



**DOTTORATO IN SISTEMI INFORMATIVI AZIENDALI
CICLO XX**

IT INVESTMENTS AND FIRM PERFORMANCE

An Analytic and Empirical investigation

- Summary -

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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 summary 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 performance¹.

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.

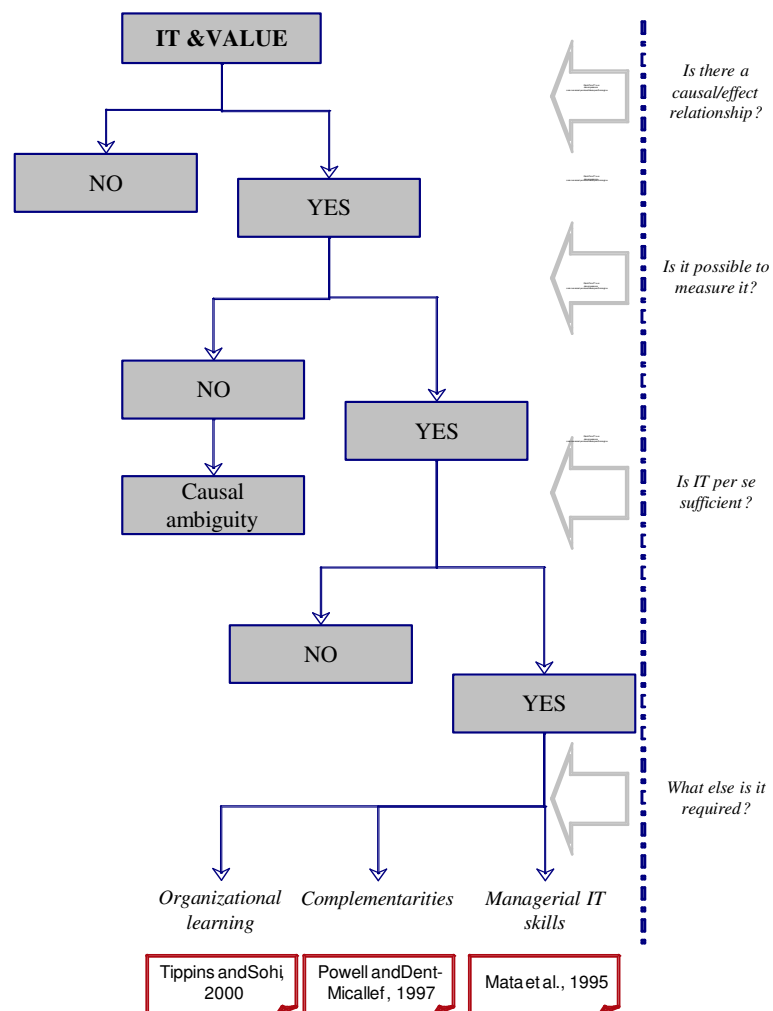
¹ As sometimes occurs, especially referring to topics that are largely studied, the first problem we encountered approaching the study of IT effects on firm performance, regards the definition itself of IT investments and firm Performance. Moreover, before we can discuss how to improve performance, it's 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.

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



2. Information systems in the firm system

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.

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 costs².

The idea of creating value through IT, for a long time, was used as a synonym of competitive advantage³.

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.

² On the point see the work of Epstein and Reja, 2005

³ Competitive advantage is normally defined as the firm ability to earn return on investment persistently above the average for the industry (Porter, 1985).

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.

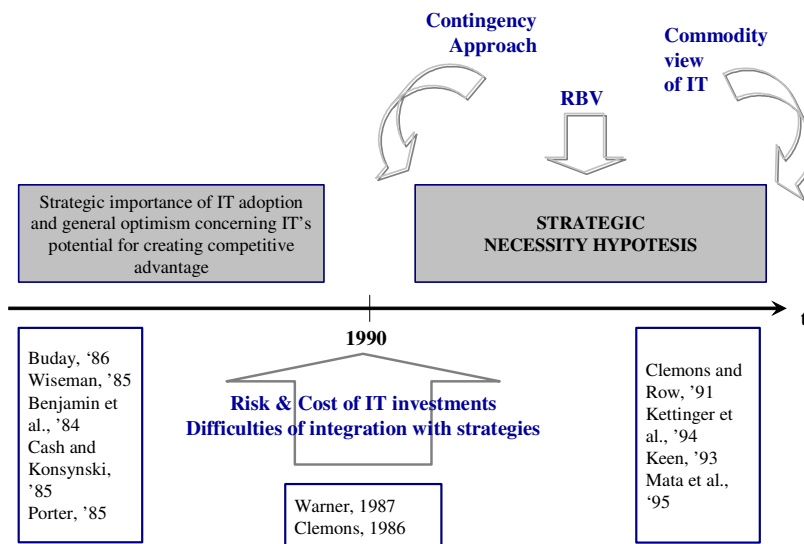
According to Clemons (1991), a comprehensive analysis reveals that IT has become a strategic necessity, but not a source of competitive advantage.

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

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, through 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.

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).

According to Hitt and Bynjolfsson (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 investments⁴.

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

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 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

⁴ According to Hitt & Brynjolfsson (1996), IT value has three different dimensions: productivity, profitability and customer value. Starting from that, the authors demonstrate how “there is no inherent contradiction between increased productivity, increased consumer value, and unchanged business profitability”. In relation to 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”.

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 holistic 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.

In this scenario, our proposition is to try to measure IT investment effects, structuring a model that, starting from these limits identified by the literature, offers a different way to approach the problem.

Viewed in systems terms, IT evaluation is a key element for firm strategy and survivor.

It 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 investment. These benchmarks can later be used to provide a measure of the actual implementation success of IT projects. Notwithstanding the above, there is an increasing shift in the view that IT 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.

4. The research model

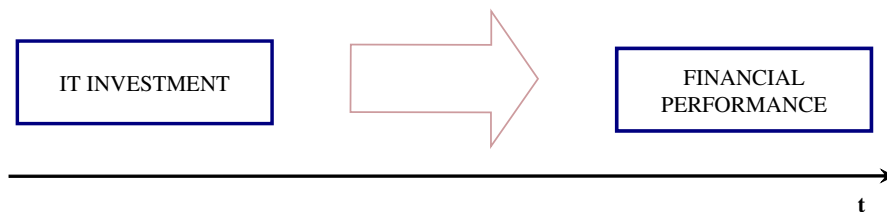
Although the importance of IT in firms activities has been clearly established, it is less clear if it has a direct role in value creation and (if it has) what type of paths can lead to better performance, thanks to IT investments and which competences should be generated.

Our research model tries to define different scenarios to understand if it's possible to verify the existence of this relationship.

Our first hypothesis states that IT Penetration exerts a positive and direct impact on Financial Performance. Organizations execute multiple business processes to deliver their product and services and achieve strategic objectives. Organizations invest in IT to enable these business processes. Such investments take various forms from implementing an ERP package to integrate all its production processes to Customer Relationship Management software for enhancing the customer experience or it could be an enterprise wide Project Management tool for efficiently managing the projects.

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

Table 3: Hypothesis 1



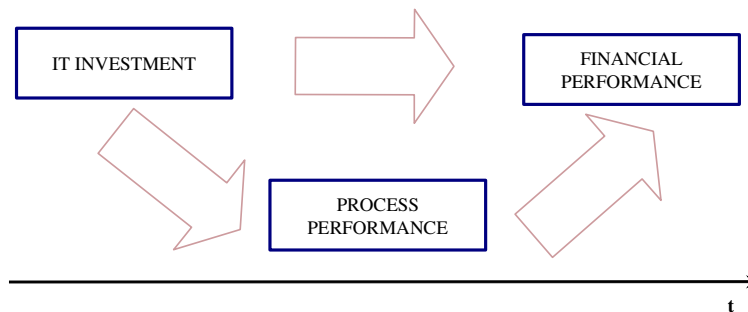
According to Barua et al. (1995), the identification of the economic impact of IT requires a process oriented, industry, or company specific model.

In that sense, the second step of our conceptual model introduces a new variable: Process Performance, adopting a process oriented approach, according to which IT investments are not able, alone, to create financial value. This relationship, in fact, is mediated by the role of Process Performance.

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 4: Hypothesis 2



The third step of our research model assumes 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 changes, 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.

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

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.

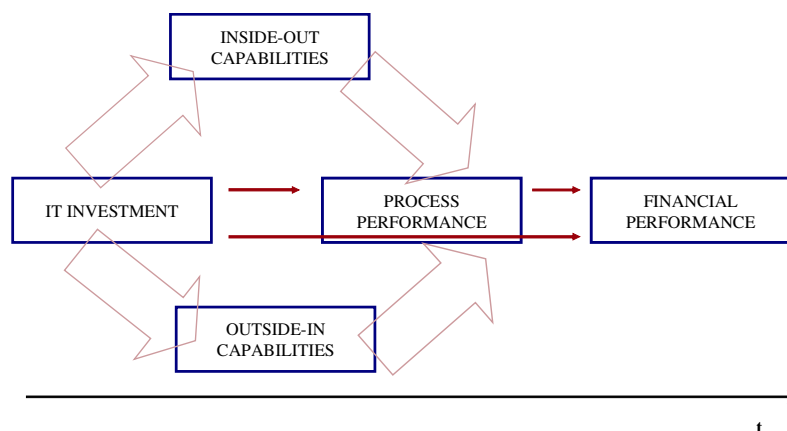
This is consistent with the results of Brynjolfsson and Hitt (1996) that indicate that the primary reason for IT investments is customer service (something similar to our definition of changes in outside-in capabilities), followed by cost savings (obtainable through changes in inside-out capabilities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

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

- (a) externally focused applications and
- (b) internally focused applications.

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

Table 5: Hypothesis 3



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, here illustrated in their main characteristics:

Table 6: IT Decisions

IT Decisions and Expected Performance Benefit		
IT Decision	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 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 (Mukhopadhyay et al. 1997, Barua et al., 1995), 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 opposite, sometimes) 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”.

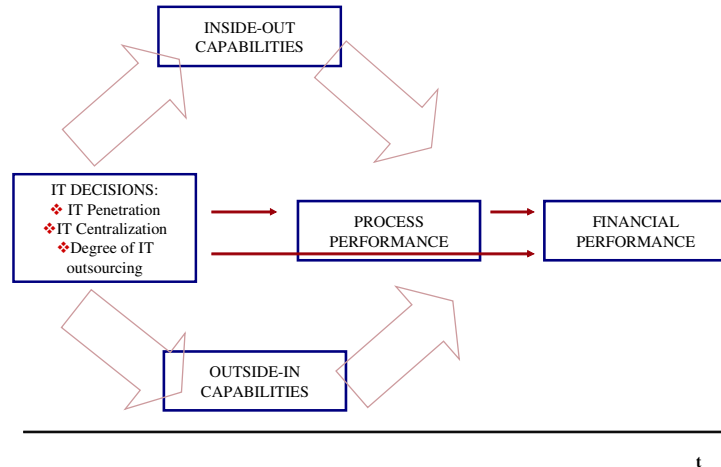
This argument is consistent to the “value added analysis” model of Porter (1985) and with the evidence of Weill and Olson (1989), King and Kramer (1989) and Barua et al. (1995) that, in their two stage analysis, found a significant positive impacts of IT on intermediate level of the firm that in the higher one⁵.

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).

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*

⁵ In this sense, they indicate “the need for more process oriented models instead of traditional ‘black box’ approaches”.

Table 7: Hypothesis 4

Summarizing all the hypothesis to test:

Table 8: 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

5. Methods

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 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 9: 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.

For our purpose, we've decided to use a cross-sectional survey, that appears 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 questionnaire 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.

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

The selected industries are 79 and vary from Manufacturing to IT services, from IT consulting to Electronics and finally from Communication to Pharmaceutical/ Biotechnology.

Survey questions use 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 10: Questionnaire and questions

Questionnaire structure
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

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

Due to the number of questions 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 and finally, the last test of the relationship between these variables was performed through the PLS–graph software as well.

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

Table 11: Steps of Analysis

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

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.

Factor Analysis, performed through SAS 9.1, was used to calculate the Cronbach's alpha that is a coefficient of reliability (degree to which the independent variable is error free)⁶.

The results of the factor validated and their Cronbach Alpha values are presented in the next figure:

Table 12: Factor Analysis: Cronbach results

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

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.

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.

⁶ Cronbach's alpha assesses how well a set of variables measures a single uni-dimensional 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.

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.

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

Table 13: Requirement of the measurement scale

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

All of the previous tests validated 5 constructs: IT Centralization, Degree of IT Outsourcing, Changes in Inside-out Capabilities; Changes in Outside-in Capabilities (reflective constructs) and IT Penetration.

Table 14: Discriminant Validity. Results

<i>It centralization</i>		rad AVE =	0,971081871
Composite Reliability =		0,971	AVE = 0,943
	mean	stand dev	t stat
centralized_decisions_regarding_IT	0,9719	0,0081	119,3904
centralized_IT_function	0,9719	0,0081	119,3904

<i>Degree of IT outsourcing</i>		rad AVE =	0,908295106
Composite Reliability =		0,904	AVE = 0,825
	mean	stand dev	t stat
external_consultants_for_technical_su	0,9022	0,0293	46,1145
external_consultants_for_reenginnerir	0,9022	0,0293	46,1145

<i>Chgs in Inside-out Capabilities</i>		rad AVE =	0,865447861
Chgs in Inside-out Capabilities		0,922	AVE = 0,749
	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_changes	0,7892	0,0619	12,8667

<i>Chgs in Outside-in Capabilities</i>		rad AVE =	0,859651092
Composite Reliability =		0,919	AVE = 0,739
	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_spec	0,8829	0,0322	27,9771
reacting_to_market_changes	0,8344	0,0543	15,3381

Moreover, to complete our model, we added two formative constructs⁷: Process Performance and Financial Performance and a control variable: Firm Size.

The different models tested are implemented using an incremental approach:

- I. direct impact of IT Penetration on Financial Performance;
- II. partial mediation through Process Performance;

⁷ 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).

- 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.

6. Results

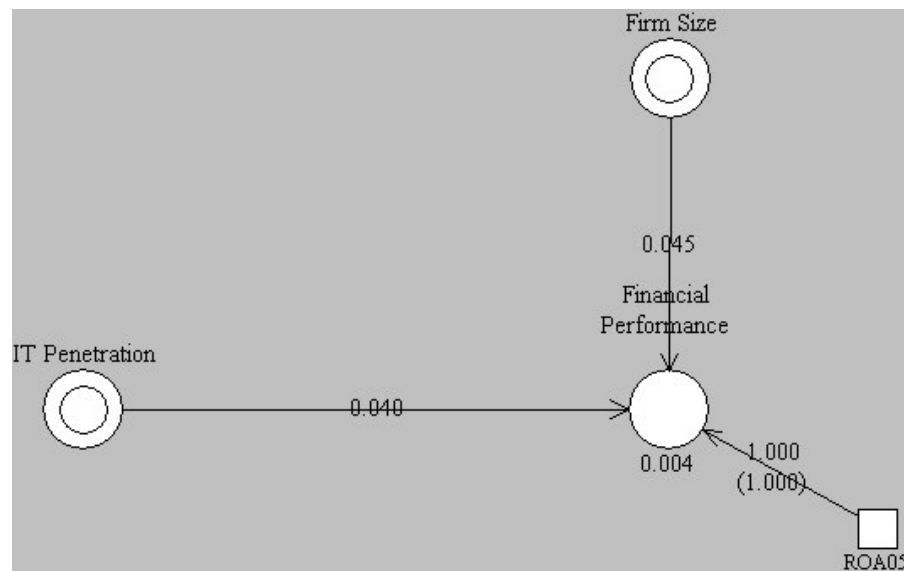
The results of the first model tested show, as expected, no statistical significant relation between IT penetration and Financial Performance.

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 15: Model 1. Results



6.1. 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

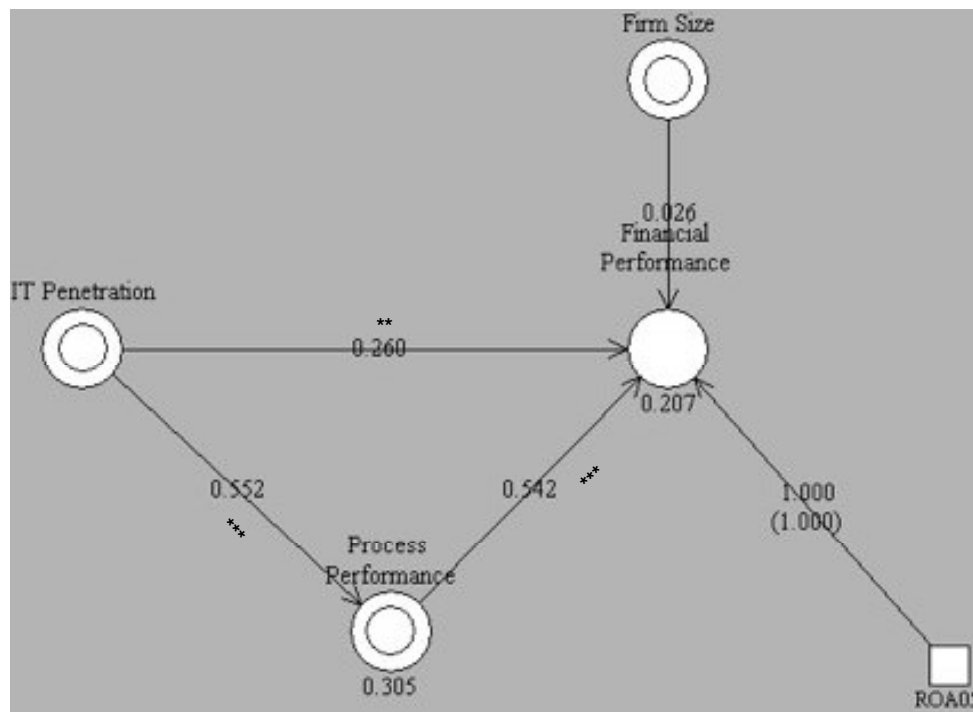
investments are related to Process Performance, as mediator variable in the relationship.

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 16: Model 2. Results



6.2. 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.

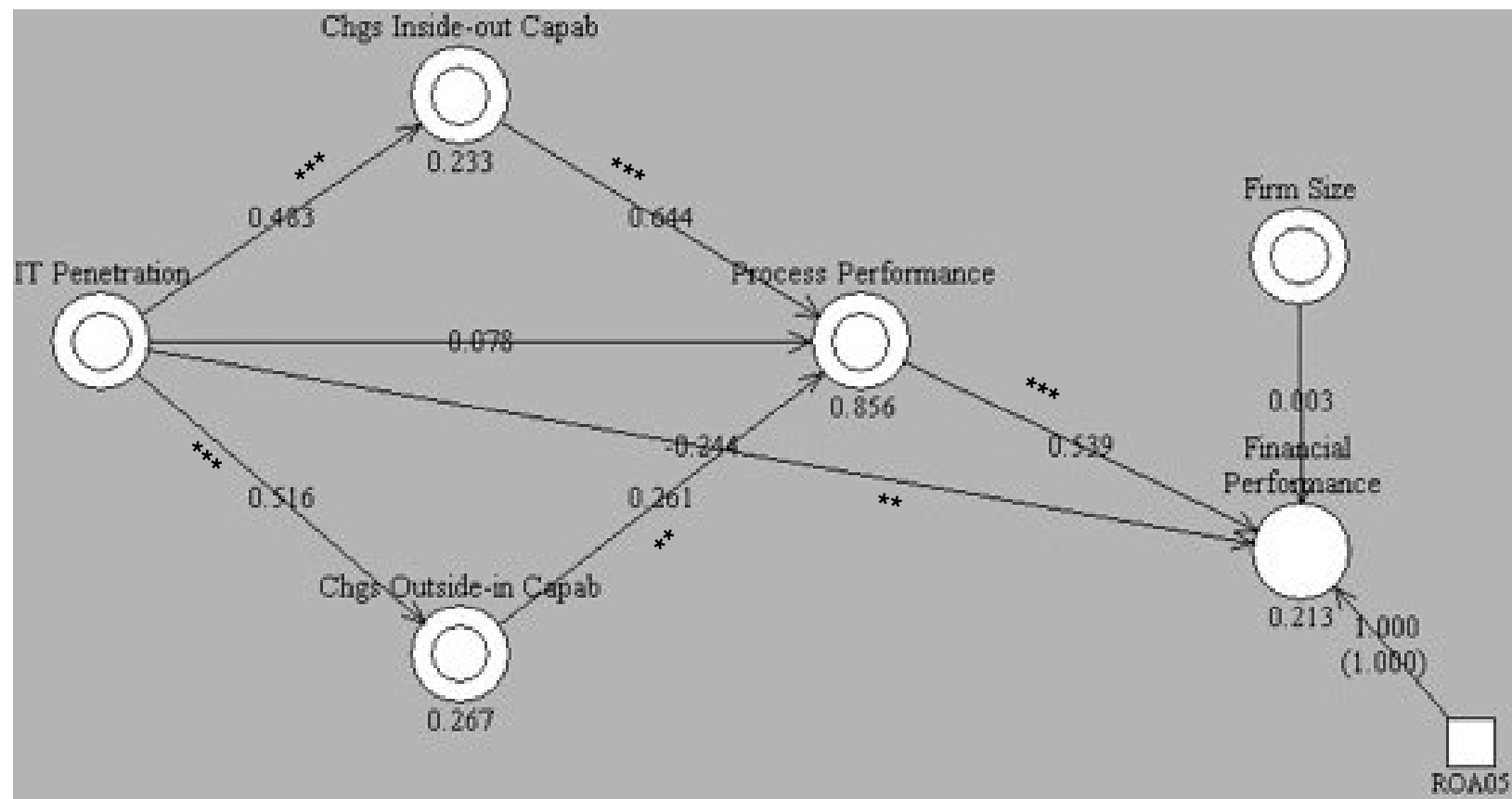
The introduction of two different orders of changes is also consistent with a general approach present in the business police literature that identifies two major streams of research on the determinants of firm performance.

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 behavioral 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 17: 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 18: Model 1, 2 and 3. A Comparison

	Model 1	Model 2	Model 3
	parameter estimate	parameter estimate	parameter estimate
Number of independent variables in the model	2	3	3
R^2	0,004	0,207	0,213
ΔR^2		0,20	0,01
Hierarchical F		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.

6.3. *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 19: 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

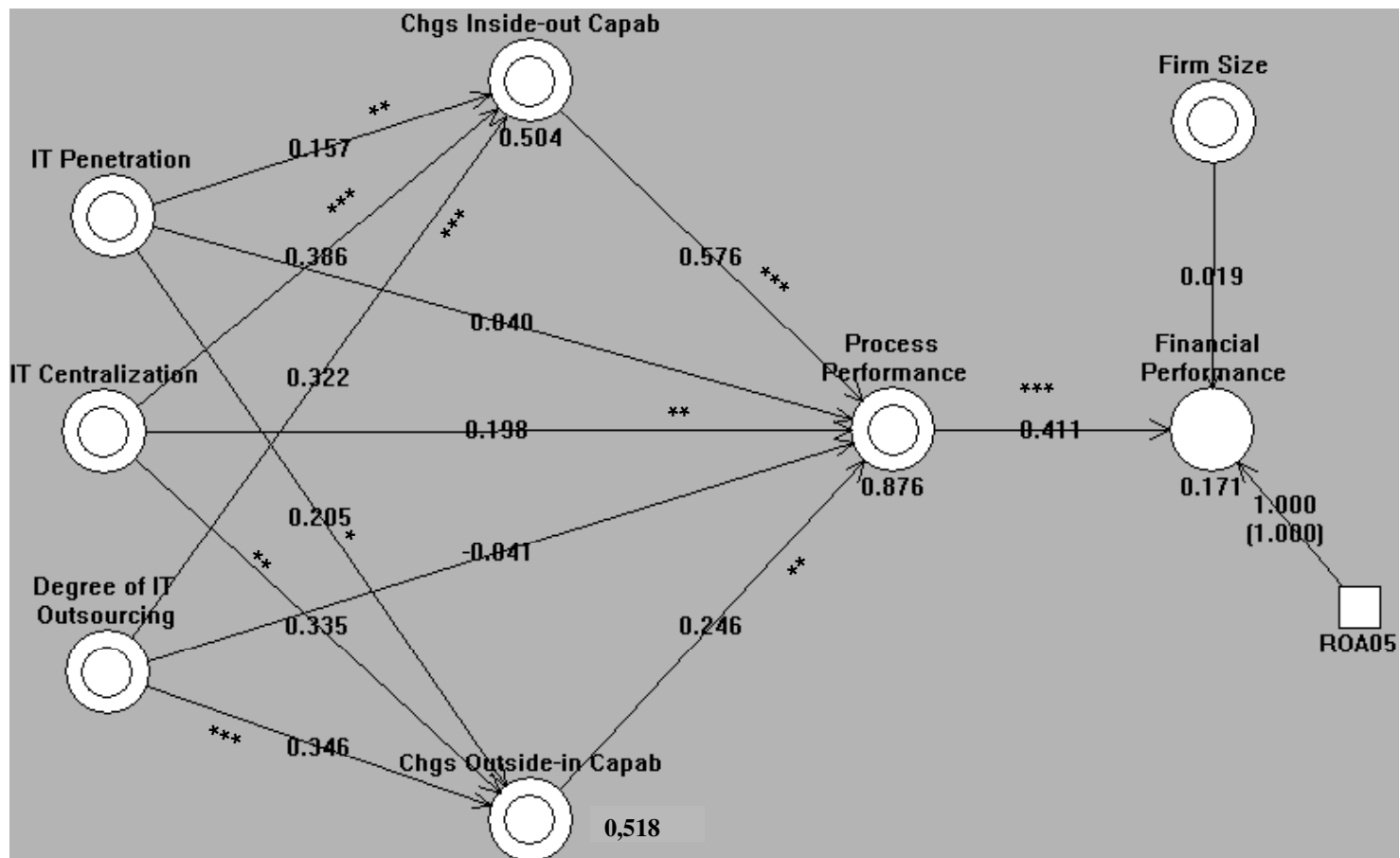
The running of our model definitely confirms the mediation role of Capabilities and Process Performance as mediator variables and the no statistical significance of Firm Size as control variable.

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 20: 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 21: 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
R²	0,004		0,207		0,213		0,171	

* 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 21:

Table 22: Conclusions

CONCLUSIONS		
	HYPOTHESIS	Results
1	IT investments, reflected by the IT Penetration, leads to enhanced Financial Performance	SUPPORTED
2a	IT investments, reflected by the IT Penetration, exert a positive impact on Process Performance	REJECTED
2b	Process Performance exerts a positive impact on Financial Performance	SUPPORTED
3	The positive impact of IT Penetration on Process Performance is mediated by changes in Inside-Out and Outside-in Capabilities	SUPPORTED
4a	IT decisions exert a positive impact on Process Performance	SUPPORTED only for IT Centralization
4b	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 projects⁸.

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

⁸ 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”.

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 literature⁹ 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

⁹ 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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