

# TOWARDS A THEORY OF ERP SYSTEMS FIRM-LEVEL VALUE

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## Abstract

*The development of a theory concerning the value generated by information and communication technologies (ICT) has been for long time a major research topic of high importance to both researchers and practitioners. Basic research objectives have been the assessment and deeper understanding of the multiple dimensions of ICT business value at the firm, sector and national economy level and also its main determinants. Recently there is a growing research interest in the value generated by particular types of information systems (IS), such as the Enterprise Resource Planning (ERP) systems. This paper reviews critically the existing empirical literature on the firm level business value of the ERP systems, which investigates the impact of ERP systems adoption on various measures of organizational performance. Then it critically reviews the literature concerning the related topic of critical success factors (CSFs) of ERP systems implementation, which aims to identify factors that result in more successful ERP systems implementation that generate higher levels of value for organizations. Based on the conclusions of this literature review on one hand, and on the experience gained from the ICT business value research on the other, are identified the necessary directions of the future research required in order to develop a theory of ERP systems firm level business value and gain a complete body of knowledge, which can help organizations maximize the value they get from their ERP systems investments.*

*Keywords: Enterprise Resource Planning (ERP) Systems, Business Value, Critical Success Factors (CSF), Business Performance.*

## 1 INTRODUCTION

Information and communication technologies (ICT) are increasingly adopted and used by organizations for supporting their internal functions and their interactions with their external environment (e.g. customers, suppliers, business partners, public authorities, business partners, etc.). Organizations make big investments for developing various types of information systems (IS) and gradually rely to a considerable extent on them. According to OECD (2003) the investment in ICT in its member countries has risen from less than 15% of the total non-residential investment in the early 1980s, to between 15% and 30% in 2001 and has an increasing trend. Irani et al (2006) in the Introduction to the AMCIS 2007 Mini-Track on Information Systems Evaluation emphasizes that

'...ICT is becoming more pervasive and central to the success of an organization. As ICT becomes more and more embedded within the organization, so the survival and growth of the organization becomes more dependant on the health of its ICT infrastructure'. In the same direction Gunasekaran et al (2006) argues that 'Information technology has spread to the extent that it is hard to envision any organization in an industrialized nation, and even in a developing nation, not using some form of IT/IS'. Therefore, a critical issue that is posed to both researchers and practitioners is to understand and assess the multiple dimensions of the value generated by these ICT investments and also to find ways of increasing and optimizing it. For this reason the development of a theory of ICT value has been for long time a major research topic of high importance to both researchers and practitioners. Basic research objectives have been the assessment and deeper understanding of the multiple dimensions of ICT business value at the firm, sector and national economy level and also their main determinants.

In addition to the above 'generic' firm level ICT business value research, recently there is a growing research interest in investigating the business value generated by particular types of IS, such as e-business systems (Zhu 2004, Zhu & Kraemer 2005, Soto-Acosta & Merono-Cerdan 2008), Enterprise Resource Planning (ERP) systems (Poston and Grabski 2001, Hunton et al 2003, Nicolaou 2004, Hendricks et al. 2006), etc. This trend is well founded on the previous IS literature, which has been emphasizing for long time (e.g. Farbey 1995) that different types of IS have different objectives and impacts, so they differ in the nature and the extent of the business benefits and the value they generate.

In this direction there has been since the late 90s a high interest by both researchers and practitioners in the business value generated by the ERP systems, which have been increasingly adopted in the last decade by organizations for supporting and integrating key business and management processes within and beyond their boundaries. As ERP systems are defined, according to Holland et al (1999), highly integrated enterprise-wide standard software packages that automate core corporate activities and business processes, such as finance, human resources, manufacturing, supply and distribution. Nah et al. (2001) define an ERP system as a packaged business software system that enables a company to manage the efficient and effective use of its resources (e.g. materials, human resources, financial resources, etc.) by supporting a process-oriented view of the business and providing a total and integrated solution for the organization's information-processing needs. Recently the concept of ERP is evolving towards the ERP II (or 'extended enterprise system') concept, reflecting the trend to open up ERP systems beyond the enterprise level to exchange information with supply chain partners (Zrimcek 2003); as ERP II is defined a packaged business software system offering the standard ERP functionality, and also additionally offers supply chain management (SCM) functionality, customer relationship management (CRM) functionality and e-commerce functionality, which support and automate its transactions with customers, suppliers, business partners, etc.

Despite the big potential benefits that ERP systems can offer, they are characterized by high levels of costs and complexity, which are extensively discussed and analyzed by the relevant literature. For instance, Shehab et al (2004) argue that ERP projects are large, costly and difficult, and also that they are risky since 'there is no guarantee of the outcome'; they further elaborate this dimension of ERP systems concluding that various types of 'ERP systems misfits' (i.e. gaps between the functionality offered by an ERP and that required by the adopting organization), such as data, process and output misfit, can reduce significantly the benefits offered by an ERP system. In the same direction Beheshti (2006) concludes that the decision to purchase and implement an ERP and the high investment required for this purpose are among the most important decisions management has to make.

For the above reasons, and taking into account the big potential benefits that ERP systems can offer and also their high costs, complexities and risks, it is of critical importance from both researchers' and practitioners' viewpoint that a theory of ERP systems value is developed, which enables us to understand deeper the multiple dimensions of ERP business value and their main internal and external determinants, and to propose ways of increasing and optimizing this value.

In this direction the present paper attempts to examine what has been done so far towards the development of a theory of firm level ERP systems value, to evaluate it taking into account the experience gained from the firm level ICT business value research and finally to identify the necessary directions of the future research required in order to develop such a theory. The paper consists of six sections. This introductory section is followed by a brief review of the firm level ICT business value research in section 2. Then in section 3 there is a critical review of the empirical literature concerning the business value of the ERP systems, which investigates the impact of ERP systems adoption on various measures of organizational performance. The following section 4 briefly reviews the existing literature on the related topic of the critical success factors (CSFs) of ERP systems implementation, which aims at identifying factors that result in more successful ERP systems implementations that generate higher levels of value for organizations. Then in section 5 the conclusions of the above literature reviews are evaluated, in the light of the experience gained from the previous firm level ICT business value research, and future directions of research are proposed towards a theory of ERP systems firm level value. Finally in section 6 the conclusions of this paper are summarized.

## **2 ICT BUSINESS VALUE RESEARCH**

As mentioned in the introduction extensive research has been conducted towards the development of ICT business value, aiming mainly at the assessment and deeper understanding of the multiple dimensions of ICT business value at the firm, sector and national economy level and also their main determinants. Most of the above research has focused on the firm level, since it is at this level that most of the ICT investment decisions are made. This firm level ICT business value research can be broadly divided into four periods:

I. In the first period (from the mid 1980s until the mid 1990s) the main objective has been to find empirical evidence of a positive association between ICT investment and business performance. However, in this period very little empirical evidence were found in this direction (e.g. Roach 1987, Brynjolfsson 1993, Strassman 1997), so critical questions were posed concerning the productivity of the big investments organizations made in ICT: do they really contribute to the productivity of firms according to their high expectations, or these expectations were just a result of ICT companies' marketing hype? This problematic is usually referred to as the 'ICT Productivity Paradox' (Brynjolfsson 1993) and is very well reflected in R. Solow's statement that 'you can see the computer age everywhere but in the productivity statistics' (Solow 1987).

II. In the second period (from the mid 1990s until mainly the mid 2000s) some studies provide empirical evidence of positive impact of ICT investment on some business performance measures (e.g. Brynjolfsson and Hitt 1996, Stolarick 1999, OECD 2004, Arvanitis 2005a), reflecting the growing expertise and maturity of ICT vendors, consultants and adopting organizations in the deployment of ICT and adapting existing processes and structures; however, some other studies still result in mixed or inconclusive results (e.g. Stiroh 1998, Hartman 2002). These mixed results lead gradually to the conclusion that some additional independent variables, associated with the internal and the external context of the adopting organization, have to be taken into account as well. During this period considerable research has also been conducted for understanding better the main dimensions of ICT business value and for identifying the main organizational variables affected by ICT at the operational, tactical and strategic level (e.g. labour costs, throughput, workforce composition, plant efficiency, delivery lead-time, flexibility, market share, etc.) laying the foundations for the development of firm level ICT investment evaluation frameworks (e.g. Irani 2002, Irani & Love 2002, Arvanitis 2005b, Gunasekaran et al 2006).

III. In the third period (from 2000 until today), since considerable evidence of positive contribution of ICT investment to various measures of business performance had already been provided by the relevant empirical literature, the research focuses mainly on the identification and deeper

understanding of the ‘ICT complements’. Through this term are denoted factors related to the internal functions of the organization, which in combination with ICT can increase the business value it generates, such as business process redesign, new human skills development, products and services innovations, ‘soft ICT investment’, etc. (e.g. Devaraj & Kohli 2000, Arvanitis 2005a, Hempell 2005, Loukis et al 2008b). The main idea of this period is very well reflected and summarized by the statement of Brynjolfsson and Hitt (2000) that ‘..both case studies and econometric work point to organisational complements, such as new business processes, new skills and new organisational and industry structures as a major driver of the contribution of information technology’.

IV. In the fourth period (from the mid 2000s until today) research starts dealing with the effect of ‘external’ factors, which are related to the external environment of the organization, such as generalized competition, industry concentration, industry dynamism, strategy, etc., on ICT business value (Loukis et al 2006, Melville et al 2007, Loukis et al 2008a). However, limited is the research that has been conducted in this direction so far, as stated by Melville, Kraemer and Gurbaxani (2004), who from an extensive review of the literature on ICT value conclude that ‘We know very little about how industry characteristics moderate the degree of IT business value’ and suggest that more empirical research should be conducted in this direction.

The authors believe that the next period of the firm level ICT business value research will focus on the development of more complex models of ICT value generation, which will include both ‘internal’ and ‘external’ factors, the interplay between them and also their combined effect on ICT business value, providing a deeper understanding of the mechanisms of ICT business value generation.

### 3 IMPACT OF ERP ON ORGANIZATIONAL PERFORMANCE

In Table 1 we can see the main empirical studies that have been conducted concerning the business value of the ERP systems and their basic conclusions; these studies have examined the impact of ERP adoption on various financial and non-financial measures of organizational performance.

Authors	Conclusion
Poston & Grabski (2001)	<ul style="list-style-type: none"> <li>• number of employees/revenues and cost of goods sold/revenues decreased</li> <li>• selling, general and administrative expenses/revenues and residual income show no significant improvement</li> </ul>
Hitt et al (2002)	<ul style="list-style-type: none"> <li>• firms that invest in ERP tend to show higher business performance in several financial performance indices</li> <li>• a reduction in business performance and productivity appears shortly after the ERP implementation was completed</li> </ul>
Hunton et al (2003)	<ul style="list-style-type: none"> <li>• ROA, ROI and ATO significantly better for the ERP adopters in comparison with similar non-adopters</li> <li>• financial performance of ERP adopters is steady, while at the same time non-adopters’ financial performance decreases</li> </ul>
Akkermans et al (2003)	<ul style="list-style-type: none"> <li>• ERP systems will play only a modest role in improving future supply chain effectiveness</li> <li>• there is a positive contribution of ERP to only to only 4 of the top 12 future supply chain issues: customization of products and services; standardized processes and information; need for worldwide ICT systems; transparency of the marketplace</li> </ul>
Nicolaou (2004)	<ul style="list-style-type: none"> <li>• possible risk of ERP actually limiting progress in SCM</li> <li>• firms adopting ERP systems exhibit higher differential performance only after two years of continued ERP use</li> </ul>

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Nicolaou & Bhattacharya (2006)	<ul style="list-style-type: none"> <li>• in the year of completion and in the following one there is a negative differential impact on performance</li> <li>• early enhancements (in the form of either add-ons or upgrades) lead to higher differential financial performance</li> <li>• late enhancements and both early and late abandonments lead to differential performance deterioration</li> </ul>
Hendricks et al (2006)	<ul style="list-style-type: none"> <li>• ERP adopters: improvement in profitability but not in stock returns</li> <li>• SCM adopters: improvement in profitability and positive stock returns</li> <li>• CRM adopters: no improvements in profitability or in stock returns</li> </ul>
Wieder et al (2006)	<ul style="list-style-type: none"> <li>• no significant performance differences were found between ERP adopters and non-adopters, either at the business process level, or at the overall firm level</li> <li>• only those ERP system adopters that also adopted SCM systems achieved significantly higher performance.</li> </ul>
Wier et al (2007)	<ul style="list-style-type: none"> <li>• the combined use of ERP and NFPI leads to significantly higher short-term and long-term ROA and SR than the use of each of them alone (in ERP-only or NFPI-only firms)</li> </ul>

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*Table 1. Empirical investigations of the impact of ERP adoption on various financial and non-financial measures of organizational performance.*

In the first of these studies Poston & Grabski (2001) examined the effect of ERP systems on firm financial performance over a 3-year period by comparing basic financial performance indices of 50 ERP adopters before ERP implementation and for a period of three years after it. The results show a statistically significant decrease only in the ratio of cost of goods sold (COGS) to revenues three years after the ERP system implementation (but not in the first or second year after implementation). On the other hand they found no significant improvement in the ratio of selling, general and administrative expenses (SG&A) to revenues and also in the residual income. Also there has been a significant reduction in the ratio of employees to revenues for each of the three years after the ERP implement. Finally the authors note that the results reveal a contradiction: while ERP systems appear to yield efficiency gains in some areas, e.g. in reducing cost-to-revenue, they leave residual income unaffected; also they propose some possible explanations of this contradiction (e.g. high costs for fine-tuning and running the ERP, organizational culture, human issues, passing some of the gains to customers as an increased customers surplus due to competition, etc.) and suggest that ‘future research is needed to clarify and examine the multitude of factors affecting the ERP and firm performance relationship’.

Hitt et al (2002) using multiyear multi-firm ERP implementation and financial data concluded that firms investing in ERP tend to show higher values in several financial performance indices, though there is a slowdown in business performance and productivity shortly after the implementation. Concerning stock value they found that financial markets reward the ERP adopters with higher market valuation, as measured by Tobin’s q, both during and after the ERP implementation. These results suggest that ERP systems yield substantial benefits to the firms adopting them, and that the adoption risks do not exceed the expected value, although there is some evidence suggesting that firms do perceive ERP projects to be risky. Another interesting conclusion is that higher level of ERP implementation (i.e. implementation of more ERP modules) is associated with higher business performance, but only up to an optimal level, while exceeding this level results in declining benefits; this provides some evidence that there is an optimal level of integration and that the broadest ERP implementation can face diseconomies of scale.

Hunton et al (2003) examined the longitudinal impact of ERP adoption on financial firm performance by matching and comparing 62 firms that have adopted ERP systems with ‘similar’ firms that had not adopted ERP systems. Results indicated in three of the examined financial performance indices, return on assets (ROA), return on investment (ROI), and asset turnover (ATO), adopters were significantly better over a 3-year period as compared to the non-adopters, while for the fourth one, the return on sales (ROS), there was no statistically significant difference. Also, they found that the above three significant differences arise because the financial performance decreased over time for the non –

adopters, while it remained steady for the adopters. Another interesting finding of this study was a significant interaction between firm size and financial health for ERP adopters with respect to ROA, ROI, and ROS: a positive (negative) relationship was found between financial health and performance for small (large) firms.

Akkermans et al. (2003) presented results from a Delphi study on the future impact of ERP systems on supply chain management (SCM), which was conducted with 23 Dutch supply chain executives of European multi-nationals. Initially these executives identified the following five key SCM issues for the coming years: 1) higher integration of activities between suppliers and customers across the entire supply chain, 2) changes in supply chain needs and required flexibility from IT, 3) more mass customization of products and services leading to increasing assortments while decreasing cycle times and inventories, 4) the locus of the driver's seat of the entire supply chain and 5) bigger supply chains consisting of several independent enterprises. A second finding was that with regard to ERP systems the panel experts saw only a modest role for ERP in improving future supply chain effectiveness and a clear risk of ERP actually limiting progress in SCM. ERP was seen as offering a positive contribution to only 4 of the top 12 future supply chain issues: more customization of products and services; more standardized processes and information; the need for worldwide ICT systems; and greater transparency of the marketplace. A third interesting finding was that there are four characteristics of current ERP systems that limit the inter-organizational SCM support they can provide: a) their insufficient extended enterprise functionality in crossing organizational boundaries, b) their inflexibility to ever-changing supply chain needs, c) their lack of functionality beyond managing transactions, and (d) their closed and non-modular system architecture. These limitations are due to the fact that the first generation of ERP systems had been designed to integrate the various operations within an individual firm but not between firms.

Investigating the effect of the adoption of ERP systems on a firm's long-term financial performance Nicolaou (2004) compares financial data of 247 firms adopting ERP systems with a matched control group of 'similar' (concerning industry and size) non-adopting firms before and after the adoption. The results show that firms adopting enterprise systems exhibit higher differential financial performance (i.e. in comparison with 'similar' non-adopter firms) only after two years of continued ERP use, while in the year of completion and the following one there is a decline of the differential financial performance. Another interesting finding of this study is that some ERP implementation characteristics affect its positive impact: implementing a system from a larger vendor, having system-led objectives, and implementing some particular types of modules increase the positive impact of ERP systems on financial performance in comparison to firms following different implementation strategies.

Nicolaou & Bhattacharya (2006) two years later examined the effects of various types of ERP system post-implementation changes (e.g. enhancements, upgrades, abandonments, switches) in firms that have adopted ERP systems on the impact of ERP on long-term financial performance. Two research hypotheses were developed in this study, which posit that both the nature and the timing of system changes affect the extent of ERP post – implementation success. The empirical testing of these hypotheses, based on a subset of the sample of the above study of Nicolaou (2004) that had made such changes, provided support to both these hypotheses: ERP-adopting firms, which initiate early enhancements in the form of either add-ons or upgrades, exhibit higher differential financial performance in comparison to other ERP-adopting firms' differential performance. These changes seem valuable, because they resolve implementation problems based on the experience gained during the first period of usage, and affect positively the subsequent level of ERP success. This finding shows the importance of post-implementation ERP management and leads to the conclusion that a significant part of value adding occurs in ongoing activities that closely follow the period of the 'basic' ERP implementation. On the contrary it was found that late enhancements and both early and late abandonments lead to differential performance deterioration in comparison to other ERP-adopting firms.

The effect of firms' investments in three types of Enterprise Systems (ES), Enterprise Resource Planning (ERP) systems, Supply Chain Management (SCM) systems, and Customer Relationship Management (CRM) systems, on long-term stock price performance and various profitability measures, such as return on assets and return on sales, has been empirically examined by Hendricks et al. (2006). The conclusions are summarized by the authors in the final section of the paper stating that 'Our analysis of the financial benefits of ES implementations yields mixed results'. Their results provide evidence that the adoption ERP systems leads to significant improvements in the profitability, which are stronger in the case of early adopters of ERP systems, but not in increases of the stock returns. Also, the adopters of SCM systems experience positive abnormal stock returns as well as improvements in profitability. On the contrary, there was no evidence of improvements in stock returns or profitability for firms that have invested in CRM systems. Another interesting finding of this study is that, despite the high implementation costs, it does not find evidence of negative performance associated with ES investments, which helps alleviate the concerns expressed about the viability of ES given the highly publicized implementation problems at some firms.

The empirical study of Wieder et al. (2006) provides further insights into the effects of ERP systems adoption on firm level and business process level performance. It was based on data on several aspects of organizational performance collected through a survey from companies that adopted ERP systems and/or SCM systems and respective control groups on non-adopters. Its theoretical foundation was the generic framework suggested by Dehning and Richardson (2002). The overall firm performance has been measured through a set of basic financial key performance indicators; the measurement of performance at the business process level was based on the 'supply-chain operations reference model' (SCOR-model) published by the Supply Chain Council ([www.supply-chain.org](http://www.supply-chain.org)). As independent variables were used ERP systems adoption, ERP systems history and ERP system extension with a SCM system. The results contradict the claims of ERP systems vendors, since no significant performance differences were found between ERP adopters and non-adopters, either at the business process level, or at the overall firm level. It was also found that the longer the experience of firms with ERP systems, the higher their overall performance, though no evidence was found of a similar effect on business process (supply chain) performance. Only those ERP systems adopters that extended ERP with SCM systems achieved significantly higher performance only at the business process level, but not at the firm level.

Wier et al (2007) investigated empirically the existence of complementarity between ERP systems adoption and non-financial performance indicators (NFPI) in executive compensation contracts in regard to business performance. In particular, they examined whether the joint adoption of an ERP system and the inclusion of non-financial performance indicators (NFPI) in executive compensation contracts significantly enhances business performance, which is measured by the return on assets (ROA) and the return on stocks (ROS), as compared to either of them alone. For this purpose they used a sample consisting of three types of firms: ERP-only, NFPI-only and ERP-NFPI ones. The results support the above complementarity hypothesis: they indicate that the combined use of ERP and NFPI leads to significantly higher short-term and long-term ROA and ROS compared with the use of each of them alone (in the ERP-only or the NFPI-only firms). From these results it can be concluded that ERP and NFPI are complementary organizational strategies, so the impact of ERP on business performance can be increased if it is combined with NFPI.

The conclusions drawn from these studies concerning the impact of ERP systems on organizational performance are mixed: some of these studies provide evidence of positive impact of ERP systems on some measures of organizational performance; however, some other studies did not find a statistically significant effect of ERP systems on the same or other measures of organizational performance.

#### 4 CFS IN ERP SYSTEMS IMPLEMENTATION

Considerable research has been conducted for identifying the critical success factors (CFS) of ERP systems implementation motivated by the big difficulties, problems and risks experienced by firms implementing ERP systems. This research is related to the above research stream on the business value generated by the ERP systems outlined in the previous section 3, since it identifies and investigates factors and actions, which can increase the business value that ERP systems generate. Detailed reviews of the articles that have been published concerning ERP implementation CFSs are provided by Shehab et al (2004), Botta-Genoulaz et al (2005) and Moon (2007). In the following paragraphs of this section we review the most important of them.

Cantu (1999) created an ERP implementation framework including five CSF, which are further analyzed into attributes, resulting in the identification of a total of 22 attributes that result in more successful ERP implementations. In particular the proposed CFS and their attributes (in parantheses) are:

- Management and Organization (Commitment, Education, Involvement, Project Team Selection, Training, Roles and Responsibility),
- Process (Alignment, Documentation, Integration, Process Redesign), Technology (Hardware, Software, Systems Management, Interface),
- Data (Master Files, Transaction Files, Data Structure, Maintenance and Integrity),
- People (Education, Training, Skills development, Knowledge management).

Nah (2001), by synthesizing the findings of a number of articles on the key critical factors for ERP implementation success, developed a unified framework, which includes the following eleven basic CSF: ERP teamwork and composition, Change management program and culture, Top management support, Business plan and vision, Effective communications, Project management, Software development, testing and trouble shooting, Monitoring and evaluation of performance, Project champion and Appropriate business and IT legacy systems.

Brown and Vessey (2003), based on in-depth case studies of ERP implementations, identified five basic CFS:

- Top management is engaged, not just involved
- Project leaders are veterans and team members are decision makers
- Third parties fill gaps in expertise and transfer their knowledge
- Change management goes hand-in-hand with project management
- A satisficing mindset, in which 80 percent solutions are accepted as 'good enough', prevails.

Furthermore, they concluded that a project's position on the maturity curve (early adopter, early majority, or late majority) can significantly influence the implementation route.

According to Umble & Umble (2003) the most prominent CFS for ERP implementation are: clear understanding of strategic goals, commitment by top management, good project management, organizational change management, good implementation team, data accuracy, extensive education and training, focused performance measures and appropriate management of multi – site issues.

Bradley (2005) examined the most important CSF proposed in the IT and ERP literature in a multiple case study of eight ERP implementation projects and identified three basic factors related to successful project but not to unsuccessful projects:

- Choosing the right project manager
- Quantity and quality of training
- Project champions

Esteves and Pastor (2000 and 2006) based on lists of CFS of ERP implementations produced by previous relevant studies and created a unified model of CSF. This model included the following CFS grouped according to their organizational or technological nature and their strategic or tactical orientation into four categories:

I. Strategic – Organizational factors: Sustained management support, Effective organizational change management, Good project scope management, Adequate project team composition, Comprehensive business process reengineering, Adequate project champion role, User involvement and participation, Trust between partners.

II. Tactical - Organizational factors: Dedicated staff and consultants, Strong communication inwards and outwards, Formalized project plan/schedule, Adequate training program, Preventive trouble shooting, Appropriate usage of consultants, Empowered decision-makers.

III. Strategic - Technological factors: Adequate ERP implementation strategy, Avoid customization, Adequate ERP version.

IV. Tactical – Technological: Adequate infrastructure and interfaces, Legacy systems knowledge, Formalized testing plan, Adequate data migration process.

These two studies also concluded that while both the organizational and the technological perspectives are essential for a successful ERP implementation project, their importance shifts as the project moves through its lifecycle: in the early and the final phases the organizational CSF are more important, while in the intermediate phases the technological CSF prevail; for this reason ERP project management is highly complex as it involves a dynamic ‘multi-success-factor management’ and the most relevant CSF may change significantly along the project.

In conclusion, this category of studies of the CSF of ERP implementation have identified a useful set of factors and corresponding actions, which can increase the business value that ERP systems generate for the adopting organizations, and in this sense can be useful elements of a theory of ERP systems value.

## **5 RESEARCH DIRECTIONS TOWARDS A THEORY OF ERP SYSTEM VALUE**

As mentioned in section 3, the empirical studies that have been conducted concerning the impact of ERP systems on business performance have resulted in mixed conclusions: some of these studies provided evidence of positive impact of ERP systems on some measures of business performance, however, but some other studies did not find a statistically significant effect of ERP systems on the same or other measures of business performance. The existing situation in the ERP systems value research has similarities to the situation in the beginning of the second period of the ICT business value research, which has been outlined in section 2 of this paper.

For explaining these mixed results the knowledge gained from these four periods of the ICT business value research can be useful. Based on this knowledge, possible explanations of these mixed results are:

I) The ERP stakeholders (ERP vendors, consultants and adopting organizations) have not yet reached a high level of expertise and maturity in implementing ERP systems, adapting them to the processes and needs of a particular organization and redesigning accordingly its business processes; there are still big differences in this expertise and maturity between different ERP vendors, consultants, adopting organizations, regions and industries.

II) In the models, which have been constructed in the studies that have been conducted for investigating the association between various business performance measures (used as dependent variables) and ERP adoption (used as independent variable), which have been reviewed in section 3, some important independent variables have not been taken into account; these variables correspond to significant ‘success factors’, which are associated with the internal context, the implementation strategy and the external context of the adopting organization, that affect ERP implementation success and benefits; some of these factors have been identified by the research that has been conducted concerning the CFS of ERP implementation, which has been briefly reviewed in section 4.

However, it should be noted that the existing situation of the ERP systems value research has also some elements similar to the ones found in the third period of the ICT business value research: the above CFS of ERP implementation are – to some extent - analogous to the ‘ICT complements’ (factors related to the internal functions of the organization, which in combination with ICT can increase the business value it generates, such as business process redesign, new human skills development, products and services innovations, ‘soft ICT investment’, etc.) identified and investigated in the third period of the ICT business value research. However, the difference is that these CFS of ERP implementation have not been sufficiently associated by the relevant empirical literature with the impact of ERP on organizational performance. On the contrary the above ICT complements have been very well associated with ICT business value by the relevant empirical literature, which has investigated whether and to what extent the presence of these ICT complements affects ICT business value (e.g. Devaraj & Kohli 2000, Arvanitis 2005a, Hempell 2005, Loukis et al 2008b).

Therefore, taking into account the knowledge gained mainly from the third and the fourth period of the ICT business value research, it can be concluded that a convergence of the research stream dealing with the impact of ERP on organizational performance (section 3) and the research stream dealing with the CSFs of ERP implementation (section 4) is necessary as a basic step towards a theory of ERP systems firm level value. For progressing in this direction further empirical research is required concerning the impact of ERP systems on various performance measures, both at the business process level and the firm level, in various national and sectoral contexts, incorporating also, as additional independent variables, factors associated with the internal context (e.g. with the internal ICT-related capabilities and the ERP implementation strategy) and the external context (e.g. the competition, the industry concentration, the industry dynamism, etc.) of the adopting organization, in order to assess and understand their effect on the business value generated by ERP systems. In particular, further empirical research is required according to the model shown in Figure 1; it consists of four layers of variables (or constructs) measuring characteristics of the external context, the internal context (including the ERP implementation strategy), the business process level benefits from ERP and the firm level benefits from ERP respectively. As we can see from this Figure 1, two types of effects should be tested and investigated: i) direct and indirect effects of external context variables on business process level and firm level ERP benefits, and ii) direct and indirect effects of external context variables on business process level and firm level ERP benefits.

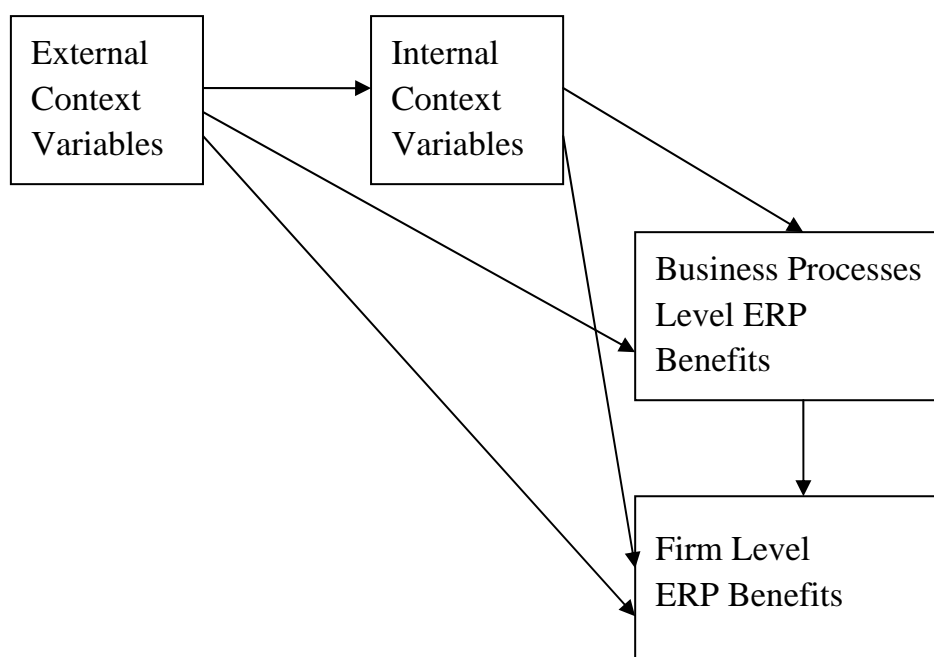


Figure 1. Model of proposed future research towards a theory of ERP systems firm level value.

## 5 SUMMARY AND CONCLUSIONS

Organizations have made big investments in the ERP systems expecting various types of benefits from them; some of these investments have resulted in success stories, but some others in failures, as reported by the relevant literature. Taking into account the big potential benefits that ERP systems can offer and also their high costs, complexities and risks, it is of critical importance from both researchers' and practitioners' viewpoint that a theory of ERP systems value is developed. In this direction this paper initially reviews critically the existing empirical literature on the firm level business value of the ERP systems, which investigates the impact of ERP systems adoption on various measures of organizational performance. It also reviews critically reviews the literature concerning the related topic of critical success factors (CSFs) of ERP systems implementation, which aims to identify factors that result in more successful ERP systems implementation that generate higher levels of value for organizations. Based on the conclusions of the literature review of these two research streams on one hand, and the experience and knowledge gained from the ICT business value research on the other, have been identified the necessary directions of the future research required in order to develop a theory of ERP systems firm level business value. In particular, it has been concluded that for progressing in this direction further empirical research is required concerning the impact of ERP systems on various performance measures, both at the business process level and the firm level, in various national and sectoral contexts, incorporating also factors associated with the internal context (e.g. with the internal ICT-related capabilities and the ERP implementation strategy) and the external context (e.g. the competition, the industry concentration, the industry dynamism, etc.) of the adopting organization, in order to assess and understand their effect on the business value generated by ERP systems.

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