the internal one. Whereas traditional strategy research has focused on advantages derived from industry and competitive positioning, the resource-based research has focused on advantages stemming from firm-specific, intangible resources such as organization culture, learning, and capabilities (Hall, 1993).

Moreover, some authors (Kettinger et al., 1994, Keen, 1993, Mata et al., 1995) underline the existence of caveats and Warner (1987), i.e., defines IT as competitive burden and focuses on the risks and costs of IT investments, and on the difficulties of integrating IT with strategy.

For Epstein and Reja (2005), typically the costs of technology are much higher than anticipated, the cost of conversion is also higher, whereas the benefits are far lower and harder to achieve than expected. Moreover, IT could represent a relevant source of risks. In firms life, there are several areas of risk; however, organizational risks, project risks, staff risks and risks from the external environment are among the most important (Murphy, 2002). Organizational risks include the risk of the project not being aligned with business objectives, being incompatible with existing organizational structures and systems, or lacking management support. Project risks relate to critical project management skills, size, complexity and duration of the project, imprecise or incomplete definition of the business problem and/or the proposed business solution, hardware and vendor

related risk, and more. Staff risks comprise the level of user commitment as well as user capabilities to exploit IT applications, and IT staff stability. With respect to the external environment, competitors' actions, government legislation and overall economic performance can impact the IT implementation and potential payoffs. Certainly, the number of potential risk elements is even greater (Epstein and Reja, 2005).

Clemons (1986) also acknowledged that, although IT had clearly produced advantages in a few spectacular cases, researchers still knew relatively little about IT impacts on most firms.

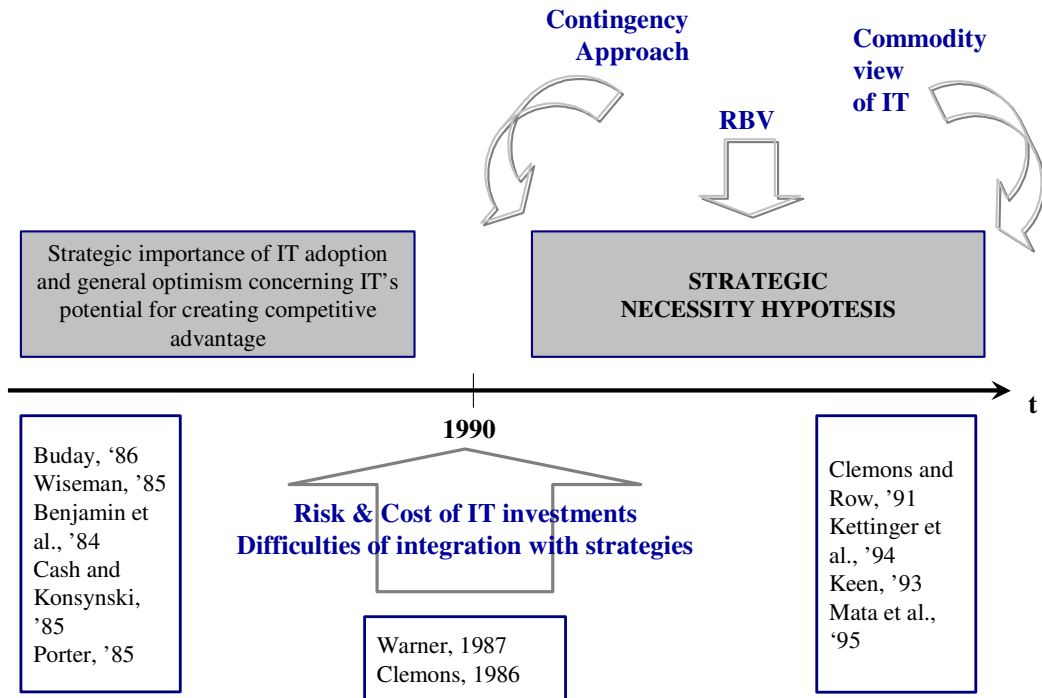
According to Clemons (1991), a comprehensive analysis reveals that IT has become a strategic necessity, but not a source of competitive advantage.

In sum, the pre-1990 IT literature focused on the strategic importance of IT adoption and innovation, and reflected a general optimism concerning IT'S potential for creating competitive advantage. But, in the attempt to give a comprehensive overview of the IT literature efforts, Powell and Dent-Micallef (1997) don't hesitate to underline also the existence of some caveats.

Warner (1987), i.e., defines IT as competitive burden and focuses on the risks and costs of IT investments, and on the difficulties of integrating IT with strategy. Clemons (1986) also acknowledged that, although IT had clearly produced advantages in a few spectacular cases, researchers still knew relatively little about IT impacts on most firms.

This literature evolution is showed in the next figure:

**Table 2: Strategic role of IT. The literature evolution**



### **3. Information systems and value creation**

#### ***3.1. The concept of IT value. Literature Review***

Before analyzing if and how IT investments can affect value, it's fundamental to understand what is value or, more correct, what is our idea of value utilized in this work.

There are, in fact, a lot of definition of (or approaches to) value.

Information value arises as the difference between a decision maker's payoff in the absence of information relative to what can be obtained in its presence (Banker and Kauffman, 2004).

IT Business Value research, then, analyzes the organizational performance impact of IT in terms of effectiveness and efficiency, trough changes in intermediate processes and changes at organizational wide level too. The analyzed impacts include productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction and other measure of performance.

IT value, so, in a huge sense, that is the one we want to adopt in this work, also has to do with the impacts of IT investments on a company's financial performance and, in that sense, with all the aspects of its life.

Obviously the relation is not immediate, but mitigated and sometimes, opposed by others variables (internal and external) that can affect this value creation process.

IT investments, i.e., create value simplifying processes, reducing time and costs, improving products' quality, enhancing better delivery policies and customization programs.

Also information sharing, in supply chain management, for example, is linked to the concept of value creation, when the full information disclosure is associated to business value gains than are bigger than the potential risks of the business partner's exploitation of sensitive demand information.

Nevertheless, the existence of a value function linked to IT has been debated a long by researchers. While some authors have attributed large productivity improvements and substantial consumer benefit to IT, others underline that IT has not a clear and valuable impact on business profitability.

According to Hitt and Btynjolfsson (1996), the empirical results on IT value depend heavily on which question is being addressed and what data are being used: “IT value can look different depending on the vantage point chosen”. In this sense, so, an important issue in the debate surrounding methodological factor relates to the appropriate measure of IT value.

The identification of the measure depends on the conjectures about what is the object that we want to measure. In other words what is the impact, or the effect of IT investments.

According to Hitt & Brynjolfsson (1996), IT value has three different dimensions: productivity, profitability and customer value.

Changing the issues, or the focus, heavily change the effect (if it exists) of an additional investment in IT.

Starting from that, the authors demonstrate how “there is no inherent contradiction between increased productivity, increased consumer value, and unchanged business profitability”. In relation t their data they affirm that “IT appears to have increased productivity and provided substantial benefits to consumers , but there is no connection between this benefits and higher business profits or stock prices” and conclude that “IT spending alone is not determinative of success”.

In the next paragraphs we will try to briefly outline the different streams of literature according to the nature of the main effect the authors linked to an improving to IT investment amount:

- (a) productivity;
- (b) financial performance and
- (c) other measures of value.

### 3.1.1. Productivity

Productivity concerns the relation between input and output, and in this scenario what is important to understand is if IT investments can enable the production of more output for a given quantity of inputs.

The economic theory of production posits that a sum of different inputs, through a production function, that is assumed to adhere to certain mathematical assumptions, generate an output that is positively correlated to each inputs. Moreover, the marginal cost of each input should just equal the marginal benefit produced by that input.

IT enters, obviously, in that function as an input<sup>2</sup>, but the so called “productivity paradox” asserts that IT investments have no net contribution to total output.

The theory of production not only posits a relationship among inputs and outputs, but also posits that a lot of different circumstances or factors can act on this relationship, modifying the expected output. Obviously the environment, but also the risky attitude of managers, or the firm history or the employee skills can hardly affect the results.

Early empirical studies of IT value examined the contribution of aggregate IT spending to productivity at the economy and industry levels of analysis typically found little or no improvement in productivity despite massive investments in IT since the early 1970s (Baily 1986, Hackett 1990, Panko 1991, Roach 1991, Strassmann 1990).

The phenomena of “IT productivity paradox” refers to the condition for which, despite enormous improvements in the underlying technology, the benefits of IS spending have not been found in aggregate output statistics.

Research on the paradox exists on two levels. The first is at the industry or economy wide level. This was summed up in 1987 by Noble Prize winning

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<sup>2</sup> The literature defines different roles and advantages of IT in the function production. Thatcher and Pingry (2004), i.e., stress the idea of IT as a way to reduce the marginal costs of improving product quality. In their words: “IT is an input that enables the firm to seek higher quality of its output”.

economist Robert Solow, who wrote, “We see the computer age everywhere except in the productivity statistics.”

The second Productivity Paradox was observed at the company level, where “there was no correlation whatsoever between expenditures for information technologies and any known measure of profitability”. It is the second version of the Productivity Paradox that most intrigues researchers in IT (e.g. Brynjolfsson 1993; Landauer 1995; Strassmann 1990; Weill 1992).

These early studies confirm either no relation or a slightly negative relation between firm-level spending on IT and firm performance.

The primary explanation for the so-called “IT productivity paradox” was that the collection of data aggregated at the economy and industry levels had led to the mismeasurement of inputs and outputs in the productivity measures and, therefore, the underestimation of productivity gains from IT investments (Brynjolfsson and Hitt 1996; Brynjolfsson 1993, 1994; McCrune 1998; Metcalfe 1992; Metheny 1994).

Loveman (1994) and Barua et al. (1995) didn’t found in their work any correlation between IT and productivity and Loveman, in particular, concluded that “investments in IT showed no net contribution to total output”. Morrison and Berndt (1990), by examining industry level data, concluded that each dollar spent on computers, instruments and telecommunication equipment increased measured output by only 80 cents on the margin.

Against the productivity paradox and the lacks on econometric evidence that computer improve productivity, Brynjolfsson (1993) underlines that “shortfall of evidence is not necessary evidence of a shortfall”.

In this sense, so, he argues that there are at least four viable explanations of these results:

- (a) mismeasurement of inputs and outputs;
- (b) lags due to learning and adjustment;
- (c) redistribution and dissipation of profits;
- (d) mismanagement of information and technology.



The first two explanations point to shortcomings in research, not practice, as the root of the productivity paradox. It is possible that the benefits of IT investment are quite large, but that a proper index of its true impact has yet to be identified. Traditional measures of the relationship between inputs and outputs fail to account for non-traditional sources of value. Second, if significant lags between cost and benefit exist, then poor short-term performance could ultimately result in proportionately larger long-term pay-offs. This would be the case if extensive learning by both individuals and organizations were required to fully exploit IT, as it is for most radically new technologies.

In the specific, the measurement problem is linked and partially caused by the weakness in available data and measurement techniques.

Normally, in fact, the only data available for a broad cross section analysis are industry level statistics that don't permit an accurate and specific study of the firm reality. Firm level production function, instead, could help in resolving these problems, better reflecting the true output of the firms, but are more difficult to collect, causing, firstly, the analysis of a relatively narrow sample of firm and, secondly, the difficulties in generalizing the results from these studies.

Brynjolfsson and Hitt underline that the collection of data aggregated at the economy and industry levels led to the mismeasurement of inputs and outputs in the productivity measures and, therefore, the underestimation of productivity gains from IT investments. Later studies attempted to address the mismeasurement problem by examining the business value of IT using firm-level (or disaggregated) data. The majority of studies have continued to focus on measuring the contribution of IT to productivity, with many finding significant contributions of IT spending to firm productivity (Barua and Lee 1997; Brynjolfsson and Hitt 1996; Brynjolfsson 1993; Lee and Barua 1999; Hitt and Brynjolfsson 1996; Jorgenson and Stiroh 1995; Lehr and Lichtenberg 1998, 1999; Lichtenberg 1995; and see Dedrick et al. 2003 for an extensive review).

The lags issue, instead, is related to the time needs to realize the benefits of IT spending, and the problems of synchronize the analysis, the available data and, from a management point of view, the expectations of managers and controller.

Investments in IT require time to develop and produce results and its benefits can take several years to appear on the bottom line; they allow organizational and operational changes in the firms that are not immediately recognized by financial data or that are initially fairly low, compromising the results of studies that don't take this problem in account.

This accords with an econometric study by Brynjolfsson et al. (1991) which found lags of two to four years before the strongest organizational impacts of information technology were felt.

A third possible explanation of the productivity paradox is that information technology may be beneficial to individual firms, but unproductive from the standpoint of the industry or the economy as a whole.

There are several arguments for why redistribution may be more of a factor with IT investments than for other investments. For instance, information technology may be used disproportionately for market research and marketing, activities which can be beneficial to the firm while adding little to total output (Baily and Chakrabarti, 1988).

Furthermore, economists have recognized for some time that, compared to other goods, information is particularly vulnerable to rent dissipation, in which one firm's gain comes at the expense of others, instead of by creating new wealth.

While redistribution implies overinvestment in IT, some researchers look at the possibility of positive externalities that may lead to less than social optimum investment.

Bresnahan and Trajtenberg (1995) propose two types of positive externalities -- vertical and horizontal externalities which a "general purpose technology sector" may face.

The vertical externality is a familiar problem of appropriability. Since it is difficult for innovators to reap the benefits, they are reluctant to invest.

In addition, the horizontal externality exists because firms are waiting for other firms to invest. The more other firms invest, the faster the speed of innovation in the general purpose technology sector. Knowing that, everyone waits; investments are too small and innovation is too slow.

The final explanation suggests that firms have systematically mismanaged information technology: there is something in its nature that leads firms or industries to invest in it when they shouldn't, to misallocate it, or to use it to create slack instead of productivity

The investments are made nevertheless because the decision-makers aren't acting in the interests of the firm. Instead, they are

- (a) increasing their slack,
- (b) signaling their prowess or
- (c) simply using outdated criteria for decision-making.

Many of the difficulties that researchers have in quantifying the benefits of information technology would also affect managers. As a result, they may have difficulty in bringing the benefits to the bottom line if output targets, work organization and incentives are not appropriately adjusted.

The result is that information technology might increase organizational slack instead of output or profits. This explanation for the productivity paradox is also linked to the mismeasurement problems above depicted: the lack of explicit measures of the value of information make it particularly vulnerable to misapplication and overconsumption by managers.

The work of Brynjolfsson and Hitt (1993) has led to conclusions that support the positive correlation between IT investments and productivity: "spending on computer capital created more value than spending on other types of capital". They affirm that, at least for the sample analyzed, the productivity paradox disappeared by 1991. Adding to that, they also tried to show the possible reasons of these results, hardly in contrast with the previous researches. These reasons can be connected to (a) a different and later time period, that appears a critical point, due to the time needed by the changes in business processes to realize the benefits of IT

spending; (b) a more detailed firm-level data not available before and, finally, to (c) the panel of the analyzed firms, all large “Fortune 500” ones. The fact that the sample was composed entirely by big firms could mean, as the authors conclude, that the high IS contribution is more present in larger firms.

Moreover, IT proponents, in a “what if effort”, argue that productivity measures ignore what would have happened without IT investments: productivity gains might have been even lower in the 1980s, and entire new industries would not have existed, including computer software and satellite services (Quinn and Baily, 1994).

### **3.1.2. Financial Performance**

Through financial performance indicator it is possible, in different ways, to measure the profitability of an investment or of a business. The idea of the proponents of the link between IT and profitability, is that by investing in IT firms can earn higher profits than they would have earned otherwise.

The literature, in that field, gives us a lot of contributes that are far to be agreed on the relation between IT investments and financial performance.

Strassmann (1997) arguments that IT investment has no impact on any measure of firm profitability, including return on assets, return on equity and economic value added.

Hitt and Brynjolfsson (1996) have argued that there is no relationship between IT investments and measures of firm profitability. In particular, they stress the idea that there is no inherent contradiction between increased productivity, increased consumer value and unchanged business profitability. They assume firm profitability as a function of the ratio of IT stock to firm employees and conclude that the results of their analysis show little evidence of an impact of IT on subnormal profitability. An explanation of this result

Alternatively, Bharadwaj (2000) found a positive and significant relationship between a firm’s IT capability and a variety of profit performance measures. Still

other studies have identified specific factors that affect the impact of IT investments on profitability.

For example, Dos Santos et al. (1993) found that innovative IT investments increase firm value, while noninnovative (or incremental, follow-up) investments do not. In addition, Shin (2001) found that IT investments do not improve firm profitability unless they are properly aligned with the firm's business strategies.

Table 3 presents and compares different approaches and conclusion of literature, about IT effects.

***Table 3: Different approaches to IT Performance***

Authors	Effects on		Measured by	note
	Productivity	+		
<b>Hitt and Brynjolfsson (1996)</b>	Business Profitability	no	f (IT stock/firm employees)	
	Consumer value	+		
<b>Bharadwaj et al. (1999)</b>	Performance	+	Tobin's q	
<b>Barua et al. (1995)</b>	Performance	no	ROA	it's necessary to distinguish between IT investment impacts that affect lower operational levels (+) and the ones that affect the higher level
<b>Weill (1992)</b>	Performance	no	sales growth; ROA; labor productivity	it's necessary to categorize IT investment by the management purpose
<b>Dos Santos et. al. (1993)</b>	Firm Market Value	no	common stock price	it's necessary to distinguish between innovative and non innovative investments because the market reacts differently to these kinds of investments
<b>Thatcher and Pingry (2004)</b>	Economic Performance	+		Product Quality moderates the relationship between IT investments and economic performance

### 3.1.3. Other measures of value

Against or in addition to the previous conclusions, in business-oriented journals a recurrent theme is the idea that information technology will not so much help us produce more of the same things as allow us to do entirely new things in new ways (Brynjolfsson and Yang, 1996).

For instance, Watts (1986) finds that information technology investments cannot be justified by cost reductions alone, but that instead managers should look to increased flexibility and responsiveness, while Brooke (1992) makes a connection to greater variety but lower productivity as traditionally measured.

The business transformation literature highlights how difficult and perhaps inappropriate it would be to try to translate the benefits of information technology usage into quantifiable productivity measures of output.

Intangibles such as better responsiveness to customers and increased coordination with suppliers do not always increase the amount or even intrinsic quality of output, but they do help make sure it arrives at the right time, at the right place, with the right attributes for each customer. Berndt and Malone's (1995) recent argument is suggestive: "we need to spend more effort measuring new forms of value, such as capabilities for knowledge creation, rather than refining measures of productivity that are rooted in an Industrial Age mindset."

All of these affirmations lead to the necessity of look beyond conventional productivity measurement techniques.

A smaller set of studies has focused on measuring the benefits passed on to consumers from IT investments.

For example, Brynjolfsson (1996) found that for the year 1987, IT investments generated approximately three times their costs in value for consumers. Similarly, Hitt and Brynjolfsson (1996), using data from 370 firms from 1988–1992, found that IT had created substantial value for consumers.

Nault (1995) affirms that the main role of IT is to enhance quality differentiation, and through that add value to the customer and give to the firm the strategic possibility to partition the market.

Another alternative to traditional productivity measures is to look at stock market data. If one assumes that rational investors will value both the tangible and intangible aspects of firms' revenue generating capacity, then changes in stock market value should approximate the true contribution of IT to the firm, not only in cost reductions, but also in increased variety, timeliness, and quality, and in principle, even the effectiveness of the firm in foreseeing and rapidly adapting to its changing environment. While relying on consumer or stockholder valuations begs the question of actual IT productivity to some extent, at a minimum these measures provide two additional benchmarks that can help triangulate IT value (Hitt and Brynjolfsson, 1994).

### **3.2. *The measurable value***

A starting question a researcher has normally to face in each study he undertakes, is "what we know and what we don't know". And, suddenly, "what we can measure and what we cannot?".

The measurement problems connected to the IT world are different and sometimes they can represent an explanation of the evidence (or lack of evidence) of researcher efforts in the field of IT business value.

These problems are normally linked to:

- (a) time asynchrony effect;
- (b) confusion effect and
- (c) data effect.

The first one (asynchrony effect) regards the fact that information systems take several years to achieve payback, while company and industry indicators in the meantime show low or negative returns. That problem is common to many other technological breakthroughs, but also to other kind investments, as the ones in CSR activities, that need time to generate value and recover the investments done. In this

sense, so, arise the trade off, of a lot of investor between short or long term orientation. According to Hitt and Brynjolfsson (1998), long term benefits were larger, 2 to 8 times as much as short term benefit.

What we've called the confusion effect, furthermore, is connected to another intrinsic difficulty on analyzing IT results. Often, even if benefits or return accrue, it is really difficult to separate the IT contribution from other variables effects. That limit requires an holystic approach to the firm and a deep analysis of the linkages between investment, processes, changes and results.

Finally, the data problem has to do with two order of facts: the concrete availability of the data (Brynjolfsson and Hitt, 1996) and the type of data studied (Barua et al., 1995).

Sometimes, in fact, to collect or obtain data is difficult, but, often, to find the right data is more difficult. A possible mistake a researcher can occurs in, is trying to study, measure and interpret an event through the incorrect set of data. The result of this process is a finding (that can confirm o not, the starting hypothesis) that is not correct at all.

In this sense, Barua et al. (1995) trying to explain the lack of potential findings about the relation between IT and business value, affirm that "by attempting to relate IT expenditures directly to output variables at the level of the firm (such as market share) through a microeconomic production function, the intermediate processes through which IT arise are ignored". For this reason, they conclude, prior research based on conventional micro economic production theory doesn't have the power to reveal an association with high statistical significance.

Lin and Pervan (2001) suggest that the confusion about IT benefits can be attributable to a number of factors, which include:

- (a) the mismeasurements of outputs and inputs (inappropriate units of analysis);
- (b) the difficulty of establishing the overall value IT;
- (c) the choice of inappropriate methods of evaluation;
- (d) lags in learning and



(e) adjustments and lack of effective IT/IS evaluation and benefits realisation management practice.

In addition to the above, there are changes in organisational structure and strategy that have arisen out of IT deployment, such as the formation of alliances and the increased use of E-commerce. Such approaches have made it even more difficult to ascertain the tangible benefits of IT, and in particular associated costs.

Adopting a more comprehensive approach, Smithson and Hirschleim (1998) categorize five different levels at which the evaluation is performed and affirm that these different perspectives could represent a big source of problems in evaluation process.

The identified levels are:

- (a) macro
- (b) sector
- (c) firm
- (d) application
- (e) stakeholder

The macro level refers to a national or international perspective, whereas the sector level refers to an industrial sector: i.e. the impact of factory automation on manufacturing industry.

At the third level, the firm one, the focus is usually the impact of a firm's IS on its performance, perhaps compared to other firms. The application level attempts to evaluate the impact of a particular application and it is the level at which this work is mostly concerned. The final level, the stakeholder level, recognises that different stakeholders have different concerns and different value systems which strongly influence their evaluation of a particular Information System.

The point here is that different concepts, frames of reference and criteria apply at each level.

Even at the level of the firm, the introduction of a new information system is likely to have consequences in economic terms (e.g., costs, output, turnover), organizational terms (e.g., changes in organizational structure or procedures), social

terms (e.g., social interaction, quality of working life, organizational culture), and management terms (e.g., information access and decision making).

Any of these aspects may improve or deteriorate and it is often problematic to isolate the factors which cause particular costs and benefits, especially when these factors themselves are highly interdependent. In addition, there are often unplanned consequences from introducing a new system and the business application area concerned may be subject to impacts from planned changes or unforeseen events which are at most only indirectly linked to the new system.

It is thus a huge problem deciding 'what' to measure, especially as many of these aspects are highly intangible (Brown, 1994). DeLone and McLean (1992) classify evaluation criteria under six categories: system quality, information quality, use, user satisfaction, individual impact and organizational impact, none of which are free of the measurement problems which have long been recognised as problematic in organizational settings (Mason & Swanson, 1981).

A key problem concerns the often conflicting perceptions of different stakeholder groups such that evaluation may become a highly political activity (Goddard, 1989; Walsham, 1993). While the information itself may have highly political implications in some organizational situations (Davenport et al, 1992), costs and benefits are also frequently politically charged (Lederer et al, 1990) and may be redistributed through political activity such that they become even more difficult to trace.

Another topic linked to the measurement issue is strictly connected to the order of change we want to measure.

Bartunek and Moch (1987) firstly introduced this definition, applying concepts from cognitive psychology to the understanding of organizational interventions.

First order changes intend to reinforce existing managerial frames, incrementally modifying current interpretations, norms, values, and processes. They presume the utility of the established organizational frames, and serve to tacitly reinforce the status quo.

Second order changes involve shifting to radically different assumptions and mode of operation, with the shift reflecting a replacement of the status quo.

Third order change is aimed at building the capacity for organizations to regularly reflect on existing assumptions, processes, interactions, and structures, and to change them if needed. Organizational change theorists have noted that future organizations must develop a self-diagnostic capacity to be aware of the perspectives from which they are operating, becoming "self-designing," "continuously improving" or "learning," via frequent, critical examination of key assumptions, processes, and structural decisions. Third order change does not imply that all organizations must change continuously, but rather that they be intermittently reflective and open to alternative frames.

As we have already said, we expect that the impact of IT on a firm's performance can be quantified only by examining the indirect effect on some organizational change that act as enabler of performance. According to Gash and Orlikowsky (1991), organizational changes occasioned by the introduction of information technology can be understood in terms of shifts in managerial technological frames over time (before, during, and after the technological intervention).

IT first order changes, typically the ones occurred in the '60s, tend to reinforce and reaffirm the existing way of doing business, improving some established operations to better achieve general goals like efficiency, productivity or reduction of costs.

Measuring first order technological change is relatively straightforward because an analysis that compares the two situations (ex ante and ex post) is possible and consistent (no radical changes was occurred).

Measurement problems arise with second IT changes (Golembiewski et al. 1976; Armenakis and Zmud 1979) that radically redesign business processes and create a discontinuity with the past (see IT investments in the '80s). While implementers typically also intend to improve productivity or decrease costs, their primary aim is to change the established assumptions and mode of operating (their

output are new processes, a different products and services, the entrance in a new market and so on).

The IT third order change, obviously, require the bigger management effort, because it requires actors to be reflective about the design and use of technology. It requires multiple loops learning path that enhance user to distinguish when current managerial frames and current technological capabilities no longer meet their needs, and be able to act to change the situation (Gash and Orlikowsky, 1991).Moreover, Irani and PED Love (2001), introduced another aspect in the debate about the IT evaluation process and the correlated difficulties: the continuous expansion of boundary surrounding the evaluation domain. The change in boundaries is in part attributed to new technology (eg, increased scope, functionality and flexibility) and its human and organizational impact on developing a new integrated organisational IS infrastructure.

In addition to that, there are many interacting socio-technical dimensions that support the organisation as an entity. Hence, investment decision-makers not only need to have the skill to evaluate IT investments, but need the foresight to assess its impact on the future of the organisation and the people who rely on and use the system. Such impact inevitably lies in terms of the integration links between legacy and future systems, benefit realisation, stakeholder exploitation, cost (direct and indirect) management and risk minimisation.

### ***3.3. Business Value of IT and the need for measurement***

Trying to summarize the main conclusion about the relation between IT investment and value, we cannot firstly underline the large amount of contributes and efforts of the literature to clearly define and treat the argument.

Despite all these resources spent on it, there is not still agreed among practitioners and theoreticians.

The truth in that not all IT investment is alike.

Investments in IT are made for different management objectives and are likely to be related to firm performance in different ways. Furthermore, the context of the

firm is important in converting IT investments into productive outputs (Weill, 1992). The necessity to carefully manage the new technology and its organizational context has been a recurring theme in organization theory.

Willcocks and Lester (1999) contend that rigorous, or indeed any form of, management evaluation of IS projects is rarely undertaken. Several reasons for the lack of use of methods are cited by literature, including it being too costly and too resource intensive. This research points to a conclusion that evaluation of IS projects, demonstrating the benefits and effect of IS, is rarely achieved.

Said that, the need for measurement nevertheless remains as a fundamental requirement for firms success.

The measurement of business value of IT investments has been the subject of considerable debate within the IS and business management literature (eg, Weill & Olson, 1989; Powell, 1992; Farbey et al, 1993; Willcocks & Lester, 1996; Remenyi et al, 2000; Irani et al, 2001).

The difficulties in measuring benefits and costs are often the cause for uncertainty about the expected impact of IT and thus, are major problems facing decision makers.

As a result, the IT evaluation process is often ignored, or ineffectively or inefficiently carried out (Irani, 2001).

The reason for this is that managers consider it takes too long, costs a significant amount of money with little visible return, and involves too many people with departmental or individual political agendas.

The implementation and maintenance of IT is invariably a costly exercise for organisations, so it is only natural for managers to assume that they should provide their organisation with a degree of economic value.

It is therefore not surprising to see that the IT productivity paradox is receiving increasing attention from researchers and practitioners in the new information-based economy. Considering the growing needs of businesses to gain a competitive advantage in their respective marketplaces, the evaluation of technological innovations (eg, E-Government, Enterprise Application Integration,

E-Commerce, and Customer Relationship Management) will remain a necessity if the benefits of IT are to be fully realised. Despite the importance of IT evaluation for organisations, the concept of evaluation has not been subjected to extensive empirical research.

This point was made by Davenport (1993) who states that most of the research on IS evaluation is highly anecdotal or case-study-based, and the analysis is rarely rigorous with little having changed in recent years.

In a similar vein, Strassman (1990) stated that if one read what experts have been saying about IT investments, they would become severely discouraged.

Needless to say, IT evaluation is important for many reasons, with organisations needing to justify their investments in IT before committing management's time and organisational resources to receive no doubt considerable procedural pain in return. The reason for this is that there are large amounts of organisational funding consumed by IT, clearly suggesting the need to prioritise heterogeneous investment proposals competing for scarce organisational resources.

Furthermore, managers need to have a better understanding of the impact of IT on the organisational infrastructure and performance. Such understanding can help an organisation better utilise resources and improve its position vis-a-vis its competitors. On the other hand, failure of such understanding may have disastrous consequences such as inappropriate resource allocation and result in a competitive disadvantage.

Viewed in systems terms, evaluation provides the basic feedback function to managers as well as forming a fundamental component of the organisational learning process (Smithson & Hirschheim, 1998). Finally, evaluation provides the benchmarks of what is to be achieved by the IT/IS investment. These benchmarks can later be used to provide a measure of the actual implementation success of IT/IS projects. Notwithstanding the above, there is an increasing shift in the view that IT/IS should be seen less as an investment that should be compared with other projects that seek funding but instead, more as a matter of consumption. The view is that IT provides the vital infrastructure that makes an organisation work and is

therefore a matter of necessity, thus questioning the need to compare with others seeking funding.

Finally, when firms make IT investments, the investments result in some direct benefits that contribute to future cash flows. In addition, the investments may also have indirect benefits in the form of new investment opportunities for the firms. In this sense, the theory of real options perfectly fits to IT decisions. For example, investment in a new technology project may improve a firm's ability to use this new technology in future projects, thus affecting the firm's future investment opportunities (Dos Santos, 1991). Financial theorists predict that managers make decisions that maximize the market value of the firm, where value is determined by the discounted value of future cash flows expected to be generated by assets already in place, plus the discounted value of investment opportunities that are expected to be available to the firm in the future. However, the value of potential future investments has been ignored, in practice and in research, because it is difficult to determine, both theoretically and practically (Mason and Merton, 1985; Myers, 1984). Hence, even if problems in measuring the direct benefits of IT investments are overcome, ex post determination of the effects of IT investments on firm performance tend to undervalue these investments. Adding to the problem, many direct benefits of IT investments are difficult to quantify and, therefore, are ignored (Strassman, 1988). One way that this undervaluation of IT investments can be overcome is by determining how IT investments affect the value of the firm. If the net discounted cash flows that will result from an investment, the net present value (NPV), are positive, because the resulting direct and indirect benefits are expected to generate a return which is greater than the required rate of return, then the value of the firm should rise. This change in value will then be reflected in the market prices of the firm's securities (Dos Santos et al,1993).

Moreover, Jones and Hughes (2001), in their work about IS evaluation processes in UK local authority, refer that IS managers face a lot of problems, corresponding to different interests forces and responsibility patterns, that can compromise the IS success.

Firstly, many organisations, they report, invest in IS without value and benefit appraisal being undertaken prior to implementation, and that no evaluation occurs after its introduction. Secondly, IS managers are concerned that their professional domain is often unfavourably perceived by senior management and IS stakeholders due to IS not achieving expectations. Thirdly, IS managers are aware that there is an increasing focus on the difficulty in demonstrating the value of IS to an organisation, via current evaluation practice. Fourthly, IS managers are disappointed that poor IS implementations are often cited as the reasons why organisations fail to reach their objectives. Finally, IS managers are frustrated that they have difficulty persuading IS stakeholders that IS evaluation is an important aspect which must not be ignored. However, against this background they are, paradoxically, under constant pressure to implement IS solutions to organisational and business problems and to be seen as champions of the information society age by promoting IS capability and potential within organisations.

The next paragraphs, will extend the approaches discussed above, introducing, also in their structure, the major ideas of our conceptual model.

Starting from the different literature thesis just discussed, we will try to understand which kind of relationship exists between IT investments and financial performance.

Firstly it's fundamental to understand if this relationship is direct (par. 3.4.) or mediated by different processes (par. 3.5), and, then, if these processes can be identified in an explicit way and adequately framed (par. 3.6).

### ***3.4. IT & Value. A Process Oriented Model***

#### **3.4.1. Creating value**

According to Heraclitus, in nature “nothing is created or destroyed but all it is transformed”.

Not so for value.



For itself nature, in fact, value can be generated, created, sustained or, unfortunately, destroyed<sup>3</sup>.

For many organizations, continuity of business operations is dependent on efficient and reliable IS operations. With the increased penetration of IT into business operations, system failures can lead to significant business disruptions and losses. For example, citing Radding (1999), losses to the tune of \$6.5 million per hour in the case of a brokerage operation, \$2.6 million per hour for a credit card sales authorization system, and \$14,000 per hour in automated teller machine (ATM) fees are expected if respective systems are shut down.

Moreover, ineffective IS operations have the potential to damage carefully built reputations for quality and reliability in product and service offerings.

According to Hitt (1996) there are only two ways to obtain value: generate it or redistribute it (i.e. from customers or suppliers). The first way has to do with productivity, the second one has to do (more) with profitability.

### **3.4.2. The conversion effectiveness**

The link existing between IT investments and value is the object we want to analyze.

In an ex ante analysis of the different scenarios, a rational investor has to consider the spectrum of things that are likely to influence the value of his investment once it is undertaken.

That issue is common to any investment decision, but in the prior research about IT investment, has been referred to it as conversion effectiveness problems within the firm (Weill, 1990). The primary emphasis was to understand those factors that are internal to the organization, especially the extent to which management is able to promote the effective implementation and utilization of the resulting systems, that act as contingencies for the appropriation of IT value. The

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<sup>3</sup> On the point, Powell and Dent-Micallef (1997), underline that IT investments carry enormous productivity power but, like other powerful weapons, misfire in the wrong hands

external influences, instead, include, for example, the actions of competitors, changes in technology in the marketplace, and the actions of government regulators.

Weill (1992) defines conversion effectiveness as the ability of firms to convert IT investments into productive outputs and suggests that it is influenced by different factors as:

- (a) top management commitment to IT;
- (b) previous experience with IT;
- (c) user satisfaction with systems and
- (d) the turbulence of the political environment within the firm.

As Weill showed, so, the results of an IT investment could be affected by internal and external elements and factors that can or cannot be controlled by managers.

This lack of control can depend on two order of cause:

- (a) objective lack of power, for what concern all the situation that a IT responsible cannot manage because it's out of his power and
- (b) subjective lack of perception or undervaluation of the external or internal circumstances.

The latter occurs when, i.e., an effective control system doesn't exist within the firms or the managers have not an effective overview or consciousness of firm activities, needs or mistakes.

The value enabler can be different.

According to Day (1994) and Slater and Narver (1995), i.e., financial performance is enhanced by the ability of an organization to learn.

### **3.4.3. The value creation path**

Different processes, at different levels of the firm, learning paths, changes in capabilities and, moreover, the context of the firm recovers a first and fundamental role in converting IT investments into productive output or, at the same time, can represents an obstacle in doing that.

Barua et al. (1995) argue that the association between IT investment and performance attenuates as the distance between cause and effect widens. The authors develop a model of IT business value in which the impact of IT on firm performance is mediated by intermediate processes.

His work suggests a perspective switch, from the black box approaches to the process oriented model approaches. The only way to measure the IT impact on performance (if it finally exists) is to study all the prior value passages occurred at lower operational level in a firm, where, really, the technology is implemented.

Adopting a process view, Soh and Markus (1995) proposed that IT investments should be converted into IT assets such as IT infrastructure and applications. Furthermore, the IT assets would have to be put to appropriate use for them to be of value to the firm. Appropriate use is expected to create intermediary effects, such as IT being embedded in products and services, streamlined business processes, improved decisions, and dynamic organizational structures, which in turn can be expected to affect firm performance.

A similar perspective is adopted by Weill (1992), who focuses on the firms ability to convert IT assets into organizational performance, identifying several conversion effectiveness factors that mediate the IT-performance relationship.

Francalanci and Galal (1998) propose that managerial choices regarding the mix of clerical, managerial, and professional employees mediate the relationship between IT and firm performance. In a synthesis of process models, Soh and Markus (1995) develop a conceptual framework which posits that IT investment leads to IT assets (IT conversion process), IT assets to IT impacts (IT use process), and IT impacts to organizational performance (competitive process).

In exploring the relationship between IT and net profit, Shin (2001), using an econometric model that examined the alignment of IT with vertical disintegration and product diversification, reveals that IT does not directly improve organisational performance but, when a firm introduces changes in structure and strategy through vertical disintegration and product diversification, then performance improvements can be achieved.

### 3.5. *IT & Value. Compete with the right capabilities*

#### 3.5.1. **IT in the Resource Based View Framework**

Due to the inconclusiveness of the literature efforts in defining the path of the value through IT investments, several studies have stressed the need for better theoretical models that explain the link between IT and value.

One of the most used is, without doubt, the Resource Based View (RBV) approach which links the performance of organizations to resources that are firm-specific, rare and difficult to imitate or substitute (Barney 1986, 1991).

The resource-based view has been used to examine the efficiency and competitive advantage implications of specific firm resources such as entrepreneurship (Rumelt 1987), culture (Barney 1986a), and organizational routines (Nelson and Winter 1982). It is also useful in the IT context, providing a robust framework for analyzing whether and how IT may be associated with competitive advantage.

In brief, RBV posits that:

- (a) firms possess resources, a subset of which enables achievement of a competitive advantage for a firm;
- (b) a further subset of these resources (leading to competitive advantage) lead to superior long-term performance for the firm;
- (c) resources that are valuable and rare can lead to the creation of competitive advantage and
- (d) such an advantage is sustainable to the extent that the firm is able to protect against resource imitation, substitution, or transfer.

IS researchers have begun to employ the resource perspective to expand and deepen our understanding of IT business value (Bharadwaj 2000; Caldeira and Ward 2003; Clemons 1991; Jarvenpaa and Leidner 1998; Santhanam and Hartono 2003).

Moreover, they also underline the existence of some limitation of this framework and in particular, to Melville et al. (2004) affirm that a limitation of the

conventional resource-based view is that it assumes that resources are always applied in their best uses, saying little about how this is done. In effect, the RBV provides a set of necessary conditions to the attainment of sustainable competitive advantage via a firm resource, but does not specify the underlying mechanisms by which this is accomplished.

### **3.5.2. Resources and Capabilities**

To analyze the potential impact of IT on firm results, and to overcome a lot of “false myths” about this relation, it’s important to distinguish IT resources between IT Assets and IT Capabilities. The first ones are easier to copy and they do not (normally) permit to achieve a competitive advantage position, instead, the second ones, IT capabilities, can (potentially) do that, because if they are embedded in a company, or in its human or intangible capital, they are difficult to trade<sup>4</sup>.

Academics have suggested different definitions of resource, assets and capabilities.

Amit and Schoemaker (1993: 35) define capabilities as the “firm’s capacity to deploy Resources, usually in combination, using organizational processes, to effect a desired end. They are information-based, tangible or intangible processes that are firm-specific and are developed over time through complex interactions among the firm’s Resources. They can abstractly be thought of as ‘intermediate goods’ generated by the firm to provide enhanced productivity of its Resources, as well as strategic flexibility and protection for its final product or service”.

In this definition, underlines Makadok (2001), there are two key features that distinguish a capability from other types of resources.

First, a capability is firm-specific since it is embedded in the organization and its processes, while an ordinary resource is not. Because of this embeddedness, ownership of a capability can not easily be transferred from one organization to another without also transferring ownership of the organization itself, or some reasonably self-contained subunit of the organization.

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As Teece et al. (1997: 518) argue, ‘That which is distinctive cannot be bought and sold short of buying the firm itself, or one or more of its subunits.’ If the organization were completely dissolved, its capabilities would also disappear, but its resources could survive in the hands of a new owner.

The second feature that distinguishes a capability from other resources is that the primary purpose of a capability is to enhance the productivity of the other resources that the firm possesses—as articulated in Amit and Schoemaker’s (1993: 35) ‘intermediate goods’ analogy. This distinction between a resource and a capability is roughly analogous to Miller and Shamsie’s (1996) distinction between ‘systemic’ and ‘discrete’ resources, Brumagin’s (1994) distinction between ‘elementary’ and ‘higher-level’ resources, and Black and Boal’s (1994) distinction between ‘traits’ and ‘configurations.’

So, Makadok (2001) defines a capability as a special type of resource—specifically, an organizationally embedded nontransferable firm-specific resource whose purpose is to improve the productivity of the other resources possessed by the firm.

This appears consistent with the affirmation of Teece et al. (1997) “Capabilities cannot easily be bought; they must be built”.

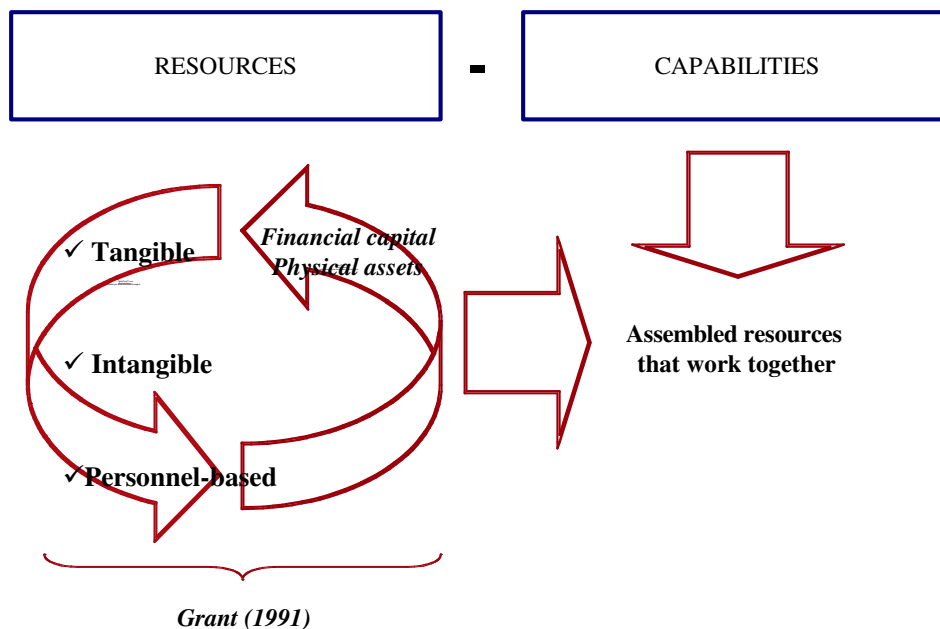
Day (1994) defines assets as the resource endowments the business has accumulated (e.g., investments in the scale, scope, and efficiency of facilities and systems, brand equity, and the consequences of the location of activities for factor costs and government support); and capabilities as the glue that brings these assets together and enables them to be deployed advantageously. Capabilities differ from assets in that they cannot be given a monetary value, as can tangible plant and equipment, and are so deeply embedded in the organizational routines and practices that they cannot be traded or imitated (Dierkx and Cool 1989).

Wade and Hulland (2004) define resources as assets and capabilities that are available and useful in detecting and responding to market opportunities or threats. Together, assets and capabilities define the set of resources available to the firm. Assets are defined as anything tangible or intangible the firm can use in its

processes for creating, producing, and/or offering its products (goods or services) to a market, whereas capabilities are repeatable patterns of actions in the use of assets to create, produce, and/or offer products to a market (Sanchez et al. 1996).

Grant (1991) underlines the difference between resources and capabilities. Moreover, he introduces a classification of resources distinguishing between: intangible, tangible and personnel based resources. While resources can serve as inputs to a process, only through capabilities it is possible to transform inputs into outputs of greater worth and create competitive advantage by assembling resources that work together.

**Table 4: Resources and Capabilities**



The causal relationship between resources and capabilities is formally stated in the dynamic capabilities perspective, where asset positions are posited to affect capability development (Teece, Pisano and Shuen, 1997).

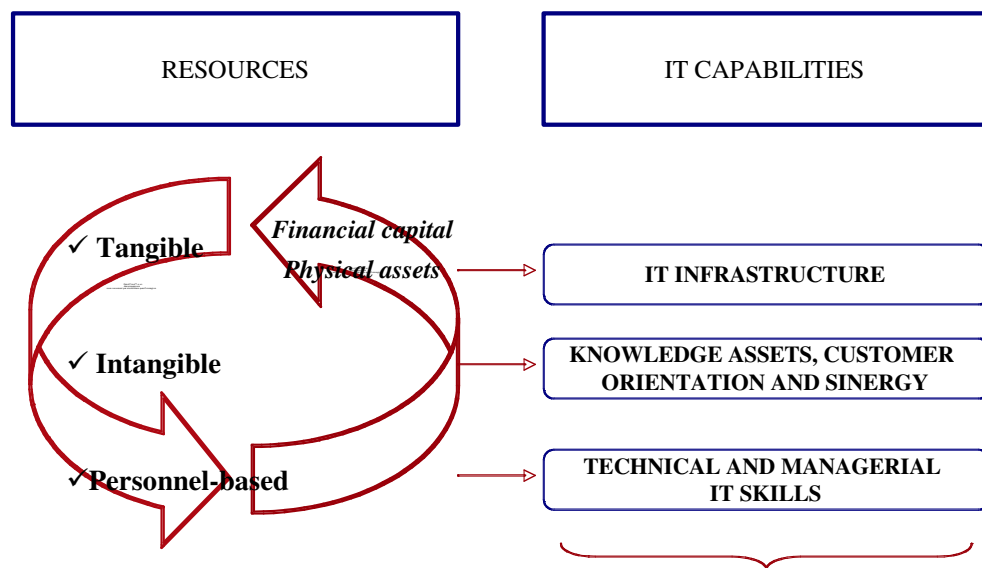
Teece et al., argued that while "the essence of competencies and capabilities are embedded in organizational processes of one kind or another the content of these processes and the opportunities they afford for developing competitive advantage are shaped by the assets the firm possesses and by the evolutionary path

it has adopted. Hence organizational processes are shaped by a firm's asset positions".

Transferring these concepts to the IT field, Bharadwaj (2000) defines IT Capability as the firm ability to mobilize and deploy IT based resources in combination or copresent with other resources and capabilities.

IT resources can be either tangible (e.g., information systems hardware, network infrastructure) or intangible (e.g., software patents, strong vendor relationships) or, finally, human that include skills and technical or managerial ability.

**Table 5: Resources and IT Capabilities**



*Bharadwaj (2000)*

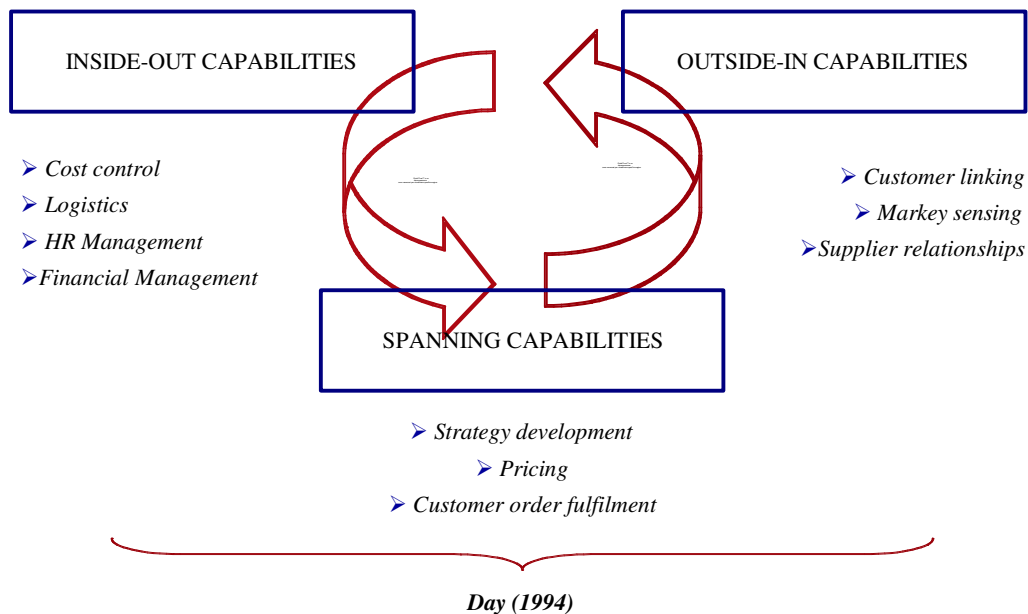
Another useful classification of capabilities, defined as “complex bundles of skills and accumulated knowledge, exercised through organizational processes, that enable firms to coordinate activities and make use of their assets”, is offered by Day (1994) who distinguish between:

- (a) inside-out capabilities;
- (b) outside-in capabilities and
- (c) spanning capabilities.



Inside-out capabilities are deployed from inside the firm in response to market requirements and opportunities, and tend to be internally focused (i.e., technology development, cost control, manufacturing/transformation processes). In contrast, outside-in capabilities are externally oriented, placing an emphasis on anticipating market requirements, creating durable customer relationships, and understanding competitors (i.e., market responsiveness, customer linking, managing external relationships). Finally, spanning capabilities, which involve both internal and external analysis, are needed to integrate the inside-out and outside-in capabilities (i.e., strategy development, managing IS/business partnerships, IS management and planning).

**Table 6: Capabilities**



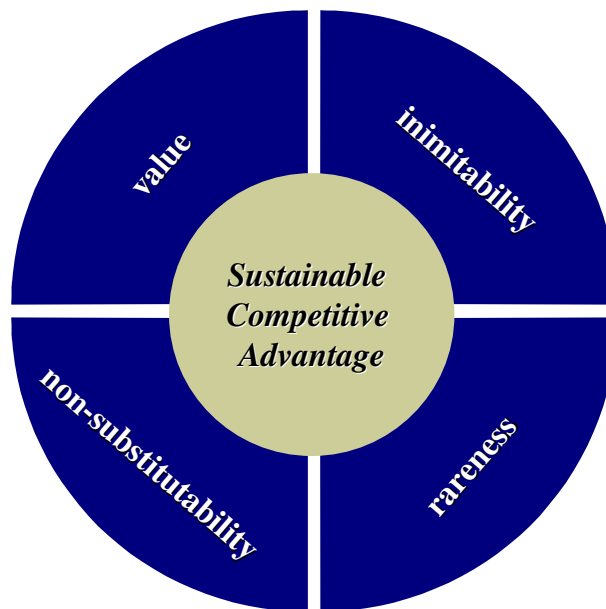
### 3.5.3. Capabilities and competitive advantage

The strategic importance of capabilities lies in their demonstrable contribution to sustainable competitive advantages and superior profitability (Day, 1994).

Barney (1991) specifies the conditions required for a resource to confer a competitive advantage. If the valuable resource is rare (i.e., few firms have access to it), it confers a temporary competitive advantage. If it is also imperfectly imitable for example, competitors don't know what factors lead to success and therefore what to imitate and there are no readily available substitutes, the resource confers a sustained competitive advantage. In this case, the firm is using the resource to implement "a value creating strategy not simultaneously being implemented by any current or potential competitors" and one that its rivals are unable to duplicate (Barney 1991).

In summary, as it showed in the next figure, the four conditions necessary for a resource to confer a sustainable competitive advantage are value, rareness, inimitability, and non-substitutability.

***Table 7: Resources and Competitive Advantage***



A resource has value, in an RBV context, when it enables a firm to implement

strategies that improve efficiency and effectiveness.

Unfortunately, value is not sufficient to achieve a competitive advantage position if the resource is in plentiful supply. Rarity refers to the condition where the resource is not simultaneously available to a large number of competitors. Moreover, even if a resource is valuable and rare, it doesn't mean that it can represent a success key for the firm, due to the fact that the high competition could lead competitors to imitate the resource or acquire a different resource that substitute the first.

The other two characteristics that transform a resource in a competitive resource are: non-imitability and non-substitutability.

According to Barney (1991), there are three factors that can contribute to low imitability: unique firm history, causal ambiguity<sup>5</sup> and social complexity. Instead, non-substitutability exists when in the competitive market there are no (or few) strategically resources that can take the place of the value, rare and non imitable resource.

Starting from this key attributes, it is also possible to distinguish between resources that help firms to attain a competitive advantage and those that help them to sustain that advantage (e.g., Piccoli et al. 2002; Priem and Butler 2001) or, respectively, the ones that represent an ex ante or ex post limit to competition (Peteraf, 1993)<sup>6</sup>. Wade and Hulland (2004) define as attributes of ex ante limits to competition value, rarity and appropriability and underline that imitability, substitutability and mobility can represent the main elements to create ex post limits to competition.

According to Mata et al. (1995) a firm acquires a sustained competitive advantage position when it's implementing a strategy not simultaneously

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<sup>5</sup> Powell et al. (2006, p. 175) define causal ambiguity as the condition under which neither the firm nor its rivals can determine the causes of firm performance. This may arise because a competence is complex, tacit, or firm specific; because the causal path from the competence to performance is impossible to specify; or because a large number of competencies interact in ways that resist precise articulation (King & Zeithaml, 2001; Reed & DeFillippi, 1990). The central causal ambiguity hypothesis is that ambiguity impairs competitive imitation, thus enabling sustainable competitive advantage.

<sup>6</sup> For a complete overview, see Wade and Hulland, 2004

implemented by many competing firms and where competitors face significant disadvantages in acquiring the resource necessary to implement this strategy. If in the market there are not significant disadvantages in acquiring the resources or they are only passing, the firm is said to have a temporary competitive advantage. Yet, if the same strategy (or the same resource) is simultaneously implemented by several competing firms, the firm experiences a competitive parity situation.

Moreover, the acquisition of a competitive advantage rents is connected to the structure and characteristics of the available resources.

The resource based view recognizes two main elements of resources:

- (a) Heterogeneity, that means that the resources and capabilities possessed by competing firms may differ and
- (b) Immobility, that means that these differences may be long lasting.

If a firm controls a resource that is not possessed at the moment by other firms, the first condition (heterogeneity) is met and if well managed, this resource may represent a source of competitive advantage (sustained or temporary). Another way to acquire a sustained competitive advantage position is leverage on resources that are immobile. We define a resource immobile, when a firm that want acquire this resource has to face a cost disadvantage in obtaining, developing or using it, compared to a firm that already possesses that resource.

This disadvantage situation is normally linked (Barney, 1991) to:

- (a) the firm history;
- (b) the causal ambiguity effect and
- (c) the social complexity.

Another approach to RBV and value is represented by the work of Makadok (2001) who define two distinct mechanisms that can create value for the firm:

- (a) resource picking and
- (b) capability building.

The former mechanism asserts that firms create economic rents by being

more effective than their rivals in selecting resources<sup>7</sup>. In contrast, the capability-building mechanism asserts that firms create economic rents by being more effective than their rivals at deploying resources.

An important distinction between the resource picking and capability-building mechanisms has to do with their timing. Under the resource-picking mechanism, economic profit is actually created before the acquisition of a resource. By contrast, the purpose of a capability, by definition, is to enhance the productive value of the other resources that are in the firm's possession. Therefore, by definition, a firm's capabilities can only generate economic profit after these other resources are acquired. By extension, this observation implies that capability building only creates economic profit if a firm is successful at acquiring other resources on which the capability in question can exert its productivity enhancing influence. No matter how great a firm's capabilities might be, they do not generate economic profit if the firm fails to acquire the resources whose productivity would be enhanced by its capabilities.

This conclusion stands in stark contrast with the resource-picking mechanism, which (as mentioned earlier) can affect a firm's economic profit even if no resources are actually acquired (by helping the firm to avoid acquiring bad resources). So, in sum, the two mechanisms differ as follows:

- (a) the resource-picking mechanism affects economic profit before the acquisition of resources and can do so even if such resource acquisitions do not actually take place, instead
- (b) the capability-building mechanism affects economic profit only after the acquisition of resources and can not do so if such resource acquisitions fail to materialize. This is because the resource-picking mechanism has its impact at the decision phase, while the capability-building

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<sup>7</sup> A concrete example that the author introduces to better explain the resource picking mechanism is the one of Microsoft's 1980 purchase of the QDOS operating system (the precursor to MS-DOS) from Seattle Computer Products for only \$50,000. Given Microsoft's private information at the time about IBM's impending demand for a personal computer operating system, Microsoft was able to purchase the QDOS asset for far less than its productive value when used as part of the nascent IBM PC standard. So, over the decades that followed, Microsoft has generated billions of dollars of economic rent from its acquisition of the QDOS resource.

mechanism has its impact at the implementation or deployment phase.

The distinction between the two mechanisms, in the words of Makadok (2001) also has other important theoretical, empirical, and normative implications because it cuts directly to the core of the rent-creation process, and the role of managers in that process. If resource-picking is the primary mechanism for creating rents, then managers make their contribution largely through forming expectations about the value to their company of acquiring particular resources. In that case, strategy research should focus mainly on information and cognition—i.e., the information collected to inform strategy formulation, and the cognitive processes used for filtering that information when choosing which resources to acquire, and when forming expectations about the value of those resources to the firm. It would also follow that research should focus on measuring these expectations, identifying the techniques used to form them, assessing the skill of managers at applying these techniques, and tracing the impact of that skill on subsequent performance. On the other hand, if capability-building is the primary mechanism for creating rents, then managers make their contribution largely through architecting and constructing capabilities internally.

Extending this architectural metaphor, it would follow that the theoretical, empirical, and normative focus should be on structural principles for appropriate design of capabilities, on the ‘raw materials’ from which capabilities are made, and on the ‘construction techniques’ by which they are built. In sum, these two mechanisms have very different implications for how strategy is done and how it should be researched, with the resource-picking mechanism implying greater emphasis on cognitive and informational factors and the capability-building mechanism implying greater emphasis on structural factors.

The importance of this approach is located in the adoption of a new and more completed way to approach the problem: while past IS studies have examined these two mechanisms independently, Makadok (2003) argued that resource picking and resource deployment are not necessarily independent and may complement each other. His results reveal that the two rent-creation mechanisms are

complementary in some circumstances but substitutes in others.

#### **3.5.4. IT and competitive advantage. Fit the pieces together**

Adopting a RBV perspective, so, IT investment cannot be viewed as source of sustained advantage per se, due to the fact that they can be easily duplicated and it is not rare and scarce.

Carr (2003), with a breakthroughs article, IT Doesn't matter, has shifted the consolidate vision of IT and its strategic value. He affirms that IT ubiquity has vanished its potential advantage power, making information and its core functions available and affordable to all. While acknowledging that IT is important, the article states it is a commodity, much like heat and electricity, and that it therefore does not provide competitive strategic differentiation.

These processes lead to the phenomena of IT commoditization that destroys all the IT potentialities, transforming them from strategic resources into commodity factors of production: "commodities can be essential to business without being essential to strategy".

In the Carr's definition (2003, p.44), the IT commoditization represents a transport mechanism that creates more value if shared and used by multiple actors that interact. At the same time this can represent its success key and the first step to its commoditization: standardization of the technology, homogenization of functionality and imitability.

Nowadays, IT is a necessary cost of doing business and, as such, senior mangers should redirect their efforts toward aggressive cost control activities. Looking at how technologies affect competition at the firm level, Carr draws a distinction between proprietary and infrastructure technologies. Proprietary technologies can be owned by a firm and used as the basis of sustained competitive advantage. Infrastructure technologies are available to all and are characterized by standards, increased ompetition and declining prices.

Responding to Carr (2003), Hal Varian agrees that it's not the IT that confers the competitive advantage, but the people who know how to use it effectively.

Before Carr, anyway, the concept of commoditization was already present in the IT research stream.

Clemons and Row advanced a commodity view of IT in 1991, arguing that competitive imitation eventually erodes most IT-based advantages. The authors also argued that, not only are ITs unlikely to differentiate competitive performance, but they may not even improve overall industry returns, since customers and suppliers may coopt any potential efficiency gains for themselves. The authors concluded that “examples of using information technology to achieve sustainable advantage through either barriers to imitation or first mover advantages do exist, but they are far less common than a trusting first scan of the MIS literature would imply” (p. 278).

The notion that IT investment per se do not generate sustainable performance advantages has received increasing support in recent IT research, and has produced a perspective known as the strategic necessity hypothesis, to which most IT researchers now adhere (Clemons, 1988; Floyd and Wooldridge, 1990; Clemons and Row, 1991; Kettinger et al., 1994).

This hypothesis consists of two propositions:

- (a) IT provides value to the firm by increasing internal and external coordinating efficiencies, and firms that do not adopt them will have higher cost structures and therefore competitive disadvantage and
- (b) firms cannot expect ITs to produce sustainable advantages because most ITs are readily available to all firms—competitors, buyers, suppliers, and potential new entrants—in competitive factor markets.

The strategic necessity hypothesis is somewhat bleaker than earlier perspectives in its estimate of the sustainability of IT-derived performance advantages, treating IT decisions more as threats than opportunities, i.e., as investments to avoid competitive decline, but with little likelihood of producing sustainable advantages.

According to this view, firms would appear to have only three feasible paths to IT-based competitive advantage:



- (a) reinvent IT advantages perpetually through continuous, leading-edge IT innovation;
- (b) move first and erect inassailable firstmover advantages;
- (c) embed IT in organizations in such a way as to produce valuable, sustainable resource complementarity.

The first two paths have proven precarious. Perpetual innovation may hypothetically produce advantages, but these advantages vanish if innovation either ceases or stumbles, and are haunted by ever-shortening IT development cycles. Firstmover IT advantages seem more promising, particularly those involving proprietary systems customized to exploit firmspecific strengths or opportunities. However, such systems typically resolve into resource complementarities (i.e., they produce advantage by merging with skills, relationships, or strategic positions), and even then the empirical data (e.g., Kettinger et al., 1994) suggest that such advantages rarely endure. For these reasons, the resource view has focused on resource complementarity as the most feasible path to IT advantage.

Despite its less optimistic view of IT's direct performance impacts, the strategic necessity hypothesis does appear to fit the emerging empirical evidence, and its resource-based origins provide a solid theoretical foundation for investigating the contexts and conditions under which IT may produce competitive advantage. Particularly, it points toward a more balanced perspective, one that acknowledges the commodity view, while allowing the possibility of advantages arising from merging ITs with other resources: if IT per se doesn't not provide distinctive advantages, then firms must use them to leverage or exploit firmspecific, intangible resources such as organizational leadership, culture, and business processes (Clemons and Row, 1991; Henderson and Venkatraman, 1993).

It's how firms leverage their investments to create unique IT resources and skills that determine a firm's overall effectiveness (Clemons,1991; Clemons and Row 1991; Mata et al. 1995).

Investigating the linkages between Information Technology and firm performance, Powell and Dent-Micallef (1996)'s findings show that IT alone have

not produced sustainable performance advantages in the retail industry, but that some firms have gained advantages by using IT to leverage intangible, complementary human and business resources such as flexible culture, strategic planning-IT integration, and supplier relationships<sup>8</sup>.

Mata et al. (1995), i.e., through a literature review of the most important IT attributes that can be considered as sources of sustained competitive advantage, isolate the effects of:

- (a) switching costs;
- (b) access to capital;
- (c) proprietary technology;
- (d) technical IT skills and
- (e) managerial skills, that include management's ability to conceive of, develop, and exploit IT applications to support and enhance other business functions.

Yet, finally they conclude that only IT management skills are likely to be a source of sustained competitive advantage, due to the fact that they are often heterogeneously distributed across firms and reflect the unique histories of individual firms.

According to Keen (1993, p. 17), "the wide difference in competitive and economic benefits that companies gain from information technology rests on a management difference and not a technical difference. Some business leaders are somewhat better able to fit the pieces together than others".

Moreover, Epstein and Reja (2005) affirm that we are witness of a crucial

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<sup>8</sup> Trough their findings, they try to explain why it is possible that IT confers economic value without produce direct competitive advantages for firms. The possible reasons are two:

- (a) the facility to obtain IT resources and
- (b) the absence of awareness, within the firms, about the strategic and competitive importance of Human and Business complementary resources. The Human complementary resources, in and of themselves, explained performance differences in retail, as did, to a far lesser degree, the Business resources. IT did not.

From this they conclude that, although the industry has invested sufficiently in ITs to negate direct IT advantages, some firms gained IT-related advantages by merging IT with complementary resources, particularly Human resources. Among IT-intensive firms, the payoffs to the Human and Business resources were significantly greater than among IT-Lagging firms.

change in the vision of how organizations can use IT, by moving from the era of technology to the technology capabilities era.

This brief literature review represents a confirmation of our general assumption relating to the importance of the link between IT, Process Changes, Process Performance and Financial Performance, that represents the basic idea of our work.

## 4. The research model

### 4.1. *Direct contribution of IT on Financial Performance*

The benefits linked to increasing IT investments are multiple.

In this first step of our work, we assume that a direct relationship between IT and Financial Performance exists.

Basically our thesis is that direct benefits of IT exert a positive impact on Financial Performance, enhancing firm's productivity, reducing costs, increasing customer satisfaction, bringing down inventory levels, enhancing employee satisfaction etc.

Gurbaxani and Whang (1991), incorporating both transaction cost economics and agency theory in their conceptual theory piece, propose that IT can have a direct impact on firms underlying cost model. Firms determine size and the allocation of decision-making by minimizing external coordination costs, internal coordination costs, and operational costs.

They argue that IT can reduce external coordination costs, resulting in a firm's increased use of markets for its value-chains. In addition, IT can reduce internal coordination costs, resulting in a firm's ability to manage a large organization more effectively, ultimately resulting in increased firm size<sup>9</sup>.

Most previous research on the value of IT to firm profitability has focused on the direct relationship between the two. Cron and Sobol (1983) examined the impact of IT investment on financial performance for medical wholesale suppliers. They found that, on average, the impact of IT was not significant, and that there was either very strong or very weak effects on financial performance for firms with large IT investments. Strong financial performance was also found in larger firms. In his study of mutual savings banks, Turner (1985) found little evidence to suggest that there was a strong relationship between organisational performance and IT

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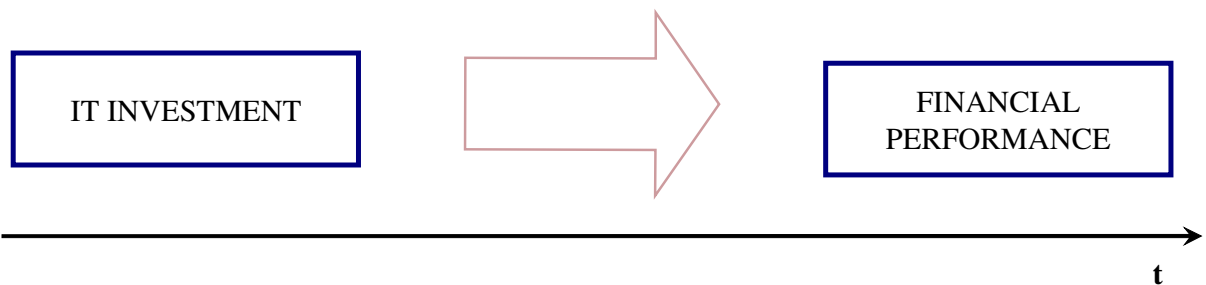
<sup>9</sup> In their article, the authors define vertical size as the range of the value chain that the firm spans using its own hierarchy, with optimal vertical size determined as the minimization point of market transaction costs (comprising both internal coordination costs and operation costs).

expenses or usage. Like Cron and Sobol, Bender (1986) also found a curvilinear relationship between IT investment and firm performance in the insurance industry. Firms with either very low or very high IT expenses performed poorly relative to those with IT expenses in between. They also found that firms with IT expenditures of 15–20% of total expenses were the best performers. Markus and Soh (1993) examined the relationship between firm profitability and a range of IT-related variables—including IT expenditure, extent of computerisation, and proportion of IT services outsourced—while controlling for bank size and diversity of banking activities. They found that the larger banks performed worse in realising returns on their IT spending than the smaller banks did. But when they considered IT spending lagged and accumulated over 4 years, they found that more extensive computerisation was associated with greater firm profitability in the larger firms than in the smaller firms.

In our first hypothesis, these direct benefits leading to increased financial performance:

***Hypothesis 1:** IT investments, reflected by the IT Penetration, leads to enhanced Financial Performance*

**Table 8: Hypothesis 1**



#### 4.2. *The role of Process Performance*

According to Barua et al. (1995), the identification of the economic impact of IT requires a process oriented, industry, or company specific model.

In that sense, the second step of our conceptual model requires the adoption of a process oriented approach, according to which IT investments are not able, alone, to create financial value.

We conjecture that IT is expected to have more significant effects (comparing with the first version of the model) on financial performance if it leverage on changes in the process performance variable (influenced by different elements such as capacity utilization, inventory turnover, change in routines, etc.).

*Hypothesis 2a: IT investments, reflected by the IT Penetration, exert a positive impact on Process Performance*

*Hypothesis 2b: Process Performance exerts a positive impact on Financial Performance*

**Table 9: Hypothesis 2**

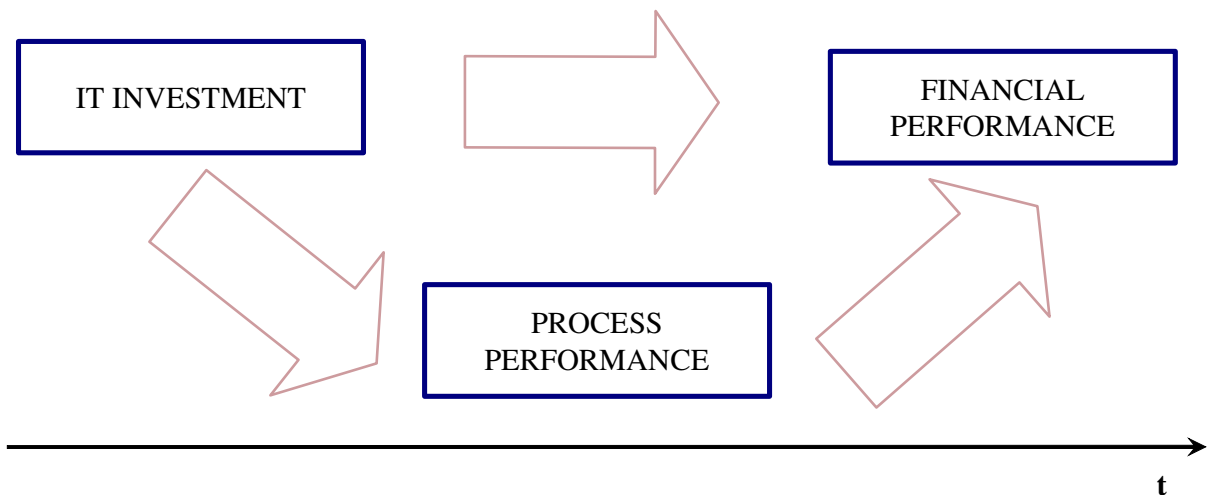


Table 9 shows that IT has a direct on financial performance and an indirect effect through processe performance, which together determine the overall performance of the firm.

An example of a direct effect is improving inventory management, which reduces inventory levels, inventory holding costs, waste, and spoilage.

An example of an indirect effect is improving decision making from having information from a new IS that was unavailable in a previous IS (Dehning and Richardson, 2001).

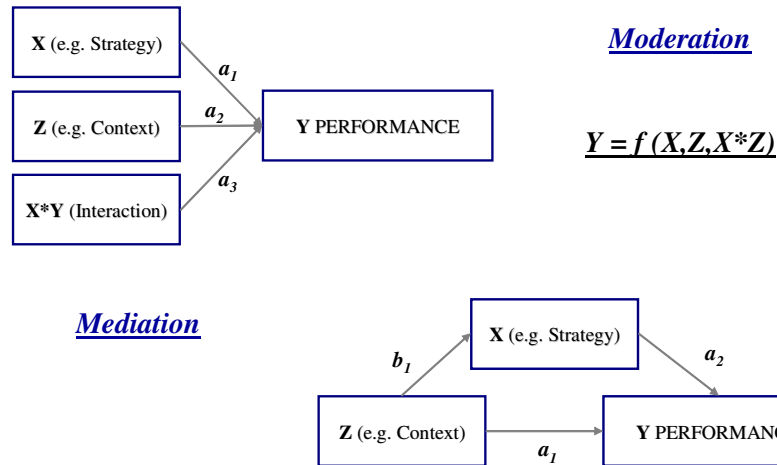
According to this hypothesis, Process Performance plays a moderator role in the relationship between IT and Financial Results.

Hypothesizing the existence of a predictor variable and a criterion variable (the first represents the independent variable whereas the latter are the dependent variable), moderation occurs when a third variable, called moderator, affects the impact that a dependent variable has on a independent one. Therefore impact of the independent variable on the dependent variable is a function of the moderating variable.

Moreover, it's important to distinguish between moderation and mediation.

Mediation whereas occurs a significant intervening mechanism exists between and antecedent, independent, variable and the consequent, dependent, variable. As a result the mediator has an indirect effect between an antecedent variable and its consequents variable and it accounts for a significant proportion the relation between the predictor and the criterion (Venkatrama, 1999).

Trying to better understand the differences between Moderation effect and Mediation effect, in the next figure is presented the graphical explanation of the two effects in the hypothesis of testing the relation between Strategy, Context and Performance (Venkatrama, 1999).

**Table 10: Mediation and Moderation effects**

Source: Venkatrama, N. (1989)

### 4.3. The development of changes

Although the importance of IT has been clearly established, it is less clear what type of paths can lead to better performance, thanks to IT investments and which competences should be generated.

Our hypothesis is that in the path that (hypotetically) lead from IT investments to Financial Performance, the firm faces different choices and decisions that influence in a dramatic way the planned results.

According to that approach the positive impact of IT investments on Process Performance (and through this way on Financial Performance) is mediated by different kinds of changes. A successful application of IT, so, is often accompanied by significant organizational change, including policies and rules, organizational structure, workplace practices, and organizational culture.

We suggest that these changes can be classified, according to Day (1994) into two homogenous groups that have similar effect and range profiles:

- (a) changes in inside-out capabilities and
- (b) changes in outside-in capabilities.



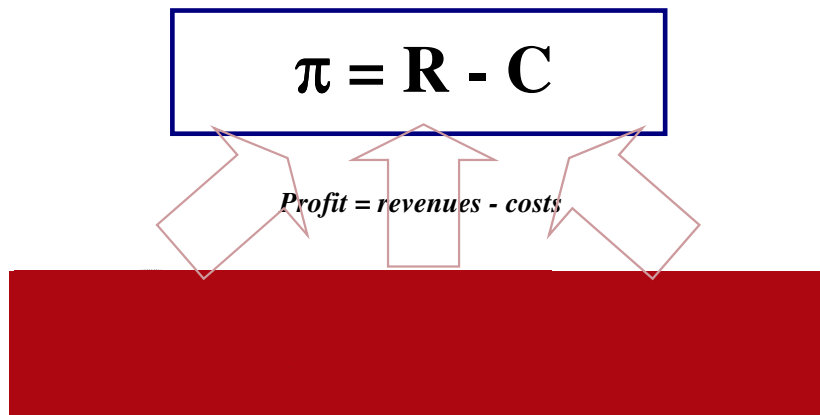
That classification, already introduced in the paragraph 3.4.2, refers to the....

It is expected that changes in these capabilities exert a positive impact on process performance and, through it, on financial performance, indirectly affect profit.

Changes in inside-out capabilities, in fact, improving internal process and achieving more effective routines, tends to reduce cost and resources waste.

Changes in outside-in capabilities, instead, enabling the business to compete by anticipating market requirements, reacting to market changes and tailoring products to customer specific needs, increase revenues.

***Table 11: Profit composition and effects***



This is consistent with the results of Brynjolfsson and Hitt (1996) that indicate that the primary reason for IT investments is customer service (something similar to our definition of changes in outside-in capabilities), followed by cost savings (realizable through changes in inside-out capabilities that lead to a more efficient production function).

Moreover this classification shows similarities to Clemons' one (1986) which distinguishes between:

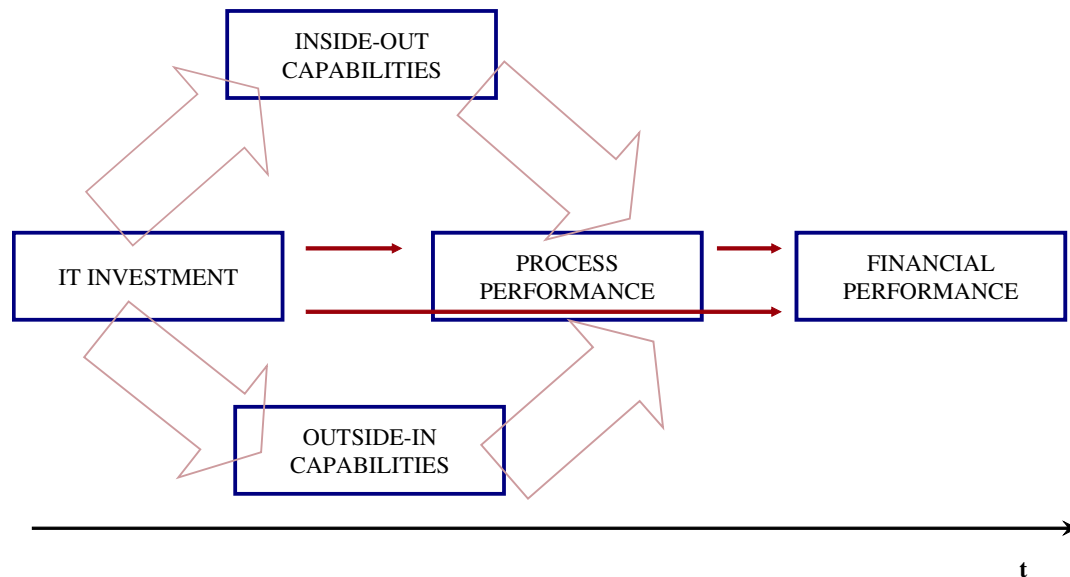
- (a) externally focused applications and

(b) internally focused applications.

The first ones connect the firm with customers or suppliers, and in our case are identified by outside-in capabilities, whereas the latter are those that improve internal efficiencies (such as factory automation systems). In other words, external applications tended to produce advantages based on switching costs, whereas internal applications tended to produce advantages based on scale economies, managerial expertise and efficiencies.

**Hypothesis 3:** *The positive impact of IT Penetration on Process Performance is mediated by changes in Inside-Out and Outside-in capabilities*

**Table 12: Hypothesis 3**



#### **4.4. IT decisions**

Three different types of IT decision are used in this study to enrich the idea of IT investment used in the previous models: IT Penetration, It Centralization and Degree of IT Outsourcing.

These concepts are explained in the next paragraphs.

The categorization of different types of IT investment or decision is fundamental, at this stage of our study, because all IT investment is not alike and different investment can produce different (and sometimes opposite) effects on firm performance.

Weill (1992), i.e., found evidence that a single measure of IT investment is too broad and should be broken down into IT for different management purposes and Dos Santos et. al. (1993) concluded that in order to define the causal relationship between IT investment and firm performance necessary to distinguish between investments (innovative and non innovative) because the market reacts differently.

Aral and Weill (2007) demonstrate that total IT investment is not associated with performance, but investments in specific IT assets explain performance differences along dimensions consistent with their strategic purpose

Using IT decisions to enhance changes (internal and external or, in our hypothesis, in different capabilities) requires that firms make choice about how technology resources are deployed and, taking in account their strategic relevance and the alignment with the corporate strategy, how it can be embedded in organizations.

With this approach, that completes the previous models, we try to overcome two limitations of previous works, individuated by a big part of the literature regarding:

- (a) the approach to IT as a single factor and
- (b) the attempt to relate IT investments directly to output variables.

IT, in fact, is composed by a number of different elements that can impact in a different (and sometimes opposite) way the system. By aggregating all the IT

variables in an unique element, a negative effect can balance (or nullify) a positive one, without a clear understanding of that dynamic on the final result.

Moreover, trying to relate directly IT investments to any kind of final performance, the intermediate processes through which performance is built are ignored. According to Barua et al. (1995), the effects of IT on enterprise level performance can be identified only through a “web of intermediate level contributions”.

This argument is consistent to the “value added analysis” model of Porter (1985) and with the evidence of Weill and Olson (1989), King and Kramer (1989) and Barua et al. (1995) that, in their two stage analysis, found a significant positive impacts of IT on intermediate level of the firm that in the higher one.

In this sense, they indicate “the need for more process oriented models instead of traditional ‘black box’ approaches”.

We conjecture that IT is expected to have a first-order effects on changes in firm’s capabilities and that these changes, improving the process performance (second-order effect), impact and partially explain the variation of the financial performance (third-order effect).

#### **4.4.1. IT Penetration**

IT Penetration represents the level of business processes supported by IT in each organizational function.

Nowadays, Information Technology is embedded in each aspect of firm life and processes, and supports all the organizational processes through which the firms respond to changes in its internal and external environment. This one seems to be the main justification to the latest massive IT investments made from companies of any industry. Despite the fact that the role of IT is quite controversial according to the value it generates, improving IT infrastructure is certainly one of the top priorities in the firms of all industries.

The amount of IT investments and the quantity of physical IT assets a firm has, are definitely elements of IT Penetration, but in a huge sense, also the

commitment to IT and the satisfaction with the system can enter in this concept. All of these aspects, in fact, have a role in adopting and put the system at work.

We defines IT Penetration in terms of six dimensions:

- (a) support offered in Sales&Marketing activities;
- (b) support offered in Accounting&Finance activities;
- (c) support offered in HR activities;
- (d) support offered in Production activities;
- (e) support offered in R&D activities;
- (f) support offered in Purchasing activities.

It is expected that this type of IT Decision will be associated with improved process performance also through changes in inside-out and outside-in capabilities. IT Penetration provides managerial and operational tools to manage the firm requirements and facilitate through technology the achievements of the organization goals.

#### **4.4.2. IT Centralization**

The constantly changing markets and the economics trend toward firms that diversify their investment and spread their presence, push ever more firms to invest in information technologies that permit to share information and manage them centrally.

Investments in IT Centralization can lead to integration policies that regard all the aspects of firm life: production, budget and control, order processing, purchasing, supply chain, stock control and so on.

The benefits correlated to centralization of process or applications in general, are linked to the concepts of:

- (a) ease to deployment;
- (b) simpler possibility of upgrades;
- (c) creation of networking;
- (d) reduction of infrastructure and manpower costs.

Arguments for centralization focus on coordination, standardization and consolidation of equipments, processes, technology, customers and vendor management.

Centralization also enables the creation and execution of a shared vision of how IT should support and drive market opportunities and growth. Finally, centralization provides significant economies of scale, reduction of redundancies and improved management efficiencies.

We conceptualized IT Centralization in terms of two dimensions:

- (a) centralization of IT decisions;
- (b) centralization of IT function.

Trying to simplify, the benefits normally linked to centralization have to do with the improvement of efficiency, the reduction of costs (personnel, maintenance, i.e.), the up-to-date and consistent data constantly available to management and to the better alignment with the global strategy of the firm. In our vision, all of these elements are related internal aspects and can be assumed as changes in internal oriented capabilities.

But also, through investments in IT Centralization is possible to increase the products/services quality and the customer service and satisfaction and, in that way, lead to changes in the external oriental capabilities.

Yet, there are also arguments against the centralization trend, centred on the necessity to allow business units to make autonomous decisions about information and customer-related requirements and on the risks connected to the inability of IT to understand and fulfill business information requirements.

#### **4.4.3. Degree of IT Outsourcing**

According to Domberger (1998), IT Outsourcing is the contracting out of IT service provision to one or more external organizations. The client organization enters into contracts with one or more suppliers (sometimes called vendors) of IT services, and managers in those firms become responsible for the management and

provision of physical, software, and/or human resources that provide IT services for the client organization.

In the last decade, IT outsourcing has emerged as an important tool for enabling organizations around the world to gain access to specific IT skills and services, focus on their core competencies, and in some cases, reduce the cost of IT service provision.

Outsourcing involves the handing over of responsibility for service provision to another organization. Inevitably this gives rise to possible conflicts of interest between the two organizations. According to Domberger (1998), outsourcing is a sound decision if the net cost to the client organization drops as a result of outsourcing, provided there is no drop in service quality.

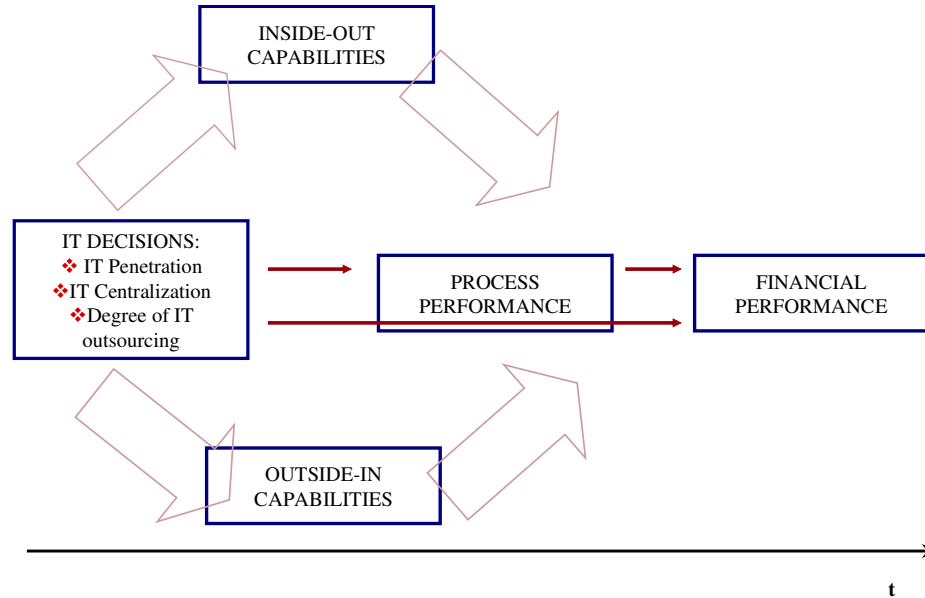
This type of decision is usually justified on an efficiency or cost displacement basis or when within the organization there are not specific and dedicate resources to develop, maintain or manage the IT infrastructure.

We conceptualized Degree of IT Outsourcing in terms of two dimensions:

- (c) use of external consultants for technical support;
- (d) use for external consultants for reengineering activities.

The debate about IT outsourcing decisions is open between authors due to the fact that some suggest that IT and its development should be considered as a strategic resource and therefore managed in-house, with the consequent development of critical core competences. Other stress that these benefits are minimal and in order to reduce cost, it's more useful to outsource these activities (Ettlie et al, 2005).

Our hypothesis is that the Degree of IT Outsourcing exerts changes in both Inside-out capabilities, modifying the functionalities of internal processes, like cost control, logistics and manufacturing processes and outside-in capabilities that refers also to the relationships with customers and suppliers. Furthermore, it is expected that this type of decision will be associated with a direct impact on process performance.

**Table 13: Hypothesis 4**

**Hypothesis 4a:** IT decisions exert a positive impact on Process Performance

**Hypothesis 4b:** The positive impact of IT Decisions on Process Performance is mediated by changes in Inside-out and Outside-in capabilities

Summarizing the hypothesis to test:

**Table 14: Hypothesis**

HYPOTHESIS	
1	IT investments, reflected by the IT Penetration, leads to enhanced Financial Performance
2a	IT investments, reflected by the IT Penetration, exert a positive impact on Process Performance
2b	Process Performance exerts a positive impact on Financial Performance
3	The positive impact of IT Penetration on Process Performance is mediated by changes in Inside-Out and Outside-in Capabilities
4a	IT decisions exert a positive impact on Process Performance
4b	The positive impact of IT Decisions on Process Performance is mediated by changes in Inside-out and Outside-in capabilities



#### 4.5. *Financial Performance*

Once we have defined our hypothesis, which suppose the existence of a relation between IT investments and performance exists, the next step is to determine that impact.

Specifically, do any of the traditional (or non-traditional) financial measurements can be useful for our purpose? In an attempt to answer this question, different financial measurements were studied for their relation to IT.

These measurements included: return on investment (ROI); return on sales (ROS); return on asset (ROA); gross profit; net sales; sales growth, etc.

Finally, we chose ROA, also supported by the literature (Rai et al., 1997; Tam. 199) that normally uses this financial ratio as indicator of firms' performance. Moreover, a critical aspect in defying this measurement tool was linked to the reference year we have chosen before.

The complete analysis of the kind of available results, the structure and nature of IT investments and results lead us to choose the 2005 as the year of our financial measure.

This decision appears coherent with some subjective elements of our work and some objective requirement of the model (suggested by the literature and already discussed). In particular, we faced three orders of problems:

- (a) the availability of financial results;
- (b) the time lag effect between IT investments and effective results;
- (c) the characteristics of the questions and the questionnaire structure.

Given our decision it could be useful, anyway, to present a brief overview on the main problems and literature positions about financial and non financial measure of firm (and IT) performance.

A fundamental issue in the debate surrounding methodological factors relates to the appropriate measures of firm profitability.

Bharadway et al. (1999) distinguish between:

- (a) accounting measures and
- (b) financial market-based measures.

The first ones, largely used in the IT-business value studies, present, according to the authors, a very important limit, adopting only an historical approach to firm events and results; instead, the last ones consider the future performance of firms, presenting, so, a better and more comprehensive judgement of firms results.

Also Dos Santos et al. (1993) criticize the use of accounting measures in analyzing the effects of IT expenditures on performance, because they don't capture the risk consequences of such investments. According to the categorization of Bharadway et al. (1999), the significant problems associated to accounting rates of return are related to the followers facts:

- (a) they typically only reflect past information and are not forward looking;
- (b) they are not adjusted for risk, and
- (c) they are distorted by temporary disequilibrium effects, tax law and accounting conventions.

#### **4.6. Control Variable**

The link between IT and performance (if exists) depends on different factors, also contextual ones. Examples of contextual factors include firm size, financial health, growth options, IT intensity.

For our purpose, to take in account these elements, we include in our model Firm size as control variable.

Control variables are used to account for factors other than the theoretical constructs of interest, which could explain variance in the dependent variable.

To reduce the effect of firm size differences in our analysis, in each model, a control variable, called "firm size" was introduced in the research model.

Firm size is perceived as an indication of past investment, history and choices of the organization and its maturity and may influence current performance.

The control variable was measured using the value of Operational Revenue, or turnover, for the year 2005, coherently with the use of the ROA of the same year as indicator of financial performance.

Regarding to size, it is expected that the more is the firm size, the more are the investments in IT, and, consequently, the more the financial return, also according to the concept of scale advantage.

IT scale advantage is present where the superiority in size and investment of a firm makes it prohibitively expensive for competitors to imitate the strategic IT user (Clemons and Row, 1991). Because the development of strategic information systems tends to involve large fixed costs and low variable costs, there exists the possibility of significant scale economies as well as significant penalty for failure (Kettinger et al., 1994).

Moreover, access to resources, economies of scale and value chain alliances commonly associated with larger firms may prohibit smaller players from directly competing with larger-scale IT innovators.

Against out idea, Im et al. (2001) present evidence that company size influences returns to IT investments: expanding the Dos Santos et al. (1993) data set, they find positive returns for announcements of IT investments for small but not large firms.

Their results indicate that smaller firms' IT investments increased the market value of the firms. The authors give two order of explanation for these results:

- (a) a dilution effect caused by more predisclosure information in larger firm;
- (b) an intrinsic elements of smaller firms that provide better incentives for exploiting IT than larger firms.

## 5. Methods

### 5.1. Introduction

Once we have defined, in the previous paragraphs, the conceptual model, it is necessary to convert it into a structural model, to test the specific hypothesis associated.

The following section explains in details the characteristics of the adopted method.

The first step regards the data collection.

Due to the structure of our work we can isolate two different types of information required and, associated with them, two kind of data, each linked to one specific object of our study:

**Table 15: Study objectives**

OBJECTIVE	DATA	SOURCE
Analysis of organizational impact	organizational information, environmental setting, IT Governance and Initiatives, changes in organizational capabilities	Questionnaire
Analysis of performance	financial performance	Osiris/Amadeus data bases

The questionnaire design, the selection of a sample of companies and the identification of the target respondents represent one of the core activities realized at this level of analysis.

The second step concerns the data collection and then (third step) the data analysis, which includes a test of the measurement model. Finally, the fourth step permits us to verify our hypothesis and draw some managerial conclusion about the relationship between IT and financial performance.

## 5.2. *Research Design: Confirmatory Survey Research*

With our research, we want to understand not only if IT investments create value, but also in which way and through which mechanisms this relationship (if it exists) works.

To do that, we have chosen a flexible instrument capable to collect information from a large number of respondents: confirmatory survey research.

Survey research is a flexible in the sense that a large amount of information can be collected and, at the same time, it permits the collection of both measurable and non-measurable variables, such as attitudes and behaviours about knowledge diffusion and capabilities creation, which would be very difficult to obtain through different methods.

Usually there are two types of survey designs:

- (a) cross-sectional and
- (b) longitudinal.

The first one is focused on the causal/effect relationship between two or more variables to a particular point in time, while longitudinal one is more appropriate when the time dimension is the essence.

Cross-sectional surveys are more appropriate when the researcher's aim is to describe a population and test differences in subset of the population at one point in time. In the case of this research it maximizes the effectiveness of the study, because the researcher uses clearly defined independent and dependent variables and a specific model of the expected relationships, which are tested against observations of the phenomenon. The classic cross-sectional design collects data at one point in time from a sample selected to represent the population of interest at that time. One can generalize safely the findings from the sample to the population at the point in time the survey was conducted<sup>10</sup>.

This is exactly the case for the model in this study, as it aims to understand how and through which mechanisms IT generates value.

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<sup>10</sup> For a complete overview, see Pinsonneault and Kraemer, 1993.

As we have already exposed, the aim of this research is to understand the causative factors at one point in time, so the research design consisted in a cross-sectional study of a large sample of companies from different industries<sup>11</sup>.

In order to make sure the data collected is free from errors, for most of the questions, Likert scales, a well accepted non-metric measurement system, was used.

### **5.3. *Questionnaire Design and Sample Selection***

Primary objective of the work, in order to give a hard quantitative background to our hypotheses, was to obtain factual data from an authentic source.

The questionnaire<sup>12</sup> was addressed either to an IT manager with good knowledge of business processes (e.g. CIO) or to a business manager who has been involved in a major IT project implementation.

Due to the self-reported nature of the data collected particular attention was given to offer to respondents incentives to provide accurate answers. This objective was achieved by distributing to each respondents a personalized feedback document where each company's individual project was benchmarked against the overall sample and by guaranteeing the confidentiality of answers.

The total length of the questionnaire had to be kept under 5 pages and its duration was kept about 15 minutes.

Shifting attention to sampling procedures, the most critical element of this part of the study is the choice of the sample frame that constitutes a representative subset of the population from which the sample is drawn.

The sample frame must adequately represent the unit of analysis (Pinsonneault and Kraemer, 1993), but it is also necessary to select the sampling frame so as to maximize the percentage of responses to the survey.

The selection of the final sample of potential respondents included European firms from different industries.

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<sup>11</sup> According to Pinsonneault and Kraemer (1993), survey research is the most appropriate when the central questions of interest about the phenomena are "what is happening?" and "how and why is it happening?"

<sup>12</sup> The Questionnaire is presented in Appendix "A"

The reason of this decision was simply the ease of reaching those firms thanks to London Business School contacts.

The selected industries vary from Manufacturing to IT services, from IT consulting to Electronics and finally from Communication to Pharmaceutical/Biotechnology. The entire sample, with the indication of the SIC code (two digit) and the relative weight of each firm, are reported in Appendix B.

This method was chosen in order to elicit a wide representation by industry sector and size of firms.

According to the previous guidelines a detailed questionnaire was developed.

Survey questions used numeric values for metric variables and a 7–point Likert–type scale anchored at strongly disagree (1) and strongly agree (7) for non–metric variables.

Given the hypotheses that were to be tested, the survey questionnaire was designed to seek factual data on the following aspects:

***Table 16: Questionnaire and questions***

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**Questionnaire structure**

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- I** Respondent's details
  - II** General organizational information and environmental setting
  - III** IT Governance
  - IV** IT Projects and Investments
  - V** Changes in organizational capabilities
  - VI** Project evaluation
- 
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**Respondent's details.**

The general purpose of this section is simply to understand the role of the respondent as well as the segment of the organization that was being represented.

**General organizational information and environmental setting.**

This section was designed to get the organizational characteristics like its size, industry, the competitive environment, brief details on its product/service characteristics and revenue (better analyzed, after, through specialized financial data bases).

Thanks to the multiple choice questions and 7-point Likert scales, we modelled the questions to understand organization's service delivery capability, characteristics of the customers' needs, demand pattern, agility requirement as well the capability etc.

As regards environmental setting, we also decided to put into the questionnaire questions about dynamism (stability/instability) and the complexity (homogeneity/heterogeneity) of the environment in which the organization operated in and environmental support for the organization's sustained growth.

The other objectives were to understand the environmental culture, the overall IT literacy level and the structural differences in applying IT for enhancing organizational performance.

According to Dess and Beard (1984), environment could be described by three dimensions: munificence (capacity), dynamism and complexity.

This section of the questionnaire was aimed at measuring those dimensions.

The first dimension is defined as the extent to which the environment could support sustained growth. Therefore is not included in the questionnaire because unrelated to the research objectives of this study.

The research in fact is more interested in the measure of the following dimensions: dynamism and complexity.

On one hand, dynamism is defined as stability–instability of the market whereas complexity is described as homogeneity–heterogeneity of the market.



On the other hand, complexity is directly linked to uncertainty perception because firm's managers working in complex environment would require to process a greater amount of information than those ones facing simple environments (Dess and Beard, 1984).

### **IT Governance.**

IT Governance is a subset discipline of Corporate Governance focused on information technology (IT) systems and their performance and risk management. The rising interest in IT governance is partly due to compliance initiatives (e.g. Sarbanes-Oxley (USA) and Basel II (Europe)), as well as the acknowledgment that IT projects can easily get out of control and profoundly affect the performance of an organization.

A characteristic theme of IT governance discussions is that the IT capability can no longer be a black box. The traditional handling of IT management by board-level executives is that due to limited technical experience and IT complexity, key decisions are deferred to IT professionals.

It implies a system in which all stakeholders, including the board, internal customers and related areas such as finance, have the necessary inputs into the decision making process.

The present section was made following semi structured interviews made in previous research papers, concerning ERP implementation projects (Masini, 2006), in order to analyze the degree of centralization, integration and conscious managing of the firm's IT systems and potentially using this aspect as a control variable in the very final validation of the model.

At this step of the research, we wanted to test the organization's consciousness regarding the role of IT, its alignment with the implemented business strategy and the decision centralization degree.

Moreover, IT Governance section was designed to capture aspects like how IT function is structured, what its decision making process is, how its role is perceived, what the level of its IT in-house capabilities is, how knowledge is managed etc.

### **IT Projects and Investments**

As discussed in the previous sections, our goal is to understand if the IT investments generate value. Here, we want to analyze the amount of IT spending by our panel's organizations.

All the questions of this section are referred to the main IT project developed by the organization in the last six years, and focus on: cost, investment duration, interested employees, impact of the project in terms of function affected by it and changes caused by this project.

According to an established view of the firm, we indicated six different functions: Purchasing, Research & Development, Production or Service Delivery, Sales and Marketing, Accounting and Finance and Human Resources and Administration.

Some questions of this section are tailored to deeply investigate if some elements of competitive advantage sources (as the literature, defines them<sup>13</sup>) exists, like the process adaptability to the standard application, the degree of software customization, the ability for the competitor to emulate the software implementation, the Knowledge Management capabilities (questions about tacit organization learning, knowledge articulation processes and knowledge codification processes etc.).

Aim here was to understand to what extent firm's knowledge is embedded in its software, to what extent it is codified in the form of manuals and training aids and the rapidity & effectiveness of transferring the knowledge to the new employees.

In particular, the objective of this section was to understand which of the firm's organizational functions is more affected by the IT project developed<sup>14</sup>.

#### **Changes in organizational capabilities**

This section was designed with the underlying objective of understanding the changes brought about in the organization's externally-oriented, dynamic and

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<sup>13</sup> See paragraph 3.4 for a general overview of the topic.

<sup>14</sup> In the next paragraph, we will refer to this concept as "IT Penetration".

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complementary capabilities by a particular IT initiative. More specifically, the questions were about:

- a. visibility of the business processes;
- b. ability to identify the source of a business process problem;
- c. clear definition of tasks and responsibilities;
- d. changes in relationship with customers, partners and suppliers and
- e. development of IT agility<sup>15</sup> (Weill et al., 2002; Sambamurthy et al, 2003).

### **Project Evaluation**

For what concerning project's performance manager's had the possibility to evaluate the main IT project in terms of:

- (a) objectives;
- (b) costs;
- (c) target deadline meeting;
- (d) errors;
- (e) spread of information and
- (f) accessibility to data.

In addition a specific item referred to the performance's improving in any single organizational function was added.

Here managers could evaluate the level of improved operation performance in every single organization function listed before due to the implementation of IT system. This item would be used as performance evaluator, in the model testing stage, in case monetary data of performance would not be available.

Summarizing, this section summarize the aim of our work, trying to obtain information about:

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<sup>15</sup> Sengupta and Masini (2006) conceptualize that IT agility is of two types: range and time. "Range-agility reflects an organization's ability to expand or shrink its capabilities in response to changes in the environment", instead, "time-agility is a reflection of the speed of response". They also link these types of IT agility to business value creation process, positing that the impacts of range-agility and time-agility on corporate performance are moderated by two factors. One moderator – internal to the organization - is the ease in attaining agility. The other moderator – external to the organization - is the dynamism of the organization's environment.

- (a) the degree of achievement of the goals linked to the IT implementation process;
- (b) the match between ex ante evaluation and results;
- (c) the perceived link between IT investments and changes in Key Performance Indicators.

#### **5.4. Data collection**

The choice of data collection method (mail questionnaire, telephone interview, or face-to-face interview) is a key methodological aspect of all research, because this element can affect the quality, the significance and the cost of the data collected.

Sampling is concerned with drawing individuals or entities from a population in such a way as to permit generalization about the phenomena of interest from the sample to the population. The most critical element of the sampling procedure is the choice of the sample frame that constitutes a representative subset of the population from which the sample is drawn. The sample frame must adequately represent the unit of analysis (Pinsonneault and Kraemer, 1993).

Mail questionnaires results to be very good for gathering factual data, but they are less effective when sensitive or complex data are needed. In general, quality and cost are highest with telephone interviews whereas quality and cost are lower with mail questionnaires. Mail questionnaires have in addition a very useful feature that is allowing managers to take their time to complete it in the most convenient time of the day.

Phone calls don't do the same and, in a way, force the manager to answer properly heretofore there is an additionally guarantee of data validity. The face to face interviews are surely more direct and completed, but very difficult to appoint and time consuming.

The choice about data collection was the mail questionnaire, due to the limits of available time and the nature of data required.

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After a screening of interesting industries, the respondents' database was created using two main sources:

- (a) London Business School ex alumni portal and
- (b) INSEAD Alumni Directory of 2004-2005.

To increase the potential response rate e-mail were personalized for every contact address in order to give the proper importance to the potential respondents. In order to enhance the response rate a reminder was sent to every manager's address and the deadline was postponed for another ten days.

The overall database size was about 3200 contacts.

The questionnaire completed, collected and considered for the analysis was about 2,5%.

Given the short duration of the data collected phase, the response rate was found to be adequate.

### **5.5. Measurement Model**

Due to the number of questions (one hundred and twelve) and the large amount of variables for each macro-section of the questionnaire, our necessity was twofold:

- (a) condense the available information and
- (b) avoid any loss of information.

The factor analysis was the statistical method used to achieve these goals.

Reliability and validity of the constructs were checked using PLS-graph software.

The final test of the relationship between these variables was performed through the PLS-graph software as well.




These procedures are described in details in the next paragraphs<sup>16</sup>.

In the meantime, the next figure can be useful to summarize the main step of this process:

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<sup>16</sup> For all this part of our work, we refer to Hair et al.,1998

**Table 17: Steps of Analysis**

Typology of analysis	objective		testing	other steps
FACTOR ANALYSIS	analysis of the structure of interrelationships		<b>RELIABILITY</b>	to verify hypotheses through PLS
PARTIAL LEAST SQUARE	theory confirmation		<b>CONVERGENT VALIDITY</b>	to test the relationship existence
PARTIAL LEAST SQUARE	theory confirmation		<b>DISCRIMINANT VALIDITY</b>	to test the relationship existence

### 5.6. Factor Analysis

Factor Analysis is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimension (factors).

The objective is to best represent all the variables in a small number of factors.

In the specific, in fact, with Factor Analysis, we want to find a way to summarize the information contained in a number of original variables into a small set of variables with a minimum loss of information and a great explication capability.

In fact, exploratory factor analysis is a statistical approach used to examine the internal reliability of a measure and to define the underlying structure in a data matrix.

Using this method firstly we extract the combination of variables explaining the greatest amount of variance and then proceed to combinations that accounts for smaller and smaller amount of variance.

Thanks to it is possible to first identify the separate factors, or dimensions, of the structure and then determine the extent to which each variable is explained by each factor (Hair et al., 1998).

### **5.6.1. Processing Factor Analysis using SAS**

Firstly, a grouping of all the variables according to the concept they refer to was made. The items were generally grouped per questions inside the same macroarea or section.

Nine groups of questions were created (i.e. environmental complexity and dynamism; IT governance; IT centralization; knowledge investments, etc.).

The software used to perform the factor analysis was SAS version 9.1.

Nine factor analysis were performed and the data checked, in order to choose items that could be expressed by one and only one factor.

The very first cut-off in the number of factor to extract per each variable, is that their eigenvalue should exceed one.

This cut-off procedure is automatically executed by the SAS software.

The above criterion is called Eigenvalue criterion and the rationale for it is that any individual factor should account for the variance of at least a single variable if it is to be retained for interpretation. Each variable contribute a value of one to the total eigenvalue. Thus, only factors having eigenvalues greater than one are considered significant. Furthermore, the most common approach to deciding the number of factors to extract is to generate a scree plot.

The scree plot is a two dimensional graph with factors on the x-axis and eigenvalues on the y-axis. Eigenvalues are produced by a process called principal components analysis (PCA) and represent the variance accounted for by each underlying factor.

From the scree plot it is easy to understand which are the factors that account for most of the variance. Therefore after having examined this plot for each set of variables the Cattell criterion was used and hence only the factor whose eigenvalue has an important gap with the other were selected.

Once the number of factors are decided another factor analysis was run in order to get the loadings for each of the factors.

For what concerning the results only the varimax rotation method was considered.

In fact unrotated factor solutions extracts factors in the order of their importance. The characteristic of rotation is to redistribute the variance from earlier factor to later one to achieve a simpler theoretically more meaningful factor pattern (Hair et al., 1998).

In order to purify and test reliability of the obtained scales the Cronbach analysis was performed thanks to SAS.

### **5.6.2. Validating Factor Results through Reliability Analysis**

Technically speaking, Cronbach's alpha is a coefficient of reliability.

Reliability is defined as the degree to which the independent variable is error free.

Cronbach's alpha assesses how well a set of variables measures a single unidimensional latent construct. It represents the most common estimate of internal consistency of items in a model. In details, it measures the portion of total variability of the sample of indicators due to the correlation of indicators.

It grows with the number of indicators and with the covariance of each pair of them. If no correlation exists (indicators are independent) then Cronbach Coefficient Alpha is equal to zero, while if indicators are perfectly correlated the Cronbach Coefficient Alpha is equal to one.

Cronbach Coefficient Alpha is not a statistical test but a coefficient of reliability based on the correlations between indicators: a high value could imply that the indicators are measuring the same underlying construct.

Some authors suggest 0.7 as an acceptable reliability threshold.

The results of the factor and Cronbach analysis for all items are showed in the Appendix C, whereas the details of the scale validation of the refined scales are presented in the next figure:



**Table 18: Factor Analysis: Cronbach results**

<i>Constructs</i>	<i>Cronbach Alpha</i>
<b>IT CENTRALIZATION</b>	<i>0,82631000</i>
<b>IT DEGREE OF OUTSOURCING</b>	<i>0,7433360</i>
<b>CHANGES IN INSIDE-OUT CAPABILITIES</b>	<i>0,79528900</i>
<b>CHANGES IN OUTSIDE-IN CAPABILITIES</b>	<i>0,8020890</i>

A better estimate could be gained using the composite reliability calculated through a bootstrap resampling procedure. This further procedure was performed in PLS–graph environment and it is explained in the following chapter about Partial Least Squares procedure. The founded factors were then ready to step at the next stage, which was the construct labeling.

### **5.6.3. Labeling of Factor and Creation of Constructs**

The labeling of the constructs obtained followed a constant procedure. Firstly there was an analysis of the different variables included in every factor and only after an accurate analysis of the concept they could express together, a label was given to each construct.

The list of the items composing the constructs follows.

(a) **IT CENTRALIZATION:**

- Centralized IT function
- Centralized decisions regarding IT

(b) **IT DEGREE OF OUTSOURCING:**

- External consultants for technical support
- External consultants for reengineering

(c) **CHANGES IN INSIDE-OUT CAPABILITIES:**

- Ease to find sources of problems

- Visibility of internal processes
- Clears definition of tasks inside the firm
- Ease of implementing organizational changes by reallocating jobs

(d) CHANGES IN OUTSIDE-IN CAPABILITIES:

- Ease to tailor our products to specific needs of a customer
- Better understanding of customer needs
- Effective managing of linkage with customers or suppliers
- Ease to react to market changes

(e) IT PROCESS PENETRATION:

- Average percentage of business processes supported by IT in each

(f) PROCESS PERFORMANCE

- Changes in Key Performance Indicator that monitor Purchasing after IT system implementation
- Changes in Key Performance Indicator that monitor Research and Development after IT system implementation
- Changes in Key Performance Indicator that monitor Production or Service Delivery after IT system implementation
- Changes in Key Performance Indicator that monitor Marketing, Sales and distribution after IT system implementation
- Changes in Key Performance Indicator that monitor Accounting and Finance after IT system implementation
- Changes in Key Performance Indicator that monitor Human resources and administration after IT system implementation

(g) FINANCIAL PERFORMANCE

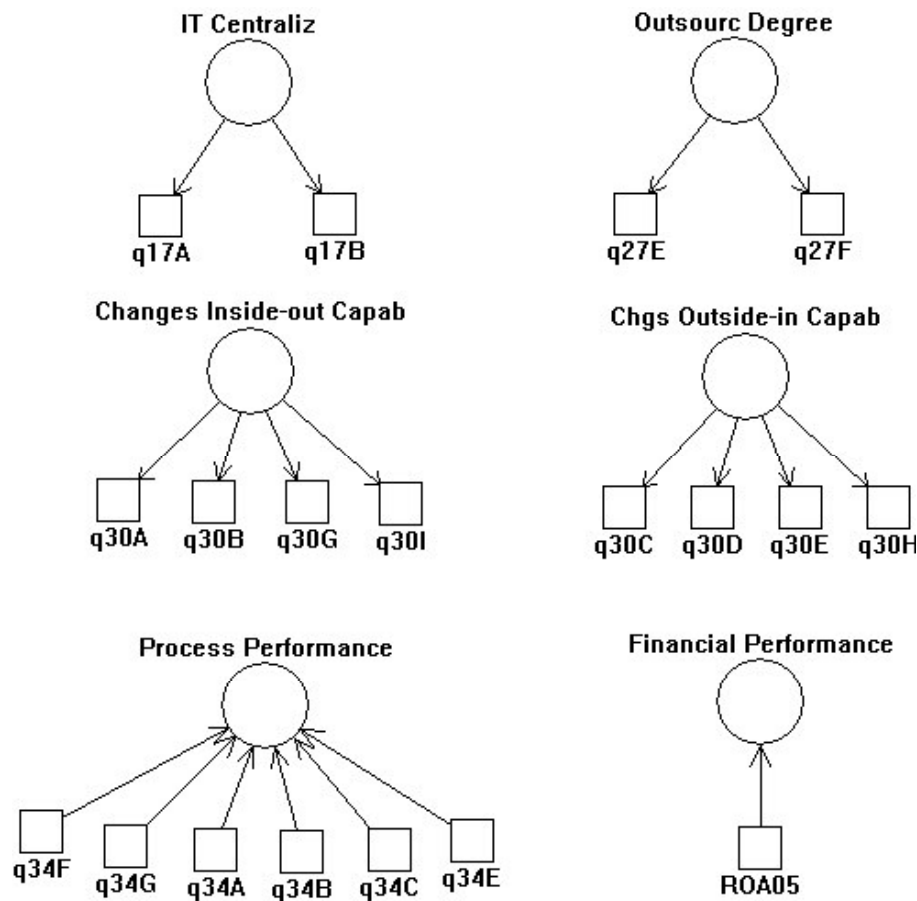
- Value of Return on Assets (ROA) ratio in 2005

The constructs involved in the testing of the models could be divided in three major groups according to their nature: two formative constructs (Process Performance and Financial Performance), one single-item construct (IT Penetration) and four reflective constructs.

Reflective items "represent the effect of the construct under study and therefore reflect the construct of interest", instead formative items cause themselves the construct under study (Wixom and Watson, 2001). In other words, all the questions included in a specific construct are affected by the same underlying concept. Formative constructs are items that cause the change or creation in a construct under study (Bollen and Lennox, 1991) and for this reason these indicators don't need to be correlated nor have high Cronbach alpha coefficient.

All the different constructs are showed in the following figure.

**Table 19: Model Constructs**



The next step was validating the model hypothesised in the previous chapter and the different existent relationship between constructs.

## **5.7. Structural Model**

### **5.7.1. Partial Least Squares and PLS – Graph**

The software used to test the models was PLS–graph (or PLS) that is based on Partial Least Squares.

PLS is here used for theory confirmation and also for suggesting where relationship might or might not exist.

It represents a structural modeling technique, specifically a component–based structural equation modeling technique, which is well suited either for highly complex predictive models or for small sample data.

PLS is, according to Chin and Todd (1995), a ”second generation data analysis technique”.

In details, PLS uses an iterative algorithm consisting of a series of ordinary least squares analysis. Specifically this methodology assumes that all measured variance is useful variance to be explained and allows each construct to vary in how it contributes to the composite score of the latent variables. In fact it does not assume equal weight for all indicators of a scale. This procedure gained interest of researchers in recent years thanks to its flexibility and its ability to model latent variable (constructs) and small samples (Chin et al., 1996).

Structural Equation Modeling is a technique that allows separate relationships for each of a set of dependent variables.

It provides the appropriate and most efficient estimation technique for a series of separate multiple regression equation estimated simultaneously.

According to Hair (1998), it is characterized by two basic components:

- (a) the structural model and
- (b) the measurement model.

The structural model is the “path” model, which relates independent to dependent variables.

The measurement model allows the researcher to use several variables (indicators) for a single independent or dependent variable.

PLS sample requirements in fact are that the sample size has to equal ten or five times, depending on the strength of the selected thumb’s rule, the greater of the number of either the number of items comprising the most formative construct or the number of independent constructs influencing a single dependent construct.

The reasons behind the utilization of PLS are the small sample size required and the possibility of manipulating formative constructs.

The chosen software to perform this modeling technique was PLS–graph version 3.00.

### **5.7.2. Assessment of Reliability and Validity of constructs**

The first step in using PLS–graph is to analyze to what extent models could be considered valid and reliable. According to Hulland (1999), PLS models are analyzed and interpreted sequentially in two stages:

- a. assessment of the reliability and validity of the measurement model and
- b. assessment of the structural model.

This sequence in fact ensures that reliable and valid measures of constructs are available before attempting to draw conclusions about the nature of the construct relationships. For what concern the adequacy of the measurement model, it can be assessed by looking at the following elements (Hulland, 1996):





- a 1. Convergent validity of the measures associated with individual constructs;
- a 2. Discriminant validity.

Validity is normally seen as the ability of a test to measure what it was designed to measure, the degree to which the operational definition of a variable accurately reflects the variable it is designed to measure or manipulate. Convergent validity represents the extent to which the variables are related to the underlying

construct. Due to the different nature of constructs used, different measures of internal consistency are used. As explained in the previous section, the distinction in the way constructs are formed leads to a distinction in the measures of internal consistency.

Trying to summarize the meaning of the main concept introduced in the previous paragraphs, the next figure may be useful:

***Table 20: Requirement of the measurement scale***

Concept		definition
<b>RELIABILITY</b>		degree to which the independent variable is error free
<b>VALIDITY</b>		ability of a test to measure what it was designed to measure
<b>CONVERGENT VALIDITY</b>		the extent to which the variables are related to the underlying construct
<b>DISCRIMINANT VALIDITY</b>		the extent to which measures of a given construct differ from measures of other constructs in the same model

Due to the nature of formative constructs, different dimensions are not expected to correlate or demonstrate internal consistency (Wixom and Watson, 2001). In fact to measure these constructs, none of the internal consistency and reliability measure are appropriate (Bollen and Lennox, 1991). Whereas, for what concerning reflective constructs, the bootstrap resampling method of 100 resamples of PLS-graph was used to determine the internal consistency and convergent and discriminant validity of the structural model.

Obviously, the higher is the reliability of the estimated constructs, the more accurate is the estimate of the structural path (Chin et al., 1996), reliability analysis of the latent variables estimates was measured through calculation of composite reliability (Werts et al., 1974).

For what concerning convergent validity of the reflective constructs, composite reliability of every construct exceeded largely the benchmark of 0.7. In addition a test related to the Average Variance Extracted (AVE) could be

performed. It represents the average variance shared between a construct and its measures and in the research case was adequate because its value exceeded largely the benchmark of 0.5 for every construct (Fornell and Larcker, 1981).

The traditional methodological complement to convergent validity is discriminant validity, which represents the extent to which measures of a given construct differ from measures of other constructs in the same model. Discriminant validity in fact describes the degree to which the operationalization is not similar to (diverges from) other operationalizations that it theoretically should not be similar to.

**Table 21: Discriminant Validity. Results**

<b><i>It centralization</i></b>		<b>rad AVE =</b>	0,971081871
<b>Composite Reliability =</b>		<b>0,971 AVE =</b>	<b>0,943</b>
	mean	stand dev	t stat
centralized_decisions_regarding_IT	0,9719	0,0081	119,3904
centralized_IT_function	0,9719	0,0081	119,3904
<b><i>Degree of IT outsourcing</i></b>		<b>rad AVE =</b>	0,908295106
<b>Composite Reliability =</b>		<b>0,904 AVE =</b>	<b>0,825</b>
	mean	stand dev	t stat
external_consultants_for_technical_su	0,9022	0,0293	46,1145
external_consultants_for_reenginneri	0,9022	0,0293	46,1145
<b><i>Chgs in Inside-out Capabilities</i></b>		<b>rad AVE =</b>	0,865447861
<b>Chgs in Inside-out Capabilities</b>		<b>0,922 AVE =</b>	<b>0,749</b>
	mean	stand dev	t stat
visibility_of_our_internal_processes	0,8952	0,0372	24,2858
finding_sources_of_problems	0,9054	0,0318	28,6051
tasks_defined_clearly_inside_organiz	0,8741	0,0635	13,5248
implementing_organizational_change	0,7892	0,0619	12,8667
<b><i>Chgs in Outside-in Capabilities</i></b>		<b>rad AVE =</b>	0,859651092
<b>Composite Reliability =</b>		<b>0,919 AVE =</b>	<b>0,739</b>
	mean	stand dev	t stat
understanding_of_customer_needs	0,8446	0,0381	22,6371
managing_of_linkage_with_customer	0,8289	0,0519	16,2131
tailoring_products_to_customers_spe	0,8829	0,0322	27,9771
reacting_to_market_changes	0,8344	0,0543	15,3381

To examine this specific kind of validity in PLS, the square root of AVE was calculated and compared to the constructs' correlations. The AVE's square root should be greater than the variance shared between the constructs and other constructs in the model, in other words it should share more variance with its measures than it shares with other constructs in a given model (Wixom and Watson, 2001).

This can be demonstrated in a correlation matrix that includes the correlations between different constructs in the lower left off-diagonal elements of the matrix, and the square roots of the average variance extracted values calculated for each of the constructs along the diagonal. For adequate discriminant validity, the diagonal elements should be significantly greater than the off-diagonal elements in the corresponding rows and columns (Hulland, 1999).

**Table 22: Correlations**

	1	2	3	4
<i>1 It centralization</i>	0,971			
<i>2 Degree of IT outsourcing</i>	0,089	0,908		
<i>3 Chgs in Inside-out Capabilities</i>	0,305	0,057	0,865	
<i>4 Chgs in Outside-in Capabilities</i>	0,405	0,104	0,108	0,860

Thus, it was possible to conclude that discriminant validity is always adequate for what concerns our constructs.

### **5.7.3. Construction and Test of The Model**

Having ascertained the reliability and the validity of the selected constructs, the next step was the construction of the models in PLS-graph environment. Several model were tested with particular attention to the number of constructs



involved and the item involved in every construct in order not to exceed the threshold given in the previous section about the sample size. The conceptual framework in fact involved interdependence between unobserved constructs. Each model was tested on a different ".gph" file. As a result the possibility to make a comparison between the different models was possible.

The very first value to determine which was the best model was the  $R^2$  value which represent the amount of variance of the dependent variable explained by the independent variables.

Therefore it indicates the predictive power of the model and it could be interpreted in the same manner as the best know  $R^2$  in a regression analysis. The following step was to analyze the relationship between the constructs in every model and see what was their role inside the specific model.

## 6. Results

The research model was tested using partial least squares (PLS) techniques.

The model includes seven latent constructs — IT Penetration, IT Centralization, Degree of IT Outsourcing, Changes in Inside-out Capabilities; Changes in Outside-in Capabilities; Process Performance and Financial Performance.

A latent variable is a hypothesized and unobserved concept that can only be approximated by observable or measurable variable. The observed variables, which we gather from respondents through various data collection models (in our case surveys) are known as manifest variables.

Process Performance and Financial Performance were defined as formative constructs.

Firm size was introduced as a control variable.

The different models, illustrated in the previous paragraphs were tested using an incremental approach:

- I. direct impact of IT Penetration on Financial Performance;
- II. partial mediation through Process Performance;
- III. partial mediation with the influence of changes in Inside-out and Outside-in Capabilities;
- IV. role of IT decisions (IT Penetration; IT Centralization and Degree of IT Outsourcing) and moderation effect of Changes in Capabilities and Process Performance.

The results of the structural models are illustrated and depicted in the next paragraphs.

### **6.1. Model 1. Direct Contribution of IT**

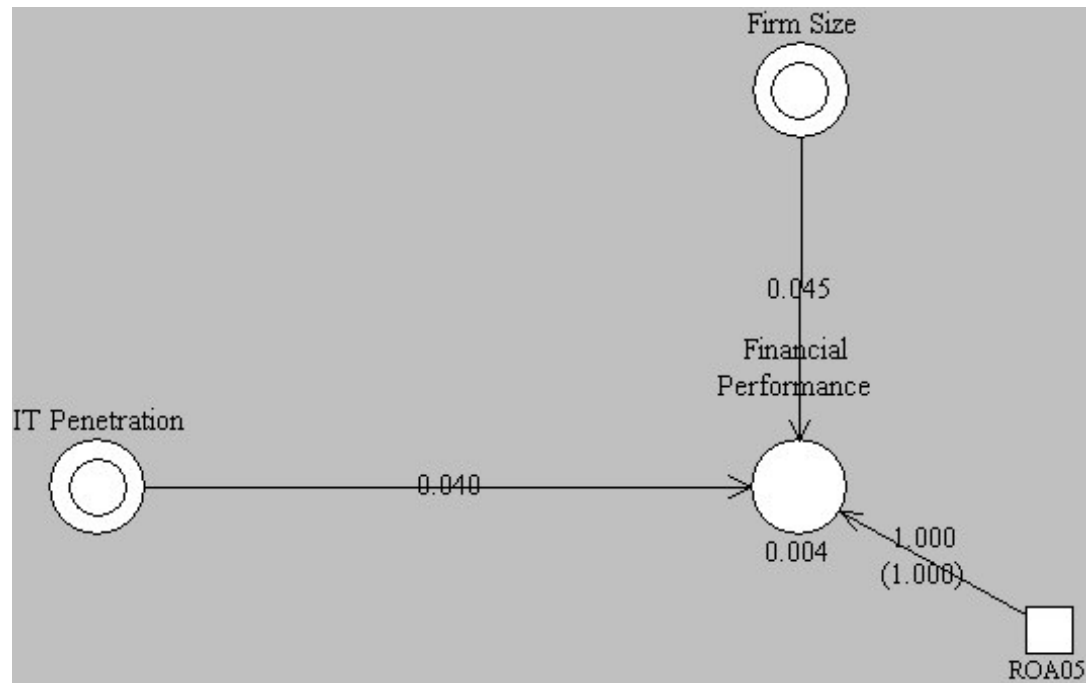
The results of the first model tested show, as expected, no statistical significant relation between IT penetration and Financial Performance.

The value of  $R^2$ , which represents, as we've already said, the amount of variance of the dependent variable explained by the independent variables, is only 0,04, demonstrating that this model can't explain not even partially, variations in Financial Performance.

Adding to that, also the control variable has no impact in this relationship.

The results show that IT Penetration does not directly improve financial performance.

**Table 23: Model 1. Results**



### 6.2. Model 2. Partial Mediation

Since the immediate effect of IT on Financial Performance doesn't appear relevant and statistical significant, more conclusive results are expected when IT

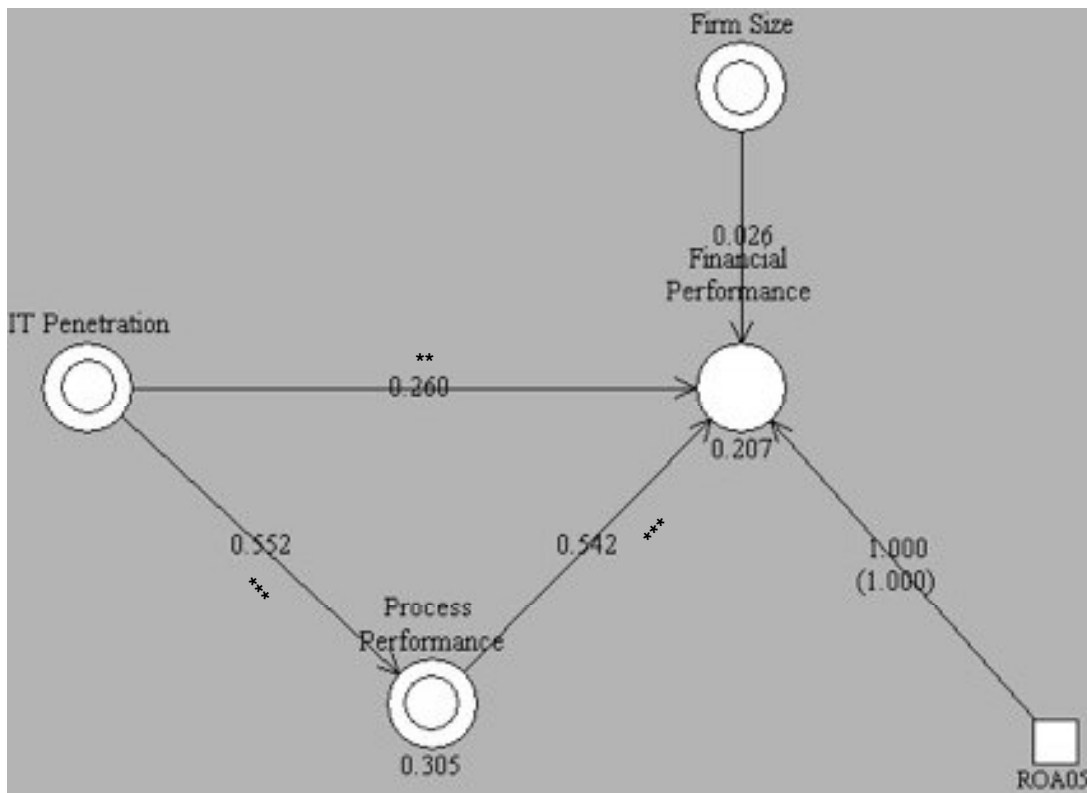
investments are related to Process Performance, as mediator variable in the relationship.

This mediator effect is supported by a growing literature (Mukhopadhyay et al., 1997 and Segars et al., 1998) and empirical studies, using intermediary performance measures such as process efficiency and quality, have reported more consistent results (Nidumolu, 1998 and Rai et al, 1997).

In our case, the introduction of the formative construct “Process Performance”, determines a positive improvement in the  $R^2$  value that now assumes the value of 0,207 (in the first model it was 0,004).

Moreover, all the relationships between the different constructs appear statistical significant. The only confirmation of the first model is represented by the no influence of the control variable, firm size.

**Table 24: Model 2. Results**



### **6.3. Model 3. The role of Capabilities**

The third model introduces the role of changes in the relationship between IT Penetration and Process Performance, according to the huge literature in the IT field that require bottom line changes in order to create higher financial results.

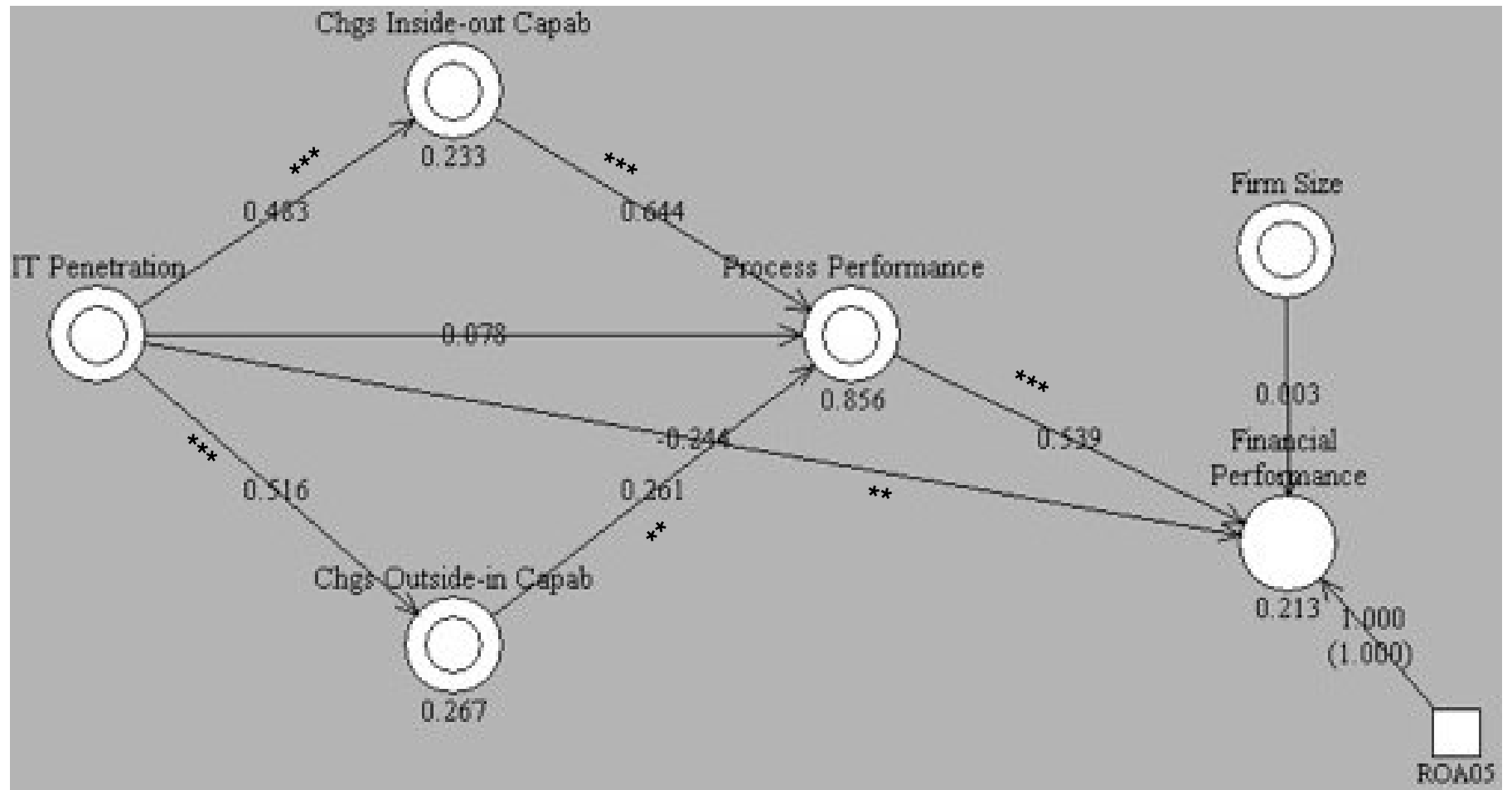
The introduction of two different orders of changes is also consistent with a general approach present in the business police literature that identifies two major streams of research on the determinants of firm performance.

One is based primarily upon an economic tradition, emphasizing the importance of external market factors in determining firm success.

The other line of research builds on the behavioural and sociological paradigm and sees organizational factors and their fit with the environment as the major determinants of success.

Our approach suggests that both elements (internal and external) are relevant, and only through effective changes in Inside-out and Inside-in Capabilities, the benefits of IT can influence Financial Performance.

Table 25: Model 3. Results



The results of the previous model show that IT Penetration per se does not directly improve Financial Performance, but, more important, that IT penetration can improve it only when the firms is open and able to make changes in its capabilities structure and application through the mediator of Process Performance.

In particular, the model shows a negative correlation between IT Penetration and Firm Performance, but the data is not relevant and for this reason not deeply analyzed.

These findings imply that IT alone does not bring success.

Although it is an essential component, it is not sufficient in itself and should be coupled with organisational changes. Firms that do not make appropriate organisational changes and develop appropriate business strategies may fail to take full advantage of IT capabilities.

Comparing the results of the first three models it's clear that the explicatory power of the second and the third is higher than the direct contribution (Model 1).

Moreover, the significance of the paths within the structural model was determined through the bootstrap resampling method. To determine whether the mediator effect is significant, Hierarchical F test was applied.

If the difference between  $R^2$  in original model and that in moderating model is significant, a significant mediator effect is concluded, as occurred in the passage from Model 1 to Model 2.

***Table 26: Model 1, 2 and 3. A Comparison***

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
	parameter estimate	parameter estimate	parameter estimate
<b>Number of independent variables in the model</b>	2	3	3
<b>R<sup>2</sup></b>	0,004	0,207	0,213
<b>DR<sup>2</sup></b>		0,20	0,01
<b>Hierarchical F</b>		18,69 ***	0,56

Now, it may be useful to enrich the concept of IT investments and IT penetration, testing the role of other variables of IT present in the firm.

#### 6.4. Model 4. IT Decisions

The last model is aimed at answering the managerial question that represents the core problem of our work: Does IT create Financial Value? And if it is, through which paths?.

Thanks to the previous model, we have demonstrated that this relationship is not direct, and that Capabilities and Process Performance play a leading role in the value creation process.

But now we want to deeply analyze the definition of IT investments.

As we have already said, a starting problem that we have faced in this work was to define, before studying their relationship, IT and Performance, due to the different approaches and multiple definitions of these two main concepts present in the literature.

For our purpose, IT decisions are here defined as the result of the joint influence of: IT Penetration, IT Centralization and Degree of IT Outsourcing.

The main characteristics of these elements, whit their strategic purpose and expected performance benefits are illustrated in the paragraph 4.4, and are here summarized:

**Table 27: IT Decisions**

IT Decisions and Expected Performance Benefit		
IT Decisions	Strategic Purpose	Expected Performance Benefit
IT PENETRATION	support of all the different activities of the firm	information provision for: managing, accounting, reporting, decision support, planning and control definition of routines
IT CENTRALIZATION	reduction of redundancies coordination standardization	reduction of cost standardization of process central control management efficiencies
DEGREE OF IT OUTSOURCING	focus on core competencies access to specific IT skills and services	reduction of cost recovering of capabilities lacks availability of newest products



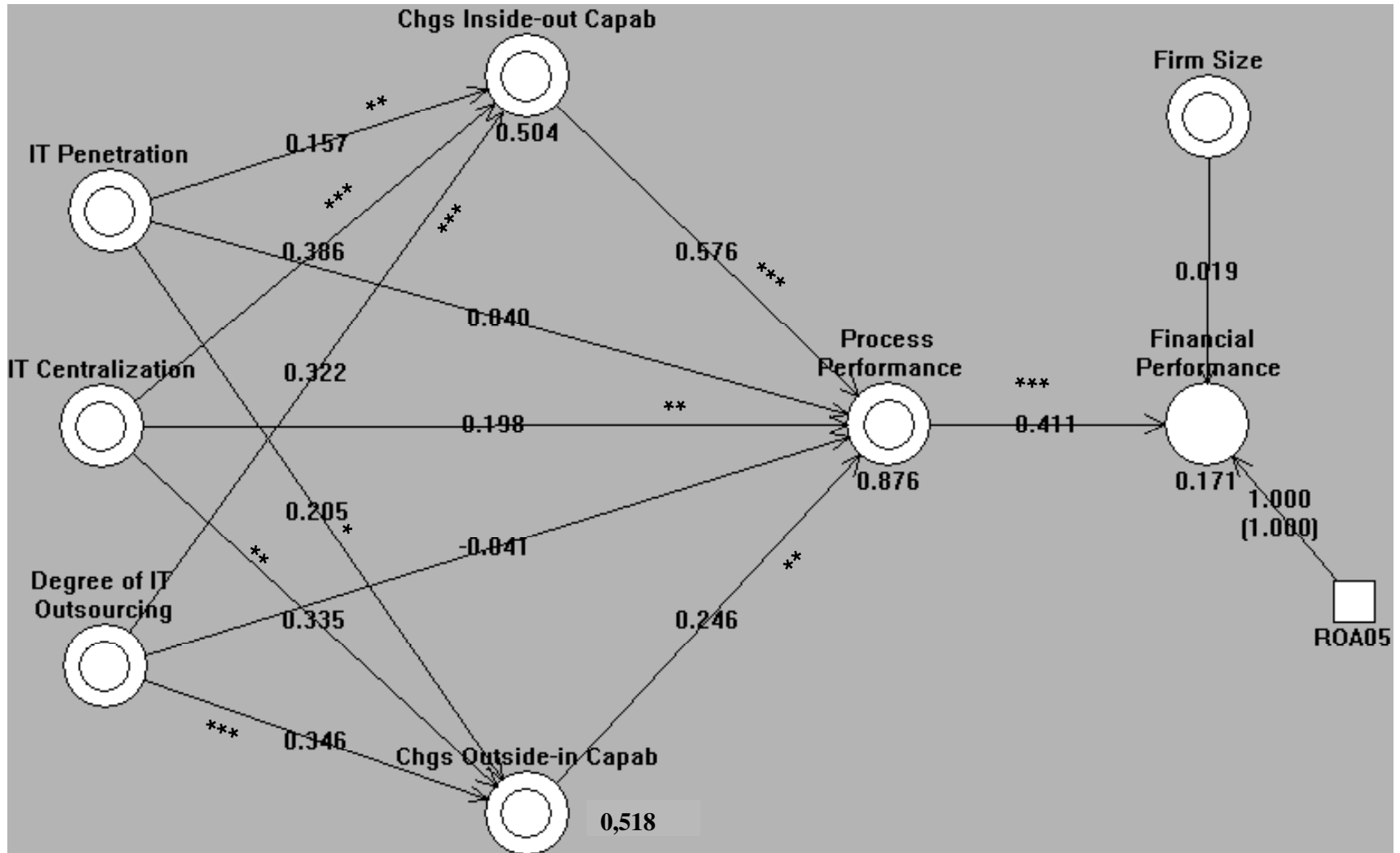
The running of our model definitely confirms the mediation role of Capabilities and Process Performance as mediator variables and the no statistical significance of Firm Size as control variable.

Moreover, it reveals that with the introduction of the three dimensions of IT Decisions, the amount of variance explained in the first order of change (considering Capabilities as the independent variables) considerably increases.

IT Penetration, IT Centralization and Degree of IT Outsourcing, in fact, jointly explain 50% of the variance of the Changes in Inside out Capabilities and the 51% of the Changes in Outside in Capabilities. All the direct relationships between IT Decisions and Changes in Capabilities appear statistical significant, as the nexus between Changes in Capabilities and Process Performance.

The direct impact of IT decision on Process Performance, instead, is no relevant, with the exception of IT Centralization.

Table 28: Model 4. Results



Trying to summarize, it's important to isolate the main findings from this research before considering some of their implications.

Comparing the different model analyzed, we found that IT per se does not directly improve Financial Performance, but may recover a fundamental role, if used to confer flexibility to the firm and make possible changes in its capabilities.

The next figure may be useful to compare the explicative power of the different models and the relevance of the relative constructs.

***Table 29: Models tested. A comparison***

	Model 1		Model 2		Model 3		Model 4	
	Estimate	t stat	Estimate	t stat	Estimate	t stat	Estimate	t stat
<i>IT Penetration</i>	0,04	0,47	0,26 **	2,48	-0,244 **	2,33		
<i>Process Performance</i>			5,42 ***	5,7	0,539 ***	4,79	0,411 ***	3,4
<i>Firm Size</i>	0,045	0,49	0,026	1,03	0,003	1,22	0,019	0,021
<b>R<sup>2</sup></b>	<b>0,004</b>		<b>0,207</b>		<b>0,213</b>		<b>0,171</b>	

\* p<0,1; \*\* p<0,05; \*\*\* p<0,01

## **7. Conclusions and managerial implication**

After having deeply tested the validity of the obtained results, an analysis of the supported/rejected hypotheses follows.

As organisations continue to readily invest significant amounts of capital into IT, research studies report contradictory findings on the relationship between IT investments and organisational productivity and performance.

It is therefore not surprising to see that the IT productivity paradox is receiving increasing attention from researchers and practitioners in the new information-based economy. Considering the growing needs of businesses to gain a competitive advantage in their respective marketplaces, the evaluation of IT investments will remain a necessity if the benefits of IT are to be fully realized.

Moreover, IT investment is both costly and risky and should be appraised for its contribution, value and benefit to an organisation.

Our model tests the relationships and the different roles that IT Decision, Process Performance and Capabilities play in the value creation process.

Mainly, all the propositions, which are general hypotheses on the mechanism under the building-value process, hypothesized in the Model were supported.

Whereas only some of the links resulted statistically significant.

It's important to summarize the main findings from this research before considering some of their implications.

The different models, tested in our research, follow:

- I. direct impact on Financial Performance;
- II. partial mediation through Process Performance;
- III. partial mediation with the influence of changes in Inside-out and Outside-in Capabilities;
- IV. role of IT decisions and moderation effect of Changes in Capabilities and Process Performance.

For what concern the first model, we had no statistical support for the existence of a direct link between IT Penetration and Financial Performance and this appears consistent to the Clemons’ strategic necessity argument.

The others models, provided full support for the idea of the mediation role of the capabilities changes: the role of Process Performance (model II) and of changes in capabilities (inside-out and outside-in) appear critical and statistical significant in improving Financial Performance.

The result’s summary is showed in table 30:

**Table 30: Conclusions**

CONCLUSIONS		
HYPOTHESIS	Results	
<b>1</b> IT investments, reflected by the IT Penetration, leads to enhanced Financial Performance	SUPPORTED	
<b>2a</b> IT investments, reflected by the IT Penetration, exert a positive impact on Process Performance	REJECTED	
<b>2b</b> Process Performance exerts a positive impact on Financial Performance	SUPPORTED	
<b>3</b> The positive impact of IT Penetration on Process Performance is mediated by changes in Inside-Out and Outside-in Capabilities	SUPPORTED	
<b>4a</b> IT decisions exert a positive impact on Process Performance	SUPPORTED only for IT Centralization	
<b>4b</b> The positive impact of IT Decisions on Process Performance is mediated by changes in Inside-out and Outside-in capabilities	SUPPORTED	

At the heart of these findings there is a fundamental argument that management must recognize.

From a managerial perspective, it’s important to understand that investments in IT affect not only the final results of a firm but firstly the bottom line, caused changes in internal and external firm capabilities at organizational and process level.

Our theoretical discussion suggests that it is possible for firms to realize financial benefits from effective management of IT, not from the simply control on it: in the words of Hitt and Brynjolfsson (1996): “IT spending alone is not determinative of success”.

In relation to ERP systems, i.e., Masini (2006) underlines that their value “does not reside in the technological assets (which are easily imitable), but rather in the ability of organizations to develop repeatable patterns of value-creating actions in the use of these assets”.

Moreover, our results are also consistent with the most basilar rule of economic that states that it’s possible for a firm to realize better financial performance from effective control on costs (and so, reducing them) or from an efficient management of revenues. These two aspects correspond two our twofold approach to changes in inside out and outside in capabilities.

Furthermore, managers need to have a better understanding of the impact of IS on the organisational infrastructure and performance. Such understanding can help an organisation better utilise resources and improve its competitive position. On the other hand, failure of such understanding may have disastrous consequences such as inappropriate resource allocation and result in a competitive disadvantage.

Viewed in systems terms, evaluation, and hopefully our model, provide the basic feedback function to managers as well as forming a fundamental component of the organisational learning process (Smithson & Hirschheim, 1998).

Finally, evaluation provides the benchmarks of what is to be achieved by the IT investment. These benchmarks can later be used to provide a measure of the actual implementation success of IT projects<sup>17</sup>.

Concluding we can agree with Powell and Dent-Micallef (1996), that, based on both statistical and anecdotal data, affirm that the value creation process requires

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<sup>17</sup> Regarding this point, it is interesting the affirmation of Irani and PED Love (2001) that completely invert the point of view: “there is an increasing shift in the view that IT/IS should be seen less as an investment that should be compared with other projects that seek funding but instead, more as a matter of consumption. The view is that IT provides the vital infrastructure that makes an organisation work and is therefore a matter of necessity, thus questioning the need to compare with others seeking funding”.

managerial support and forethought, IT-strategy integration, a flair for organizational design, and perhaps a bit of luck.

## **8. Limitation of the study and further implementation**

Overall, our results should be viewed in the context of a few limitations that also indicate some avenues for future research. The main limitations regard:

- (a) the introduction of the environment, as moderator of the tested relationships;
- (b) the definition and modelization of antecedents of IT decisions and
- (c) the enlargement of financial performance measures used in the model.

Firstly, evaluate an information system is a very difficult task also because of the uncontrolled environment in which most systems operate. In this sense, the introduction of the environment variable as moderator in the studied models, could represents a really powerful tool to understand how different environments, with their munificence, turbulence and complexity can influence the relationship between IT and performance reflecting the uncertainty in an organization's operating scenario.

Secondly, an explicit provision of IT strategy as antecedent of IT decisions could represent an important enlargement of our hypothesis, introducing a more completed, although complex, frame to our model. It is expected that through this provision the explication power of the model will grow.

The IS alignment literature<sup>18</sup> also reflects the perspective of resource complementarities, used for the deployment of our model, but its central premise is that mutual coherence between IS priorities and initiatives and firm strategies is necessary to effectively prioritize IT activities and channel IS resources toward areas of strategic importance to the firm.

Empirical studies have found that firms with a higher IS alignment are more likely to utilize IT for strategic purposes (Sabherwal and King, 1992), arrange IT resources and capabilities to support market positions (Henderson and

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<sup>18</sup> For a complete overview of this topic, see Henderson and Venkatraman, 1993; Palmer and Markus, 2000 and Segars and Grover, 1998



Venkatraman, 1993), and focus IT efforts on areas most critical to the firm (Das et al., 1991).

Finally, as noted before (Ahituv and Giladi, 1993 and Hitt and Brynjolfsson,1996), IT is only one of the many elements that effect firm financial performance and, for what concern our model, it doesn't control these other factors. Moreover, the simple definition of performance is not so simple and trying to depict the more complete possible scenario, further works could focus on the enrichment of variables used to define and implement performance indicator.

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## Appendix A

**SURVEY: BUSINESS VALUE OF INFORMATION TECHNOLOGY****INSTRUCTIONS**

The objective of this survey is to evaluate the role of Information Technology in your organization in creating value. We sincerely appreciate your time and effort in completing the questionnaire. By doing so you are directly helping your organization to: (i) benchmark your organization against the industry average; (ii) identify strategies for augmenting the return on your IT investments; (iii) prepare the ground for future new IT projects or IT upgrades.

The questionnaire **is best addressed either to an IT manager with good knowledge of business processes (e.g. CIO) or to a business manager who has been involved in a major IT project implementation.**

We guarantee that all **your answers will remain absolutely confidential** and that they will not be used to evaluate individually the performance of your organization.

Completing the questionnaire **takes about 15 minutes**. Please try to answer all the questions, even by just providing a best guess. In most of the questions you will simply be asked to express your opinion on a statement or to compare alternative choices by checking a number. Please answer these questions according to the following key:

AGREEMENT DISAGREEMENT WITH A STATEMENT:

EXAMPLE:                                    **1 2 3 4 5 6 7**  
STATEMENT .....                       

- 1** = I STRONGLY DISAGREE WITH THIS STATEMENT
- 2** = I DISAGREE WITH THIS STATEMENT
- 3** = I MILDLY DISAGREE WITH THIS STATEMENT
- 4** = I AM INDIFFERENT ON THIS STATEMENT
- 5** = I MILDLY AGREE WITH THIS STATEMENT
- 6** = I AGREE WITH THIS STATEMENT
- 7** = I STRONGLY AGREE WITH THIS STATEMENT

For some of the questions that require quantitative information **it is not necessary to report precise data**. A rough estimate based on your personal judgment is largely sufficient.

In case of doubts, do not hesitate to contact us.

Thank you very much for your precious collaboration!

Please return the completed questionnaire to:

MARIA FEDERICA IZZO  
London Business School  
Sussex Place  
London NW1 4SA  
United Kingdom  
<http://www.london.edu>

<mailto:fizzo@london.edu>  
Tel: +44 (0)20 7000 8824  
Fax: +44 (0)20 7000 7001

**All responses will remain completely confidential. No individual respondent or organization will be identified in relation to the data reported in this questionnaire.**

## YOUR CONTACT DETAILS

1. Your name (optional):
2. Your job title:
3. Address:
4. Phone and e-mail:
5. If your organization is a subsidiary of a larger organization, are you answering this questionnaire as a representative of:  The subsidiary  The parent organization

## General Characteristics of your organization and of its market

6. Name of your organization:
7. Industry sector:
8. Location of headquarters (country):
9. Main geographical markets (country/region):
10. Number of sites/offices/branches:  <10  10-50  51-100  101-500  >500
11. Number of employees:  <100  100-500  501-1,000  1,001-5,000  >5,000
12. Turnover (million  £ or  euros):  <100  100-500  501-1,000  1,001-5,000  >5,000
13. Number of new products/services developed in the last 5 years:  <5  5-10  11-20  21-50  > 50
14. Number of products/services categories developed in the last 5 years:  <5  5-10  11-20  21-50  >50
15. Average product/service life cycle (in years):  <1  1-2  3-5  6-10  >10

**16. Please describe the characteristics of your organization by agreeing/disagreeing with the following statements:**

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Our business is restricted to a single country		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
We provide customized products/services		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Customer requirements are very homogeneous		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Products/services are made-to-order		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Demand is extremely stable over time		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cost is a more important criterion than fast deliveries from select suppliers		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
We often face non-routine problems in our business		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

We are often obliged to modify our schedule to process urgent orders	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
We often need to update technology/equipment to keep up with our competitors	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
We often need to rapidly rotate jobs among employees to implement organizational changes	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

## IT governance

17. Please describe your organization's IT governance practice by agreeing/disagreeing with the following statements:

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Our organization's IT function is completely centralized (i.e. no IT function in BUs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our organization's decisions regarding IT applications are mostly centralized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We perceive IT primarily as a strategic enabler of the business	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our organization's IT strategy is completely aligned with our business strategy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our organization's IT Systems are organized around legacy systems and are hardly integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have highly integrated and standardized methodologies for implementing IT projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In our organization it is very easy to shift resources and priorities across our IT projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accommodating changes in our Information systems due to factors such as vendor upgrades is very difficult	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our line managers' knowledge/understanding of the IT potential to improve their business is deep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In our organization the procedures for approving new IT projects are very detailed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our IT personnel ensure "Systems Availability" as per the Service Level Agreements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our IT personnel's understanding of the business processes is deep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## IT projects and investments

18. After 2000 have you implemented any Business Application (e.g. ERP, CRM, HRMS) or have you upgraded a Business Application? yes no

19. What product(s) have you adopted (vendor/release: e.g. SAP, Oracle, etc...): \_\_\_\_\_

20. Please indicate the most important Bus. Application that you have implemented/upgraded during 2000-2007: \_\_\_\_\_

**IN ALL THE REMAINING QUESTIONS OF THE SURVEY PLEASE REFER TO THIS PROJECT**

21. Please estimate the total project cost (as a % of your annual revenue): \_\_\_\_\_ %

22. Specify approximately the major cost items associated with the project (as a % of total project cost):

Software licence	<input type="text"/>	%
Hardware	<input type="text"/>	%
Salaries of employees devoted to implementation	<input type="text"/>	%
External support (consultants, etc)	<input type="text"/>	%
Other (please specify: _____)	<input type="text"/>	%

**TOTAL COST**  %

23. When did the system implemented become fully operational (live date)? (month/year): \_\_\_\_ / \_\_\_\_

24. What was the project duration (months)? \_\_\_\_

25. What percentage of your employees uses the application? \_\_\_\_%

26. Specify approximately what % of your business processes is supported by IT in each of the organizational functions listed below:

	0%	20%	40%	60%	80%	100%
Sales & Marketing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accounting & finance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human resources & administration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Research & development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Purchasing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. Please describe the technical characteristics of your IT project by agreeing/disagreeing with the following statements

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
Our processes had special features that could not be fully supported by a standard software package	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To improve the fit between our processes and the software we adapted our processes to the software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To support our special processes we heavily customized the software by adding new code	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To support our special processes we adopted software add-ons from other vendors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We made large use of external consultants to obtain technical support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We made large use of external consultants to reengineer our processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

28. Which of the following functions required the most significant interventions to customize the software, either through re-coding or through add-ons adoption (tick as many boxes as appropriate)?

Purchasing     Research & Development     Production or Service Delivery     Sales & Marketing     Accounting & Finance     Human Resources & Administration

29. Please describe your software implementation and support strategy by agreeing/disagreeing with the following statements

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
We made many organizational changes in our company during/after the software implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We made many business process changes in our company during/after the software implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
During the software implementation project we held many meetings to configure the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
At these meetings we spent a lot of time to discuss the technical specifications of the software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
At these meetings we spent a lot of time to discuss alternative business process configurations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
At these meetings employees could openly criticize management decisions if they disagreed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We often held face-to-face meetings between the software implementation team and end-users	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
During the project we created many manuals and written documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Documents or manuals describing critical parts of our software are easily accessible	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
It is really difficult to train and educate new employees to use the software	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
We usually train new employees by giving them manuals or written procedures that they can study	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
We usually train new employees by having them coached by more experienced employees	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
It would be really difficult to replace an attriting employee with the software knowledge	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
It would not be very difficult for a competitor to replicate our software implementation approach	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

## Changes in Organizational Capabilities

**30. Please evaluate the changes observed in your organization after the software implementation by agreeing/disagreeing with the following statements:**

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
We have a better visibility of our internal processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can find more easily the sources of problems in our processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have a better understanding of our customers' needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can manage the linkages with our customers or suppliers more effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can more easily tailor our product/services to the specific needs of our customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We have now stable relationships with our suppliers and business partners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tasks and responsibilities are defined more clearly inside our organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can more easily react to market and environmental changes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can more easily implement organizational changes by reallocating jobs/responsibilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We can more easily update technology/equipment to keep up with our competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**31. In which ones of the functions listed below have you experienced most of the changes described in question 30 above (tick as many boxes as appropriate)?**

Purchasing     
  Research & Development     
  Production or Service Delivery     
  Sales & Marketing     
  Accounting & Finance     
  Human Resources & Administration

## Project evaluation

**32. Please indicate the 2 most important objectives that you planned to achieve through your IT investment and the degree of achievement for each of these objective as of today:**

Objective 1: \_\_\_\_\_ Achieved up to: \_\_\_\_\_ %

Objective 2: \_\_\_\_\_ Achieved up to: \_\_\_\_\_ %

**33. Please evaluate the success of your project by agreeing/disagreeing with the following statements:**

	Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree
The total cost of the project was higher than the budget initially established	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
We could not meet the target project deadline initially established	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
After the system went live we experienced fewer data errors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
After the system went live the information in our organization was available more timely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
After the system went live it was easier to obtain the data we needed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**34. For each of the following functions, please indicate whether after the IT system was implemented you observed any changes in the Key Performance Indicators that monitor the performance of the following functions :**

Deteriorated 1 2 3 4 5 6 7 Improved

Purchasing (e.g. Cost of selecting or managing suppliers)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Research & Development (e.g. Time-to-market for new products)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Production or Service Delivery (e.g. Inventory turnover)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Marketing, Sales & distribution (e.g. Lead time)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Accounting & Finance (e.g. Time to consolidate accounts at the end of the financial year)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Human resources & administration (e.g. Time required to hire a new employee)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

**Thank you once again for your precious collaboration!**

## Appendix B

<i>PANEL COMPOSITION</i>			
<b>sic code</b>	<b>sector</b>	<b>number</b>	<b>%</b>
73	BUSINESS SERVICES	15	19%
48	COMMUNICATIONS	8	10%
60	DEPOSITORY INSTITUTIONS	6	8%
50	WHOLESALE TRADE	5	6%
35	INDUSTRIAL AND COMMERCIAL MACHINERY AND COMPUTER EQUIPMENT	4	5%
65	REAL ESTATE	4	5%
37	TRANSPORTATION EQUIPMENT	3	4%
38	MEASURING, ANALYZING AND CONTROLLING INSTRUMENTS	3	4%
80	HEALTH SERVICES	3	4%
20	FOOD AND KINDRED PRODUCTS	2	3%
28	CHEMICALS AND ALLIED PRODUCTS	2	3%
33	PRIMARY METAL INDUSTRIES	2	3%
36	ELECTRONIC AND OTHER ELECTRICAL EQUIPMENT AND COMPONENTS	2	3%
41	TRANSPORTATION	2	3%
57	HOME FURNITURE, FURNISHINGS, AND EQUIPMENT STORES	2	3%
80	HEALTH SERVICES	2	3%
14	MINING AND QUARRYING OF NONMETALLIC MINERALS, EXCEPT FUELS	1	1%
17	CONSTRUCTION-SPECIAL TRADE CONSTRUCTION	1	1%
25	FURNITURE AND FIXTURES	1	1%
30	RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS	1	1%
49	ELECTRIC, GAS, AND SANITARY SERVICES	1	1%
59	MISCELLANEOUS RETAIL	1	1%
61	NON DEPOSITORY CREDIT INSTITUTIONS	1	1%
63	INSURANCE CARRIERS	1	1%
75	AUTOMOTIVE	1	1%
79	AMUSEMENT AND RECREATION SERVICES	1	1%
83	SOCIAL SERVICES	1	1%
91	EXECUTIVE, LEGISLATIVE, AND GENERAL GOVERNMENT, EXCEPT FINANCE	1	1%
92	JUSTICE, PUBLIC ORDER, AND SAFETY	1	1%
93	PUBLIC FINANCE, TAXATION, AND MONETARY POLICY	1	1%
<b>Total</b>		<b>79</b>	<b>100%</b>

## Appendix C

<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>	<i>FACTOR 3</i>
q11	turnover	<b>0,893</b>	-0,0436	0,05212
q10	#employees	<b>0,89207</b>	-0,01747	0,15843
q13	#products/services_categories	<b>0,64555</b>	-0,21642	0,27736
q15	#sites	-0,79211	-0,08344	0,01105
q16D	products_made_to_order	0,01967	<b>0,84774</b>	0,10815
q16B	customized_products	-0,09012	<b>0,83562</b>	-0,00088
q16C	made-to-order_products	0,03473	0,01381	<b>0,80734</b>
q16A	single_country_business	0,17399	0,09208	<b>0,70835</b>
<b>EIGENVALUE</b>		2,85628836	1,5218086	1,0510312
<b>CONBACH ALPHA</b>		<b>0,82631000</b>	<b>0,6198840</b>	<b>0,3177550</b>



<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>	<i>FACTOR 3</i>	<i>FACTOR 4</i>
q16G	Facing_non-routine_problems	<b>0,76137</b>	0,03707	-0,15518	-0,03552
q16H	ease_of_schedule_modification	<b>0,7358</b>	0,01093	0,38586	0,07191
q12	#new_products_last5y	-0,40859	<b>0,77336</b>	0,17968	-0,09258
q16J	need_for_job_rotation	0,38868	<b>0,73388</b>	-0,01785	0,21263
q16I	need_for_updating_technology	0,51403	0,55707	0,00788	-0,38629
q16E	stable_demand	-0,00998	0,10178	<b>0,79693</b>	-0,29229
q16F	costs_versus_delivery	-0,05133	-0,01669	<b>-0,61049</b>	-0,47994
q14	averagePLC	-0,01088	0,01174	-0,09974	0,81414
<b>EIGENVALUE</b>		<i>1,9797987</i>	<i>1,3651397</i>	<i>1,1869657</i>	<i>1,0449627</i>
<b>CONBACH ALPHA</b>		<b>0,46909000</b>	<b>0,3412990</b>	<b>-0,2212680</b>	
<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>	<i>FACTOR 3</i>	<i>FACTOR 4</i>
q17J	IT_potential	<b>0,81357</b>	-0,12518	-0,24057	-0,06117
q17C	IT =strategic_enabler	<b>0,80402</b>	0,08706	0,1335	-0,05936
q17D	alignment_IT&business_strategy	<b>0,76188</b>	0,15858	-0,33732	0,21572
q17B	centralized_decisions_regarding_IT	-0,02371	<b>0,92893</b>	-0,06575	0,1182
q17A	centralized_IT_function	0,1032	<b>0,91982</b>	0,0007	-0,07843
q17E	legacy_system	0,0165	-0,01126	<b>0,75926</b>	0,3159
q17F	collect_know_on_IT_manag	-0,37029	-0,01312	<b>0,71333</b>	0,03703
q17G	integrated&standardized_IT_projects	-0,06074	-0,05248	<b>0,62901</b>	-0,44298
q17K	approving_IT	0,1202	0,14342	-0,00548	0,86711
q17I	accomodate_changes	0,07963	0,2446	-0,29722	-0,33199
q17H	ease_to_shift_resources	0,43039	0,12748	-0,1599	-0,49701
<b>EIGENVALUE</b>		<i>2,8949837</i>	<i>1,7797729</i>	<i>1,4502231</i>	<i>1,2483763</i>
<b>CONBACH ALPHA</b>		<b>0,75500700</b>	<b>0,8583490</b>	<b>0,5634630</b>	

<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>	<i>FACTOR 3</i>
q27A	special_features_not_supported	<b>0,82766</b>	-0,19567	-0,18867
q27C	customized_software_by_new_code	<b>0,82337</b>	-0,01862	0,27915
q27D	adoption_of_add-ons	<b>0,63082</b>	0,2931	0,08208
q27E	external_consultants_for_technical_support	0,04963	<b>0,90199</b>	0,03631
q27F	external_consultants_for_reengineering	-0,02301	<b>0,84983</b>	-0,11246
q27B	adapted_processes	0,07891	-0,06513	0,96874
<b>EIGENVALUE</b>		<b>1,82699613</b>	<b>1,67270574</b>	<b>1,00766720</b>
<b>CONBACH ALPHA</b>		<b>0,64063200</b>	<b>0,7433360</b>	

<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>	<i>FACTOR 3</i>	<i>FACTOR 4</i>	<i>FACTOR 5</i>	<i>FACTOR 6</i>
q29I	easy_to_access_documentation	<b>0,81949</b>	0,20153	0,07738	0,14136	0,01398	-0,08407
q29K	employee_training_through_written_documents	<b>0,78541</b>	-0,18164	0,08747	0,01601	0,01175	0,0822
q29H	Creation_of_manuals	<b>0,68553</b>	0,25532	0,36109	0,30486	-0,00784	-0,02747
q29G	holding_of_face-to-face_meetings	0,15018	<b>0,77395</b>	0,18851	0,12036	-0,08803	0,19905
q29F	employees_disagreement_to_management_decision	0,14391	<b>0,7593</b>	0,03733	-0,12175	-0,28285	-0,13986
q29L	new_employee_coached_by_experienced_employee	-0,11465	<b>0,75382</b>	-0,04573	0,02011	0,18484	0,14097
q29B	business_process_changes	0,41271	0,1096	<b>0,78087</b>	-0,12777	0,064	0,10317
q29E	time_spent_for_BP_configurations	0,0857	0,10439	<b>0,69476</b>	0,2443	0,09398	-0,104
q29A	Organizational_changes	0,00768	-0,11199	<b>0,62177</b>	0,09531	-0,20996	0,48128
q29D	time_spent_on_technical_specifications	0,27358	-0,1689	-0,05797	<b>0,79771</b>	-0,10565	0,24143
q29C	Holding_of_meetings	0,06454	0,20572	0,31527	<b>0,77175</b>	0,22952	-0,09877
q29M	difficult_to_replace_software_knowl_of_employee_	0,05837	0,00348	-0,13722	-0,11053	<b>0,82533</b>	0,19128
q29J	difficult_to_train_new_employee	-0,03335	-0,13647	0,26415	0,27468	<b>0,70768</b>	-0,1351
q29N	difficult_for_a_competitor_to_replicate_our_implem	-0,00878	0,20334	0,03598	0,06281	0,13021	0,846
<b>EIGENVALUE</b>		<b>3,40386589</b>	<b>1,93794288</b>	<b>1,52109825</b>	<b>1,20369741</b>	<b>1,07354134</b>	<b>1,01854242</b>
<b>CONBACH ALPHA</b>		<b>0,74550100</b>	<b>0,6955040</b>	<b>0,6112990</b>	<b>0,56595300</b>	<b>0,4965500</b>	

<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>
q30B	finding_sources_of_problems	<b>0,85383</b>	0,07501
q30A	visibility_of_our_internal_processes	<b>0,8253</b>	0,12066
q30G	tasks_defined_clearly_inside_organization	<b>0,73278</b>	0,15799
q30I	implementing_organizational_changes_by_reallocat	<b>0,65449</b>	0,20537
q30J	updating_technology_to_keep_up_with_competitors	0,5983	0,40325
q30E	tayloring_products_to_customers_specific_needs	0,18688	<b>0,80661</b>
q30C	understanding_of_customer_needs	0,26096	<b>0,77186</b>
q30H	reacting_to_market_changes	0,26205	<b>0,66581</b>
q30D	managing_of_linkage_with_customers_or_suppliers	0,3602	<b>0,61141</b>
q30F	stable_relationship_with_suppliers&business_partne	0,08638	-0,67599
<b>EIGENVALUE</b>		<i>4,25677614</i>	<i>1,55594697</i>
<b>CONBACH ALPHA</b>		<b>0,79528900</b>	<b>0,8020890</b>

<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>
q33D	informations_available_afterLD	<b>0,84054</b>	-0,03246
q33C	data_errors_afterLD	<b>0,80651</b>	-0,0929
q33E	obtaining_info_afterLD	-0,5885	-0,36795
q33A	costs>budget	0,22976	<b>0,85091</b>
q33B	project_deadline_not_meet	-0,21197	<b>0,82634</b>
<b>EIGENVALUE</b>		<i>1,8599177</i>	<i>1,4930651</i>
<b>CONBACH ALPHA</b>		<b>0,68092600</b>	<b>0,6394710</b>
<i>Question</i>	<i>Item Description</i>	<i>FACTOR 1</i>	<i>FACTOR 2</i>
q34B	changes_afterLD-R&D	<b>0,79071</b>	-0,25391
q34C	changes_afterLD-production	<b>0,72716</b>	0,21161
q34A	changes_afterLD-purchasing	<b>0,6824</b>	0,28181
q34F	changes_afterLD-Accounting&Finance	0,0214	<b>0,74541</b>
q34E	changes_afterLD-Marketing	0,09756	<b>0,72573</b>
q34G	changes_afterLD-HumanResources	0,46895	<b>0,49386</b>
<b>EIGENVALUE</b>		<i>2,1752299</i>	<i>1,1891890</i>
<b>CONBACH ALPHA</b>		<b>0,59751700</b>	<b>0,4948980</b>