Universidad de Granada

Facultad de Ciencias Económicas y Empresariales
Departamento de Organización de Empresas
Programa Oficial de Doctorado en Ciencias Económicas y Empresariales

TESIS DOCTORAL

TITULO:

IMPLEMENTACIÓN DE TECNOLOGÍAS DE LA INFORMACIÓN Y COMUNICACIÓN (TIC) AVANZADAS E IMPLICACIONES EN LA GESTIÓN ESTRATÉGICA DE LA CADENA DE SUMINISTRO

MENCIÓN DE DOCTORADO INTERNACIONAL

Tesis doctoral presentada por:

Marco Guillermo Opazo Basáez

Dirigida por:

Prof. Dr. Daniel Arias Aranda
Prof. Dr. Oscar Bustinza Sánchez

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No te rindas, aún estás a tiempo
De alcanzar y comenzar de nuevo,
Aceptar tus sombras,
Enterrar tus miedos,
Liberar el lastre,
Retomar el vuelo.

No te rindas que la vida es eso,
Continuar el viaje,
Perseguir tus sueños,
Destrabar el tiempo,
Correr los escombros,
Y destapar el cielo.

No te rindas, por favor no cedas,
Aunque el frío queme,
Aunque el miedo muerda,
Aunque el sol se esconda,
Y se calle el viento,
Aún hay fuego en tu alma
Aún hay vida en tus sueños.

Vivir la vida y aceptar el reto,
Recuperar la risa, ensayar el canto,
Bajar la guardia y extender las manos,
Desplegar las alas e intentar de nuevo,
Celebrar la vida y retomar los cielos.

(Benedetti, 2011)

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General Introduction

A Erna y Marcos

If you're going to try, go all the way. Otherwise, don't even start

(Bukowski, 2009)

1.1. Introduction to the Research Topic

1.1.1. Introduction

Today's market volatility pushes organizations to evaluate continuously their organizational and competitive strategies in order to maintain their position in the marketplace in a successful and sustainable way. Such conditions have prompted organizations across industries to adopt Information and Communication Technologies (ICT) for effective Supply Chain Management (SCM) and strategy implementation (Gatignon and Xuereb, 1997; Vendrell-Herrero et al., 2016). According to Salomon and Cohen (1999) ICT can be defined as group of technologies used to process, store and disseminate information, facilitating the performance of information-related human activities, provided by, and serving both the public at-large as well as the institutional and business sectors. These technologies are considered as critical enablers of organizational competencies and firm performance, becoming the cornerstone of firm operations across industries (Kumar, 2010). Such capabilities have revolutionized organizational computing over the past decade, qualifying ICT as the most important development in the corporate use of IT (Davenport, 1998).

Several authors assert that ICT are associated with improvements in firm performance, principally by redesigning business processes, integrating managerial functions, accelerating reporting cycles, and expanding information capabilities (Mabert et al., 2003). Through the years it has been claimed That ICT offer a wide range of benefits for SCM such as; synchronization of procedures, applications, and metrics that span intra- and inter-firm boundaries; providing accurate, timely, and integrated information oriented to improve organizational decision making (Su and Yang, 2010). Some authors like Ward and Zhou (2006) claim that ICT positively affect SCM and improve supply chain performance, particularly strengthening buyer-supplier relationships through more efficient processes and reduced lead time.

Much of these findings reflect the inherent capacity of ICT to impact organizational structure and firm strategy, whereas promote and disclose the importance of an integrative approach.

The general idea behind this, according to Sheu et al. (2006) is that better IT capacities and better communication contribute to an enhanced platform for both parties to engage in supply chain coordination, participation, and problem-solving activities. This perspective has been positively accepted; on this matter, Bowersox et al. (1999) and Frohlich and Westbrook (2001) claimed that wider scope of integration with supply chain partners has a positive association with supply chain performance improvement. Finally, According to, Drucker (1998) and Lambert and Cooper (2000) the success of firms will depend firmly on its IT and managerial abilities to integrate and coordinate the intricate network of business relationships among supply chain members.

In light of the aforementioned, this PhD thesis focuses on the role played by ICT within the supply chain scope, as a tool for enhancing supply chain management and developing innovative strategies based on Information integration; considering the necessary requirements that play a key role for such purposes. To that aim, the current research provides a vast and detailed theoretical framework which introduces the main concepts concerned with describing supply chain management, Enterprise Resource Planning (ERP) systems and technology-supported strategic initiatives with a wide and complete literature review on these concepts. Further, it provides well-defined research methodologies to clarify the role of Information technologies on diverse Firm strategies.

1.1.2. Importance of the Research Topic

Along the decades, there has been a growing consensus over the strategic importance and the contribution of ICT towards strategic objectives in SCM (Porter, 1990; Gatignon and Xuereb, 1997; Mentzer et al., 2001; Sandoe et al., 2001; Flynn et al., 2010). According to Kathuria et al. (1999). IT capacities have shown to provide a clear

competitive advantage and can be a differentiating factor in terms of company performance. As well, Dutta and Manzoni (1999) argue that ICT adoption increases organizational capability development and strategic impact.

According to Porter and Millar (2001) ICT offers organizations the opportunity either to enhance differentiation or to lower costs. From one side, ICT may allow firms to achieve a differentiation advantage by securing relationships with customers through improved product/service quality and by enhancing its ability to quickly respond to market changes. From the other side, ICT can enable cost advantages by playing a direct or indirect role in the cost of various activities in the value chain. In addition, ICT benefits are widely related with high organizational performance, as well as the alignment with strategic objectives (Kearns and Lederer, 2003; Sanders, 2007).

According to Zailani and Rajagopal (2005) in today's dynamic era of e-business, competitive advantage and sustainability is obtained by those organizations that have carefully linked their internal processes to external suppliers and customers in unique supply chains. Thus, the main objective is to develop and coordinate manufacturing processes seamlessly across the supply chain in a manner that most competitors cannot very easily match (Anderson and Katz, 1998; Lummus et al., 1998).

Consequently, the importance of this PhD thesis comes from the fact that it focuses on highly relevant subjects for organizations and academia. Particularly, due to the control of the SCM and the role of ICT have acquired a remarkably importance in the last years, spanning multiple industries and business sectors. Thereby, we attempt to contribute to the development of highly transcendent fields of study, two topics that constitute the most fundamental elements for organizations strategy and positioning maintenance in the 21st century marketplace. Thus, this research provides innovative and relevant insights for organizations seeking to effectively engage information technologies, supply chain competencies and firm performance.

1.1.3. Scope of the Research

The present PhD thesis examines the role of ICT in supply chain and firm strategy. To this aim, we explore ICT capabilities considered crucial for the successful sharing, integration and dissemination of strategic information across the firm and among partners, as a source for value generation in supply chain initiatives. Moreover, we constitute ICT effects and resulting benefits as essentials in defining and developing competitive and innovative firm strategies.

This PhD Thesis is oriented at organizations which have implemented ICT to support their SCM , this include any type and size of companies belonging to the private or public sectors, which have adopted ICT to coordinate, organize, and monitor operations, processes, resources, and activities.

Once delimited the scope of the study, we reveal the questions that we attempt to clarify through it.

1. What are the key supply chain elements behind achieving supply chain integration? What is the role of information technologies in this process?
2. What is the role of Bolt-on extensions and ERP systems enabling customer orientation and Servitization strategies? Why is customization an important aspect for better ICT capacities?
3. What are the effects of ERP systems on firm's competitive priorities? To what extent are ERP systems relevant for enabling better firms' performance?
4. What are the features of innovative ICT technologies, comprised in the Internet-of-things paradigm for smart service generation? What is the role of information in smart service generation?

1.1.4. Objectives of the Research

The overall and main objective of this PhD thesis is to examine the impact of ICT in SCM and firm strategy, exploring ICT potential and resulting benefits for supply chain initiatives and innovative ICT-enabled firm strategies.

The individual objective of each chapter is described below:

In the second chapter, the objective is to settle a comprehensive and vast review of literature on; (a) Supply Chain Management (SCM), providing insights definitions and/or explanations of key processes and highlighting the importance of partner's integration for competitive purposes, (b) Information and Communication Technologies (ICT), distinguishing the role of ERP systems and innovative ICT advances to support new business strategies, and (c) Innovative firm strategies, enabled by the capacity of ICT to re-formulate the traditional supply chain, delimitate the competitive firm strategy, and generate new and highly disruptive services.

In the third chapter, the main objective is to present the research methodologies and the results obtained from three individual research studies included in this thesis; the first of this studies is denominated *"The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain"*, and focuses on the role of ICT to reformulate the traditional scope of supply chain towards customer orientation. The second study presented in this chapter is called *"The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance"*, and refers to the effect of ICT over the strategic choice adopted by firms and their consequences on firm performance. Finally, the third study is called *"A Roadmap towards Smart Services in Healthcare"*, and focuses on the role of new ICT advancements to provide innovative custom-oriented services in healthcare sector. These three studies are focused on the strategic role of ICT to enhance firm performance and customer value, through better SCM strategies.

In the fourth and fifth chapter, the objective is to analyze the conclusions and implications derived from the results of the studies described in chapter three, as well; this chapter provides the limitations of the studies and future research lines.

1.1.5. Outline Structure of the Research

Besides the present introductory chapter, this thesis includes three more chapters in which we develop more specifically the central topic of this research, to finally conclude with a last chapter on conclusions.

In chapter two, we present a comprehensive literature review on the main topics of this thesis. Firstly, the chapter introduces the concept of Supply Chain Management (SCM), describing fundamental supply chain key processes and sub-processes at strategic and operational levels. Furthermore, crucial aspects on supply chain integration, describing the set of approaches utilized to effectively integrate suppliers and customers are provided, at this point, the chapter also introduces different strategies oriented for such purposes such as: Supplier Relationship Management (SRM), Customer Relationship Management (CRM), and Demand Supply Chain Management (DSCM).

Secondly, chapter two presents the role performed by Information and communication technologies (ICT) in SCM. Principally, it describes features and functions of ERP systems as a tool for enabling efficient customer-supplier collaboration and coordination across the supply chain; furthermore, it introduces an innovative ICT advancement denominated the Internet-of-Things (IoT), which promises to revolutionize multiple business sectors across industries.

Thirdly, chapter two describes diverse strategic orientations or firm strategies aimed at generating market differentiation and value generation. Particularly, it´s analyzed the concept of Servitization and its strategic effect towards service provision in manufacturing firms. As well, it introduces the concept of smart services; an innovative strategy that allows the provisioning of customized and person-oriented healthcare services.

In chapter three, we present the research methodology and findings of the thesis. For such purposes, the chapter presents the methodological approach and the results emerged from (a) "*The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain"*, which following a single-case study

methodology analyzes the features of Bolt-on extensions to customize generic ERP systems and extend the system capacity to consistently integrate customer and supplier information in highly customer-oriented supply chain initiatives. (b) "*The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance"*, which following an empirical analysis examine the effect of operational ERP systems benefits on both competitive priorities and firm performance. And (c) "*A Roadmap towards Smart Services in Healthcare",* which following a taxonomy of technologies comprised in the Internet-of-Things (IoT) paradigm analyze the technological requirements necessary for the provision of custom-adapted-services, designed to meet specific users' requirements.

Finally, in chapter four and five, we discuss the major conclusions emerged from the study. For such purposes we provide main implications derived from it. Finally, we present limitations of the study and future research directions.

Chapter 2

Theoretical Framework and Review of the Literature

2.1. Supply Chain Management (SCM): Processes and Features

2.1.1. Introduction

Nowadays, firms operate in a global business environment which is characterized by an increasing turbulence and competitiveness. This volatile landscape forces companies to develop high quality products that meet consumers' needs, faster and at lower costs. Therefore, on the one hand, this increasing competition has pushed firms to improve their internal operations, enabling them to concentrate their efforts on their core activities and outsource non-core activities. Nevertheless, this phenomenon may cause that variables related to quality, delivery and price of products, depend not only on the capabilities of a company, but also largely on its network (Modi and Mabert, 2007). On the other hand, this increasing competition has driven firms toward the integration of suppliers and customers into their overall value chain processes (Klein, 2007; Prajogo and Olhager, 2012). Therefore, the integration among companies of supply chain is a key factor for competitive position, especially when the environment is characterized by uncertainty and dynamism (Youssef, 1992; Handfiel and Nichols, 1999; Frohlich and Westbrook, 2001; Sanders 2007, 2012).

This integration involves upstream and downstream relationships (Bustinza et al., 2015). In this sense, Hammer (2001) argues that successful companies are those that apply this approach in their business activities by working closely with partners to design and manage processes that go beyond their organizational boundaries. Furthermore, Harland et al. (2007) argue that in the current environment, in many cases, competition is not a matter of company competitiveness, but a matter of supply chain competitiveness.

To achieve this integration, sharing relevant information among components of the supply chain becomes crucial. Besides, in these situations Information and Communications Technologies (ICT) play a central role by allowing information sharing among suppliers and customers while facilitating information availability and improving the quality of information transferred. Thus, integration is a both sided advantage (supplier-customer) in a way that suppliers can organize detailed

production and customers are able to respond in time to market needs, reducing uncertainty, inventory levels and costs (Lee and Whang, 1998).

For such purposes, many companies have implemented ICT in their supply chain initiatives, as a way to facilitate the alignment of forecasting and scheduling of operations between partners of supply chain, allowing better inter-firms coordination (Prajogo and Olhager, 2012). In fact, now days, the impact of the Internet on Supply Chain Management (SCM) allows sharing a large amount of information along the supply chain in real time, including operations, logistics and strategic planning data. This circumstance provides firms with more visibility, improves production planning, inventory management, and distribution, among other benefits (Devaraj et al., 2007; Sanders, 2007).

2.1.2. Supply Chain Management (SCM)

Since its beginnings, the concept of Supply Chain Management (SCM) has been defined with multiple perspectives in the literature (Croom, 2005). In this way, Oliver and Webber (1982) considered it as the mere planning and control of the total materials flow, while Ellram (1991) considered SCM as an alternative form to vertical integration. Other perspectives consider SCM as the management of relationships between both corporate functions and across companies and define it as the management of a network of organizations or entities (Ellram and Cooper, 1993; Lee and Ng 1997; Christopher, 1998).

Recent literature such as Council of Logistics Management (2003) argues that SCM implementation comprise the integration of corporate functions and business processes within and across companies; so, SCM includes more than just the activities of any individual corporate function (Lambert et al., 2005). In this line of reasoning, Croom (2005) proposed SCM to focus on some of the core processes and functions related to the management of supply chains (for example, fulfillment, operations planning and procurement). Currently, SCM is considered a dynamic and volatile process that requires the coordination of all activities among partners of the supply chain in order

to satisfy the final customer and maximize total supply chain profitability (Sanders, 2012).

Over the last decades, academics have attempted to describe the key business processes of supply chain management. The Global Supply Chain Forum (Cooper et al., 1997) defined Supply Chain Management as ''the integration of key business processes form end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders'' (Lambert et al., 1998). Its implementation is compound by three key elements: the supply chain network structure, the supply chain business processes, and the management components. Lambert et al. (2005) argue that supply chain network structure is comprised of member firms linked to key processes. In this framework, eight supply chain management processes are identified: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management.

Moreover, the Supply Chain Council developed the Supply-Chain Operations References framework (SCOR model) in 1996. Initially, this framework included four business processes. Later, in 2001 (Supply-Chain Council, 2001), a fifth process was added resulting into plan, source, make, deliver, and return (Lambert et al., 2005). Srivastava et al. (1999) suggested an alternative framework incorporating three business processes: customer relationship management, product development management, and supply chain management. Another framework was suggested by Bowersox et al. (1999) based on three contexts: operational, planning and control, and behavioral (Lambert et al., 2005). On the basis of this latter framework, Melnyk et al. (2000) included eight business processes: plan, acquire, make, deliver, product design/redesign, capacity management, process design/redesign, and measurement (four of eight business process were already included in the SCOR model).

Supply chain management frameworks focused on cross-functional interactions through the firm and on the relationships stablished with other supply chain members were introduced in later research (Mentzer, 2001; Mentzer et al., 2001; Mentzer, 2004).

Therefore, SCM is referred as the integration of all activities that add value to customers, from product design to delivery, taking into account the existence of three flows between the initial suppliers and final customers: a flow of goods, a flow of information, and a flow of money (Fisher, 1997; Lee and Whang, 1998; Huang et al., 2002; Pagell, 2004; Power, 2005; Nurmilaakso, 2008; Prajoso and Olhager, 2012; Sanders, 2012). For Simchi-Levi et al. (2000) ''SCM is a set of approaches utilized to effectively integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide cost while satisfying service level requirements''.

Nowadays, managing relationships with customers, suppliers and the rest of partners of the supply chain is a challenge and an element of competitive differentiation (Arias-Aranda et al., 2010). To achieve this, a greater coordination and synchronization is necessary through information process sharing based on cooperation among firms, where Information and Communications Technologies (ICT) on various value-adding activities along the supply chain have an essential role (Naylor et al., 1999; Gunasekaran and Ngai, 2004; Bagchi et al., 2005; Wagner and Sweeney, 2010). In this sense, Sanders (2012) distinguishes three SCM activities: coordination, information sharing, and collaboration. Higher integration is characterized by an increased logistics-related communication, greater coordination of the firm's logistics activities with those of its suppliers and customers, and more blurred organizational distinctions between the logistics activities of the firm and those of its suppliers and customers (Stock et al., 2000; Prajoso and Olhager, 2012).

2.1.3. Supply Chain Integration

There has been a growing interest concerning the strategic importance of integrating suppliers and customers into the overall supply chain (Clinton and Closs, 1997; Ragatz et al., 1997). This inclusion is referred in literature as supply chain integration (Prajogo and Olhager, 2012), and it is characterized by cooperation,

collaboration, information sharing, trust, partnerships, shared technology, and a major shift; from managing individual functional processes, to managing integrated chains of processes (Akkermans et al., 1999).

This supply chain integration is widely supported by the effect of Information integration; this refers to the process of sharing key information along the supply chain, carried out by Information and Communication Technologies (ICT). Its main purpose is to obtain the transmission and processing of information required for supply chain decision making in real-time (Wong et al., 2011; Prajogo and Olhager, 2012). All these components play a key role improving supply chain capabilities by offering high-speed communication and connectivity between suppliers and customers, changing the old fashioned adversarial relationships into strategic alliances and long-term cooperative relationships (Tan et al., 1998). According to, Drucker (1998) and Lambert and Cooper (2000) the success of firms will depend firmly on its managerial ability to integrate and coordinate the intricate network of business relationships among supply chain members.

Lee and Whang (1998) define the types of information that partners supply chain should share to get a greater coordination and efficiency:

- Inventory level. When information about inventory level of partners supply chain is shared, inventory levels of the chain as a whole are reduced, decreasing space needs and costs. In addition, replenishment production and shipment can be scheduled more accurately (Devaraj et al., 2007).

- Sales data. Normally, sales data variance is lower than order data variance. When firms share only information about order data with suppliers, demand can be distorted creating ''the bullwhip effect''. According to Lee et al. (2004), this refers to the phenomenon where orders to the supplier tend to have larger variance than sales to the buyer (generating demand distortions). Such distortions propagate upstream in an amplified form (creating variance amplification). Suppliers incur in excess raw materials and manufacturing costs, inefficient utilization and overtime along with

increasing warehousing expenses and additional transportation costs due to inefficient scheduling and higher shipping rates.

• Order status for tracking/tracing. Allowing customers to know about order status within the supply chain increases control and confidence. Sharing this information improves service customer to a large extent.

• Sales forecasts upstream to suppliers. Forecasts act as notification of future orders to suppliers. Suppliers can use this information to develop a production plan. However, when customers behave in an opportunistic way by communicating suppliers higher than real forecasts, there is a risk of inefficiency. According to Lee et al. (1997), Frohlich and Westbrook (2001) and Devaraj et al. (2007), sharing real demand forecasts from customers provide suppliers more visibility planning for capacity and material requirements minimizing inefficiencies.

• Production/Delivery Schedule. Getting to know suppliers' production schedules in advance, helps customers improve production schedules, reduce forecast uncertainty and enable more detailed production quantity and timing as well as reliable delivery (Lee and Whang, 1998; Lancioni et al., 2000; Wei and Krajewski, 2000; Krajewski and Wei, 2001; Devaraj et al., 2007).

• Other information sharing. Lee and Whang (1998) argue that information such as performance metrics (product quality data, lead times, queuing delays at workstations, service performance, etc.) and capacity information is susceptible to be shared for optimizing purposes.

Figure 2.1. Provide an overview of the key elements that enable Supply Chain integration.

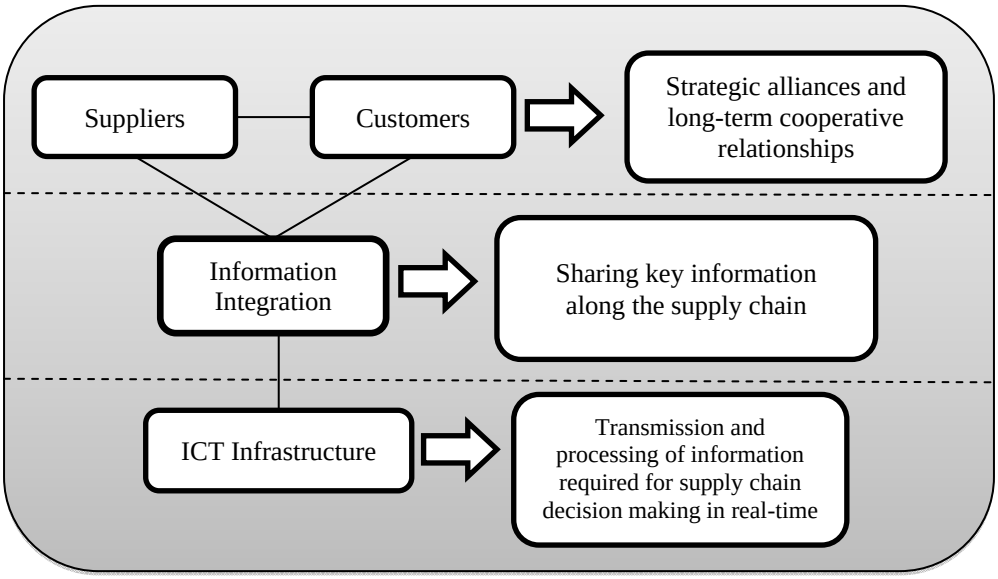

Figure 2.1. Supply Chain integration key elements

2.1.4. Customer Relationship Management (CRM)

CRM is a customer-oriented business strategy focused on finding, obtaining, building up, and consolidating a strategic long-term relationship with key and profitable customers, principally using an information system to manage daily customer interactions between a company and its customers. The main scope of all CRM perspectives is mainly focused on a cooperative and collaborative relationship between customers and the firm. Dwyer et al. (1987) described such cooperative relationships as interdependent and long-term oriented, instead of being discrete and short-term transactions.

CRM has updated the traditional metrics used by managers to measure the success of their products, services, and customer information. Financial, market-based indicators such as profitability, market share, and profit margins are still important. However, CRM has opened the door for new metrics like: customer acquisition costs, conversion rates (from lookers to buyers), retention/churn rates, same-customer sales rates, loyalty measures, and customer share or share of requirements (Lehmann, 2005).

Even though, there exist several types of CRM programs, widely specified, they can all be classified into three categories: continuity marketing, one-to-one marketing, and partnering programs. The categorization depends on the objective: end-consumers, distributor customers, or business-to-business (B2B) customers (Parvatiyar and Sheth, 2001). One fundamental perspective of CRM is the use of customer-associated knowledge to deliver appropriate products or services to customers. Thus, companies can manage all customer information in real time, absorbing customers' requests and specifications and integrating their needs into the development of future products (Levine, 2000).

2.1.5. Supplier Relationship Management (SRM)

SRM business strategy, in contrast, can be defined as the process involved in selecting, finding, obtaining, keeping track of, and managing important purchasing suppliers, principally using an information system and the Internet (World-Wide Web) to manage daily supplier interactions between a company and its suppliers. Commonly defined as 'the mirror image of Customer Relationship Management' (Croxton et al., 2001), while CRM defines a structure for how the relationship with customers is developed, managed, and maintained, SRM defines how a company collaborates with its suppliers.

According to Herrmann and Hodgson (2001), SRM is 'the process involved in managing preferred suppliers and finding new ones whilst reducing costs, making procurement predictable and repeatable, pooling buyer experience and extracting the benefits of supplier partnerships.' SRM works efficiently, using segmentation of suppliers by giving priority to suppliers that have provided high-quality items for a long time, or to those suppliers that provide strategic items, and according to the value that they represent for a company, creating a different strategy for each client.

2.1.6. Demand-Supply Chain Management (DSCM)

One integrative approach, that includes a collaborative development of products and services, aligning business partners' activities both intra-enterprise and inter-enterprise, is demand-supply chain management (DSCM). This is a consumer-centric business model oriented to enhance market responsiveness capabilities. It is based on a 'sense-and-respond' philosophy centered on acquiring new capabilities to offer high customer value in dynamic market conditions, redefining network structure, information, and knowledge-sharing mechanisms, and relationships (Haeckel and Nolan, 1996). Defined by Chase (2008) as a 'dynamic network of a company's customers; customers' customers; and direct and indirect marketing, sales, and service providers who facilitate the firm with the capability to get, keep, and nurture profitable lifetime relationships in better and faster ways,' DCM design is based on a deep market understanding and has to be adequately managed to satisfy different customers' needs (Agrawal, 2012).

Its approach includes important synergies between SCM and marketing by centering on particular and specific customer needs and designing the chain to satisfy these needs from end-customers back to suppliers (Heikkila, 2002). One important difference between DSCM and SCM is that DSCM attempts to analyze and understand demand for markets within a firm's current and potential product range. Supply chains, on the contrary, emphasize efficiencies in the production and logistics processes, while DSCM accentuates effectiveness in the business (Langabeer and Rose, 2002). The key success for many demand chain users is given by the appropriate use of information, through a rich set of well-chosen and timely data to drive their replenishment processes (Lee and Whang, 2001). Thereby, DSCM entails integration among suppliers, manufacturers, and customers based on physical distribution and information transfer as a way to improve customer service.

Figure 2.2. Provide an overview of the concepts comprised in the Demand-Supply Chain Management approach.

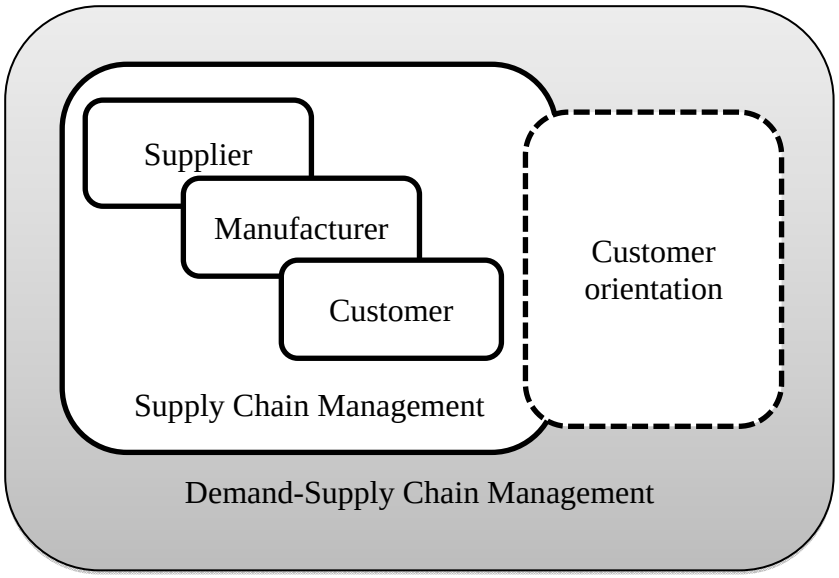

Figure 2.2. Demand-Supply Chain Management approach

2.1.7. CRM – SRM: Toward a Customer-Oriented Supply Chain

Harland (1996) describes the relationship between customers and suppliers as "valuable bridges, as they give one actor access to the resources of another". Slack (2005) argues that, in customer orientation, the supplier perspective must be understood as a way to increase sales revenues. From the customer perspective, on the other hand, as a means of reducing risks, decreasing uncertainty, and making maintenance and support costs predictable. Moreover, the importance of promoting and developing products and services becomes crucial, since customers and suppliers are considered relevant factors in the decision-making process (Lertsakthanakun et al., 2012).

Implementation of the right ICT infrastructure allows companies to integrate, store and manage supplier-customer information sharing in a single integrated system as enterprise resource planning (ERP) systems. Thus, integration makes information available for timely dissemination to important supply chain partners for responsive decision making and future market actions (Lertsakthanakun et al., 2012). Information integration indicates electronic linkages and integrated sharing of information within

and beyond the organization's boundaries with the aim of facilitating cross-functional coordination in the supply chain (Kulp et al., 2004). Information integration across supply chain partners enables close communication and allows information sharing to support their supply chain operations. It also determines future performance improvement actions (Daft and Lengel, 1986).

As a result, organizations integrate their partners' information into the supply chain much more easily, reducing supply chain management uncertainty and facilitating decision making (Galbraith, 1973; Bensaou and Venkatraman, 1995). Such information sharing will expedite and facilitate cross-functional cooperation from the customer's side, integrating customer requirements and specific needs into the development of new products and services.

Such information will also allow companies to direct their efforts to "what is demanded", and, from the supplier side, to agree on competitive costs and high-quality components to develop future products and services. In this way, companies can aim to fulfil customers' needs and requirements according to their specific demands, to "satisfy what is demanded" by reorienting the traditional supply chain into a customer-oriented supply chain.

Figure 2.3. Provide an overview of all the main concepts/enablers of a customer oriented supply chain.

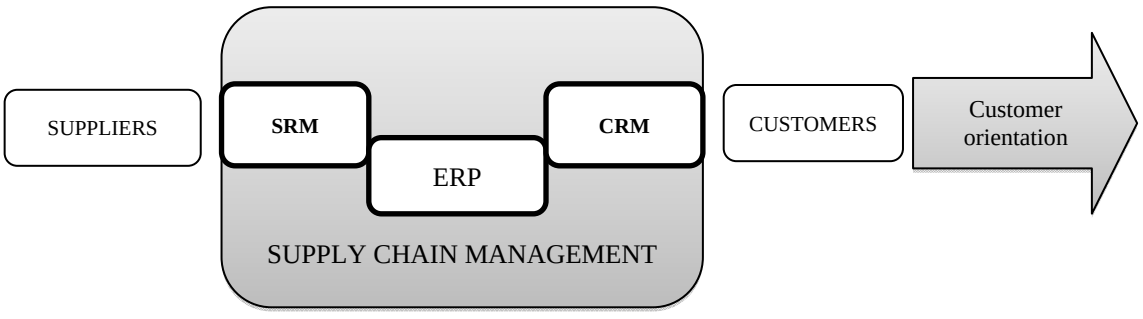

Figure 2.3. CRM – SRM: Toward a customer-oriented Supply Chain.

2.2. Information and Communication Technologies (ICT) in Supply Chain Management

2.2.1. Introduction

The use of Information and Communication Technologies (ICT) has become a strategic necessity in today's highly volatile global business landscape characterized by ever-dynamic markets and fierce competition. As a result, ICT usage has exploded rapidly across industries, growing two times faster than the Gross World Product in the last ten years (Siegler and Gaughan, 2008). Although the mere fact of possessing a specific kind of software does not guarantee improvements in the organization's competitive position (Yusuf et al., 2004; Ray et al., 2005; Chen and Tsou, 2012; Hameed et al., 2012), ICT adoption envisions remarkable effects on management control practices, which may help organizations to achieve objectives and lead to improvements in performance (Kallunki et al., 2011).

In current global markets, firms are forced to satisfy more demanding customers in order to obtain competitive positioning and competitive advantages. This involves changing traditional business structures into a flexible and integrated Supply Chain Management (SCM) strategy. In this sense, ICT adoption envisions remarkable effects on management control practices, which may help organizations to achieve objectives and lead to improvements in performance (Kallunki et al., 2011). Moreover Internet has augmented the richness of communications through greater interactivity between the firm and the customer (Watson et al., 1998).

Therefore, the main impact of ICT in SCM is the possibility of sharing a large amount of information along the supply chain in real time, including operations, logistics and strategic planning data. This fact provides firms with more visibility, improving production planning, inventory management, and distribution (Devaraj et al., 2007; Sanders, 2007). The value creation process extends beyond the boundaries of the firm, and involves integrating business processes among partners of the chain (Stevens, 1989; Tan et al., 1998), enabling integration, collaboration and coordination across individual firm functions and throughout the supply chain (Sanders, 2007).

Nowadays companies seeking to integrate their business processes implement ICT in order to be more flexible and responsive. In this way companies are able to break traditional barriers between departments or functions and reduce unnecessary efforts and time wastage, as a result, companies are able to orient all their efforts in what really matters, gaining competitive advantages over its competitors (Sanders, 2012).

2.2.2. ERP Systems

Enterprise Resource Planning (ERP) systems constitute an essential and widely used platform upon which companies build and integrate all their business process and overall management (Hendricks et al., 2007; Ince et al., 2013). Their main objective is to coordinate firm's business activities and automate business processes, which rely on data analysis to enhance operational performance (Chou and Chang, 2008; Madapusi and D'Souza, 2012). Through their integrated modular structure, these systems allow better availability of business information by connecting production and supply activities, offering multiple useful indicators for analyzing in real-time or near real-time enterprise data and resources (HassabElnaby et al., 2012).

Over the last two decades ERP systems implementation among firms has become increasingly common, as the technology becomes more established and prices come down (Deep et al., 2008; Ahmad and Cuenca, 2013). Literature suggests that these systems can have a significant and sustained impact on diverse aspects of operations strategy competitiveness (Li et al., 2006; Quiescenti et al., 2006; Su and Yang, 2010). Particularly, streamlining processes within a company and improving its overall effectiveness, while provides a means to externally enhance competitive performance, increase responsiveness to customers, and support strategic initiatives (Sandoe et al., 2001).

ERP systems can be described from different perspectives. Firstly, it can be comprehended as commodity, a product in the form of computer software. Secondly, it can be perceived as a development objective of mapping all processes and data of an enterprise into a comprehensive integrative structure. Finally, ERP can be seen as the key element of a technological infrastructure designed to support the capacities of all

tools and processes that comprise the firm, so that they ensure the goals of flexibility of operational processes (Ng et al., 1999; Klaus et al., 2000).

ERP systems enable the flow of information between all business functions inside the boundaries of the firm and manage the connections to other partners of the supply chain (Sanders, 2012). As well, ERP systems incorporate different information in a centralized database that is accessed by all partners supply chain, facilitating the availability of trustworthy information to decision-makers (Holsapple and Sena, 2005; Yang and Su, 2009).

Moreover, the systems allow every function of supply chain to store and retrieve information in real-time as well as to avoid information delays and distortions along the supply chain and increase transparency (McAfee, 2002; Wagner and Sweeny, 2010; Sanders, 2012). In this sense, Gunasekaran and Ngai (2004) define ERP as the system that connect different functions within a firm (such as marketing, operations, sourcing, logistics) as well as a firm's supply chain partners (such as suppliers, distributors, third party logistics providers), enabling the partners to share information such as order status, product schedules, sales records, plan production, logistics and marketing promotions.

Table 2.1. (Taken from Umble et al., 2003) provide an overview of the scope of ERP systems, including functions supported by them.

Functions supported by ERP systems	
Financials Accounts receivable and payable Asset accounting Cash management and forecasting Cost-element and cost-center accounting Executive information system Financial consolidation General ledger Product-cost accounting Profitability analysis Profit-center accounting Standard and period-related costing	**Operations and Logistics** Inventory management Materials management Plant maintenance Production planning Project management Purchasing Quality management Routing management Shipping Vendor evaluation
Human Resources Human-resource time accounting Payroll Personnel planning Travel expenses	**Sales and Marketing** Order management Pricing Sales management Sales planning

Table 2.1. Overview of ERP systems. Taken from Umble et al. (2003)

2.2.3. ERP Benefits

ERP systems can yield significant benefits promoted principally through the augmented bidirectional information sharing across the global manufacturing value chain, from supplier-to-customer, integrating real-time information into processes accelerating interaction and implication in supply chain strategies (Devaraj et al., 2007). ERP systems provide the required infrastructure to streamline business processes and expedite the flow of data and information across the supply chain (Warfield, 2007; Xu, 2007; Li et al., 2008), offering direct communication channels to the different functional areas within the organization (Stratman and Roth, 2002; Li et al., 2008).

As a result, the system facilitates the coordination of activities across the firm to develop more efficient operations and to take advantage of new opportunities (Bradford and Florin, 2003). Furthermore, literature indicates that ERP implementation may enhance operational performance and significantly influence operational efficiency (Cotteleer and Bendoly, 2006; Federici, 2009; Ram, et al., 2013), mainly, eliminating redundant steps and simplifying processes, resulting in speeding up manufacturing activities within a firm (Chou and Chang, 2008). Therefore, ERP systems can upgrade business operations providing diverse overall benefits to the organization, such as reduced supply chain cost, shortened production time, improved products' quality, and enhanced services to the customer (Lin et al., 2011).

A large variety of studies have tackled the analysis of ERP system benefits. In this regard, the categorization provided by Gattiker and Goodhue (2004) divides these benefits into four categories: information flow improvement, centralization of main management activities, reduction of information system costs, and achievement of best practices in processes management. Likewise, Yusuf et al. (2004) distributes the main benefits of ERP into three dimensions: business processes automation, access to information in real time, and supply chain management improvement through E-commerce. Further Shang and Sheddon (2007), identifies five groups of generic benefits; benefits related to IT infrastructure (flexibility, usability and cost efficiency), operations (cost reduction, improved productivity, quality, attention to the customer, etc.), management (relationships with other agents, decision making and planning),

strategy (alliances, innovations, improvements in differentiation and cost, etc.) and organizational benefits (learning, empowerment, new guidelines for behaviour, etc.).

2.2.4. ERP Customization

ERP systems offer a wide range of integrated business solutions for the core processes (Rosemann et al., 1999). Important benefits are attached to using this software, including managerial control, speedy decision making, and a huge reduction in business operational costs, among others (Holland et al., 1999). Nevertheless, specific operational characteristics have pushed companies toward the customization of the package, seeking to configure the system to their specific needs (Hong and Kim, 2002).

In literature, a wide range of studies highlight the importance of customization decisions in ERP adoption success (Motwani et al., 2002). In this sense, Sprott (2000) claims that an ERP package is basically designed to be modified or customized, since nearly every ERP package is based on a modular approach. Each module includes specific functionality and configurable options, and ERP vendors commonly provide their customers with an open or proprietary programming domain for modifying the system, which ultimately means; that every ERP software demands some type of customization to fit specific requirements. Moreover, Luo and Strong (2004) argue that customization implies modifications of an ERP software package to fit the organization's existing business processes; they also define two essential types of adaptation commonly faced by organizations dealing with ERP systems:

Table 2.2. Provide the types of adaptations commonly faced by organizations dealing with ERP systems.

Concept	Description	Authors
Process customization	Type of customization that refers to the situation in which a business process is customized to fit the ERP system; also called organizational adaptation	(Robey et al., 2002; Boudreau and Robey, 1999).
Technical customization	Type of customization that refers to the situation in which the ERP system is customized to fit the business process; also called system adaptation	(Davenport, 1998; Glass, 1998; Brehm et al., 2001)

Table 2.2. Types of ERP systems adaptation commonly faced by organizations:

It is important to mention that technical customization may be an enhancer of competitive advantage. If particular business processes define the structure of an organization and represent source differentiation among their competitors, these processes should not be changed to fit some basic or generic ERP software system; rather, the system should be changed to fit the processes.

According to Brehm et al. (2001), one intrinsic characteristic of ERP software is that the system has been developed as a packaged software solution rather than a customized system. ERP software thus comes with incorporated assumptions and procedures about business processes, which rarely match the organization's processes.

2.2.5. ERP Bolt-on Extensions

One innovative response to organizations' growing demands for customization has been the development of Bolt-ons extensions. Bolt-ons can be defined as specialized external extensions that complement generic ERP package functionalities and are designed to meet the needs of a particular customer segment. According to Caruso (2005), Bolt-ons provide enterprises with the latest technological advances to

manage specific functional areas, thereby increasing ERP system functionality for all existing business processes.

Normally developed by a third-party vendor, these applications are intended to fill the company's gap between the business processes and the ERP system. According to Watts et al. (2008), 'Bolt-ons are added to ERP software to provide increased functionality and efficiency to the enterprise system.' Using Bolt-ons as a means to achieve ERP software customization has become widespread practice. According to a research survey performed by Callanan (2002), 77% of the companies surveyed felt that their system was average or below average before adding any bolt-on, and 50% of the companies indicated the willingness to add Bolt-ons through their IT teams as a way to make up for the shortfalls of their generic ERP package. In another survey study performed by Watts et al. (2008), more than 67% of the companies surveyed had implemented the ERP system, and more than 95% of those ERP users had deployed at least one bolt-on.

Over time, more IT departments will realize the customization potential of these extensions, which are ready to operate without system code modifications. Although there exist a wide range of these extensions in the market, we focus in the potential of two of them, particularly; we assess the role of CRM and SRM Bolt-ons and their importance in supply chain integration and customer orientation.

We can define the CRM Bolt-on extension as a software solution capable of integrating all customer information; its main objective is to provide detailed data about customers' preferences and their behavior. With this information, companies can interact with, classify, and recognize their most valuable customers, with whom it is necessary to create cooperative and collaborative long term customer–supplier relationships.

Likewise, we can define the SRM Bolt-on extension as a software solution capable of integrating all supplier information. This solution's main objective is to manage all relationships with suppliers, using the information to facilitate procurement and provide segmentation tools. Companies can interact with, classify, and recognize their

most valuable suppliers, with whom they must create cooperative and collaborative long-term supplier– customer relationships.

An ERP system strengthened with Bolt-on extensions will allow the interconnection of internal operations in a company with suppliers and customers in the supply chain structure. In the transition from pure product to product-service offerings, the value chain could be broken if firms do not encompass supply and demand chain perspectives (Bustinza et al., 2013), and Bolt-on extensions are a tool to analyze value chain performance. This comprehensive system allows supply chain information integration and collaboration backwards and forwards through the ERP system, on one side, through the supplier relationship management Bolt-on (SRM) and, on the other, through the customer relationship management Bolt-on (CRM). These extensions allow integration beyond the scope of the company, integrating customer-supplier information as part of the whole value chain.

2.2.6. Internet-of-Things (IoT)

Over the last few years the traditional host-to-host internet model is evolving from an Internet used for interconnecting end-user devices to an Internet used for interconnecting physical objects that communicate with each other and/or with humans, under a novel paradigm named the Internet-of-things "IoT". (Miorandi et al., 2012). Introduced for the first time by the work of the Auto-ID Center at the Massachusetts Institute of Technology (Sarma et al., 2000), this new paradigm heralds a global network platform of interconnected objects (billions or trillions of machines) that not only harvests information from the environment (sensing capabilities) and interacts with the physical world around them (actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications (Gubbi et al., 2013), to this aim, incorporates Human-to-Machine (H2M) processes that allows human interaction with devices/objects (Minoli, 2013), and Machine-to-Machine (M2M) processes wherein objects can communicate with each other without the need of any type of human

intervention or involvement, making them "Smart". Hence, the general idea behind this concept is the pervasive presence around us of a variety of things/objects or machines augmented with sensing capabilities, which through unique addressing schemes, facilitates cooperativeness between technologies and people in order to reach common goals (Atzori et al., 2010).

The IoT paradigm is not a single technological breakthrough, but rather a combination of aspects and technologies coming from different approaches such as: Ubiquitous computing, Pervasive computing, Internet protocol, Sensing technologies, Communication technologies, and embedded devices that merge together in order to form an ecosystem where the real and digital world meet and are continuously in symbiotic interaction (Borgia, 2014). In IoT domains, different types of data (e.g., the information of sound, light, heat, electricity, mechanics, chemistry, biology, and location) can be acquired in real time by technologies such as RFID tags, Wireless Sensors Networks (WSN), and other devices integrating real world information into the digital world (Bandyopadhyay and Sen, 2011).

The real-time information access from the physical world will lead to innovative services capable to generate greater efficiency and productivity in the global economy (Turber et al., 2014), principally due to the IoT ecosystem will accelerate the generation of multiple business opportunities and will introduce novel business models capable of delivering substantial economic and social benefits (Mattern and Floerkemeier, 2010; Gluhak et al., 2011). In addition, the constant stream of information will facilitate the capacity to respond to events in the physical world in an automatic, rapid and informed manner, contributing with new opportunities for dealing with complex or critical situations (Gubbi et al., 2013).

As a consequence, in time IoT advancements will give rise to an extensive variety of Smart items, Smart services, Smart products, and Smart things, which can be stablished as material-digital developments or everyday material objects/structures of our daily lives configured/structured/constituted with embedded sensing systems capable of providing both, conventional (developed/designed/made-for) functions and digital information access through wired/wireless communication attributes.

Furthermore, the capacity to perform sensing tasks; collecting information about environmental or natural phenomena, physiological parameters, or user habits, will give birth to a wide range of applications and customized services, irrespective of the application domain.

Figure 2.4. (Taken from Gubbi et al., 2013) provide an Internet-of-Things overview showing end-users and application areas.

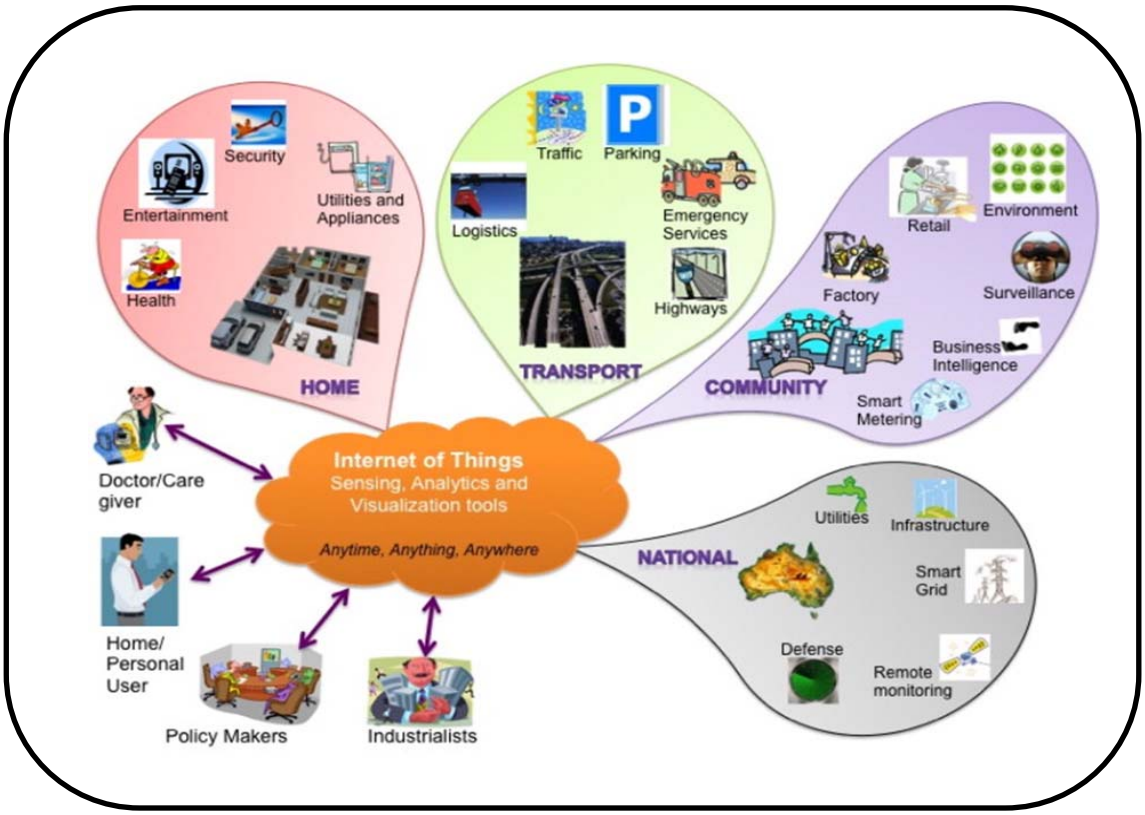

Figure 2.4. Internet-of-Things end-users and application areas. Taken from Gubbi et al. (2013)

2.3. ICT as enablers for Supply Chain Strategies

2.3.1. Introduction

The adoption of ICT in organizations has changed the competitive landscape across industries, introducing multiple features for SCM and firm strategy (Prahalad and Oosterveld, 1999). Main benefits come from the ever-expanding capabilities of ICT, which provide key advantages for SCM such as supply-chain visibility, real-time transmission, data processing, and information integration along supply chain; facilitating and speeding up partners' cooperation, interaction, and implication in supply chain initiatives (Prajogo and Olhager, 2012). From a supply chain perspective ICT deliver high value enabling companies to improve their efficiency, productivity and innovation, enhancing flexibility and responsiveness to meet the changing market requirements (Cash and Konsynski, 1985; Gunasekaran and Ngai, 2004). Otherwise, from a strategic perspective, ICT facilitate the management of linkages among supply chain activities, which are crucial in enabling competitive advantages (Porter and Millar, 1985), as well, simplify the implementation of a wide range of strategies (Barney, 1995). As a result, ICT adoption has turned into a major component of the competitiveness in many Industries. In fact, in today's information-intensive business environment, ICT systems have become so pervasive that they are now considered a fundamental requirement to respond to ever changing competitive dynamics.

2.3.2. Smart Services

The irruption of Internet-of-Things (IoT) will hasten the generation of a wide diversity of Smart products, allowing manufacturers to collect data on how their products are being used by customers/end-consumers in different settings and learn how to optimize them for future use. However, the main challenge for companies has to do with the management of the collected "in-context" data for further value creation. This will result in the adaptation of products, wrapping valuable services around them such as: remote monitoring and diagnostics services, as a way to build, support, and

improve customer relationships; extending manufacturing frontiers—from Smart products to Smart services provision (Byun and Park, 2011).

Whereas Smart products generate a constant stream of data with which producers can improve products, usage, and maintenance. Smart services are about value generation and recognition of new opportunities for innovation driven by collaboration and participation with customer/end-users. These services extract meaning from the data initially collected from a customer/end-users and return back that meaning in the form of a service—a Smart service—capable to meet customized needs, requirements, and provide suggestions (Anttiroiko et al., 2014).. However, these types of services require a different paradigm compared to the service offerings of the past. To begin with, they are fundamentally preemptive rather than reactive or even proactive. Preemptive means your actions are based on intensive field intelligence; you launch a preemptive strike to head off an undesirable event when you have real-world evidence that the event is in the offing (Halloran, 2012).

Smart services are thus based upon actual evidence, e.g., that a machine is about to fail, that a customer's supply of consumables is about to be depleted, that a shipment of materials has been delayed, and so on (Allmendinger and Lombreglia, 2005). One of the most sensitive aspects for Smart services is data management, as the volume of the generated data and the processes involved in the handling of those data become critical. For this purpose, many companies are starting to focus on the benefits of big data analytics tools (Lee et al., 2014), this means machine intelligence which enable institutions to discover hidden patterns, unknown correlations, tendencies, and meaningful trends behind data; crucial in developing good-enough predictive analytics models to identify customer/end-users specific needs and requirements on time, and even to anticipate and foresight the future and identify problems before they occur.

2.3.3. Servitization

New business models demand more than production and end-product delivery to maintain companies' competitive positioning. The traditional way of doing business, of

companies "offering what is produced", is changing to "producing what is in demand", including features, specifications, and customers' requests. This new approach leads companies into new business transactions highly customer oriented, moving from discrete sales of products to creating relationships based mostly on supporting bundles of products and services (Baines et al., 2016). Referring to this creation of services that add value to products, Vandermerwe and Rada (1988) introduce the term "Servitization". A few years later, Vandermerwe (2000) launched one of the most fundamental principles of Servitization, claiming that "services tend to be more difficult to imitate and lock the user into a long-term relationship". Baines et al. (2007) define Servitization as "a strategy that involves the innovation of an organization's capabilities and processes to shift from selling products to selling integrated product and service offerings (or "solutions") that delivers value-in-use". It has been argued that companies may obtain higher margins by offering services than only by offering product sales; services thus increase company revenues (Anderson et al., 1997; Oliva and Kallenberg, 2003).

According to Mathieu (2001), Servitization allow companies to respond effectively to business conditions and to develop competitive advantages to overcome market obstacles. Neely (2008) claims that it is not enough for manufacturers to increase the proportion of services provided (Vendrell-Herrero et al., 2016). The company must also change its mentality, transforming relationships from transactional to relational and developing service offerings to meet customer needs. This shift requires changing both managers' perspectives and the business models employed to provide the services (Barnett et al., 2013). Thus, to succeed in Servitization, manufacturers will need new guiding principles, structures and processes for their production and support operations (Oliva and Kallenberg, 2003). Companies must be efficient in interpreting what their customers need and coordinating all business activities to fulfil those requirements (Vendrell-Herrero and Wilson, 2016; Bustinza et al., 2013).

When Servitization increases, the complexity of what is offered increases as well. Manufacturers must pay close attention to managing complex networks of product and service suppliers (Johnson and Mena, 2008; Saccani et al., 2007).

In any case, the road to Servitization is not an easy task and requires that companies modify their strategies, key capabilities, organizational form and company culture, and the attitudes of their employees (Brady et al., 2005). Finally, both culture and operations must change when firms move towards service provision (Barnett et al., 2013).

Chapter 3

Research Methodology and Results

3.1. Methodology and Results

3.1.1. Introduction

The present chapter presents research methodologies and findings of three different studies that focus on the role played by ICT within the supply chain scope, as a tool for enhancing supply chain management and developing innovative firm strategies. For such purposes, the chapter presents a fist study called *"The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain"*, which by following a single-case study methodology analyzes the features of Bolt-on extensions to customize generic ERP systems and extend the system capacity to consistently integrate customer and supplier information in highly customer-oriented supply chain initiatives. The second study is denominated *"The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance"*, which by following an empirical analysis examines the effect of operational ERP systems on firm performance through the analysis of firm's competitive priorities and firm's key performance measures. Finally, the third study is called *"A Roadmap towards Smart Services in Healthcare"*, and by following taxonomy of technologies comprised in the Internet-of-Things (IoT) paradigm analyzes the technological requirements necessary for the provision of custom-adapted-services, designed to meet specific users' requirements.

3.1.2. The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain: Evidence from a Single Case Study

- **Antecedents of the Study**

Servitization has become a widely pursued field of research due to services' creation of mutual value through a shift from selling products to selling product-service systems (Baines et al., 2007; Aurich et al., 2007; Parry et al., 2012; Aquilante et al., 2016). One of its main characteristics is the increased level of customer orientation

(Bastl et al., 2012). Customer orientation is determined by inter-firm cooperation (Rindfleisch and Moorman, 2003), which generates long-term relationships between business partners, particularly, cooperative supplier-customer relationships that allow more frequent communication and more open sharing of business-relevant information (Uzzi, 1997; Eggert and Helm, 2003). This supplier-customer relationship enables easier deployment of services through relational exchange (Zajac and Olsen, 1993).

To establish such cooperative relationships, firms should take into consideration essential requirements when implementing Servitization. During the switch, companies face several challenges, as among them, strategy, organization and enterprise management, marketing, production, delivery, Servitization design, communication and managing supplier-customer relationships during the product–service shift (Brax, 2005; Barnett et al., 2013). An efficient Information and Communication technology (ICT) structure is essential, supported by an Enterprise Resource Planning (ERP) system to integrate processes and functions within the supply chain. Moreover companies can link their integrated solutions to respond more efficiently to customers (Cohen et al., 2006; Davies et al., 2006; Johnson et al., 2008).

By implementing customer relationship management (CRM) and supplier relationship management (SRM) Bolt-ons in an ERP system, companies are able to integrate important partner information in Supply Chain Management (SCM). They thus have the ability to response faster to market demands, developing working patterns for product and service designs jointly so that this cooperative relationship between customer and suppliers can generate a source of competitive advantage (Dyer and Singh, 1988; Cannon and Homburg, 2001). Thus, the purpose of this study is to explore the use of Bolt-on extensions in ERP systems and how they may enable a Servitization strategy, particularly we attempt to analyze the use of CRM and SRM bolt-ons as enhancers for a customer oriented supply chain.

Figure 3.1. Provide a conceptual research framework of the study, including the key concepts comprised in it.

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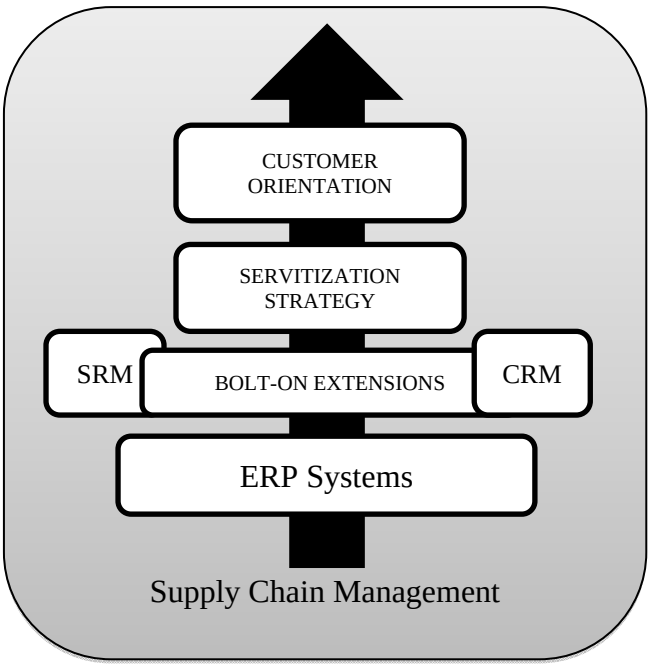

Figure 3.1. Conceptual research framework of the study

3.1.2.1. Research Methodology

The theoretical maturity of the Bolt-on extensions literature, specifically in the context of customer orientation, could be defined as nascent. According to Edmondson and McManus (2007), nascent theories are theories that have "received little research of formal theorizing to date or else that represent new phenomena in the world". We adopt a case study research methodology, which is considered to be a qualitative methodology appropriate for the study of information systems development, implementation, and use within organizations (Benbasat et al., 1987; Myers, 1997; Eisenhardt et al., 1989). This is also an appropriate research strategy for studying a contemporary phenomenon in its natural context (Benbasat et al., 1987; Yin, 1994; Barratt et al., 2011) or for areas in which terminology and a common language and set of definitions are not yet clear or widely accepted (Darke et al., 1998), including areas where a phenomenon is dynamic and not yet mature or settled (Darke et al., 1998).

More specifically, this study adopts a single-case design that attempts to describe the existence of a phenomenon efficiently (Siggelkow, 2007) and that can be adopted successfully for exploratory research (Darke et al., 1998). Moreover, this approach allows researchers to investigate phenomena in depth, providing rich description and understanding (Walsham, 1995). Thus, single case study research is appropriate for theoretically immature phenomena because it allows for deep research enquiry and enables us to get as close as possible to the research phenomena (Dyer and Wilkins, 1991). Some examples of previous single-case studies in information systems research are those performed by Markus (1983), Myers (1994) and Shanks (1997). The philosophical perspective in this research is interpretivist, attempting to produce an understanding of the contexts of information systems and the interactions between these systems and their contexts (Darke et al., 1998) while also attempting to understand phenomena by accessing the meanings that participants assign to them (Orlikowski and Baroudi, 1991).

The unit of analysis is Tire.CO, a B2B high-technology-based industrial company, ERP system user for three years and pioneer in tire recycling in Spain. The company is located in three different cities—Granada, Madrid and San Sebastian. Based on the tire deconstruction process, this company develops new products that have not been developed before in the industry, focusing on target customers in different sectors, such as environmental engineering, railway industry, civil engineering and the shipbuilding industry.

A semi-structured interview was the sole data collection instrument. An in-depth interview with the company's IT project manager in the city of Granada was performed by one of the authors in company's facilities. The interview focused on features and challenges of customer orientation, including customization, bolt-on usage, integrated solutions, information integration, buyer-supplier relationship, cooperation and information sharing (Anderson and Narus, 1984; Goodhue et al., 1992; Goodhue et al., 1992; Uzzi, 1997; Akkermans et al., 2004; Luo and Strong, 2004; Caruso, 2005; Don et al., 2012). The interview was recorded, and extensive notes were also taken.

Table 3.1. Shows a tentative scale developed to measure customer orientation by using bolt-on extensions.

Semi-structured interview	
Variable	Open-ended questions
Customization	In your company, which organizational and/or technical factors have determined ERP system Customization?
Bolt-on perception	Would you please describe how the functionality and efficiency of your ERP system have improved by adding bolt-ons?
Customer-oriented supply chain	As a way to satisfy customer needs, how does customer information influence the development of services and products in your company?
Information Integration	How do integrated solutions manage information sharing, information transfer, and cooperation between customers and suppliers in your company?
Bolt-ons and servitization	In what way do these bolt-on extensions enhance customer orientation in your company?

Table 3.1. Tentative scale developed to measure customer orientation by using bolt-on extensions

3.1.2.2. Results

The interviewee confirmed the importance of long-term relationships with partners, mutual cooperation and information sharing. Information sharing with customers was considered essential to determining the customer's needs and requirements and to developing products and services. The interviewee understood this concept directly as a way to determine specifications and particular characteristics related to product design. All of the products provided by Tire.CO can be considered to be tailor-made. Accordingly, customers are involved in every single stage of product development, including design, testing, evaluation, and manufacturing, thereby establishing relations based on transparency, collaboration and constant flow of information feedback.

"In our case, customer information influences us totally. Because every product is custom designed, the customer relationship tends to be long-term, including a first phase where the customer discovers our material and a second in which we develop the product together—and there's where two flows of information converge. The customer will provide us with the critical requirements of the product".

"The road to market for a product is connected to a close relationship with our customers. Because we must transform raw materials into final products through various processes, we have a long term relationship with our customers until the product goes to market".

For Tire.CO, the use of integrated solutions in managing information sharing represents a functional tool, exchanging and storing information of strategic partners and customers. In particular, customer information is carefully managed because it represents information on the market in strategic business sectors. Tire.CO sets the boundaries of information to be transferred; a set of communication norms are established with each customer in which the scope of the project basically defines the extent of the information to be transferred, according to confidentiality agreements previously arranged as a means to ensure exclusiveness.

"Our information system is not very sophisticated, but we generally share files and important information with our customers…in the end, knowledge of the market will be provided by the customer. He knows how a product should be made…This gives us continuous information management according to the required extent of protection and the number of people who will share it".

As the company grew, the business model was modified to facilitate the coordination of R&D alliances in product development with technological partners around the country. This was considered a determining factor for ERP system customization, as the company's integrated system was strengthened during this process. In addition, although Tire.Co deals with multiple customer profiles, it does not have a formal system to manage customer information. Even when most of its partners have implemented integrated solutions, the use of email and Internet is still considered essential to information exchange.

"Our company extends across several cities. This has forced us to consider how our information system adjusts to our real operational design… Because we are so dispersed, we use our information system to be perfectly coordinated.… A business model like this one, where you have to interact with multiple customer profiles, requires the implementation of an information system that can be used for that purpose".

Currently, the company has integrated 7 Bolt-on extensions into its ERP system, but none is oriented to managing customer-supplier information. The interviewee understood the importance of bolt-on extensions in gaining confidence, time optimization, and product development to the system`s benefits from the beginning. Moreover, it was impossible for him to estimate how truly important they are because, as he said, the system has never performed without them.

"I think in two ways: first trust and second optimization of time. Time is as essential as product development, because even if you have a product with a lot of potential on your hands, you may drown or die before the product is ready for the market if time gets away from you. These tools help us to develop projects in the short run and faster, also inspiring confidence and facilitating information sharing".

"I couldn't evaluate them because we were born with them (bolt-ons); it was the only way for us…. I can't compare before and after their incorporation because we have always had them…. We have definitely increased their use because our company is growing…but I can really tell you that I can't imagine doing it in another way. Without these tools, our work capacity would be greatly impaired, no doubt about it".

The case study organization is strongly oriented to mutual cooperation and information sharing with customers (Rindfleisch and Moorman, 2003; Neely, 2008). In every project, the company maintains close relationships, and every product is developed jointly according to the requirements previously requested by customers (Neely, 2008; Rindfleisch and Moorman, 2003; Bastl et al., 2012; Rindfleisch and Moorman, 2003), thereby establishing long-term collaborative relationships (Vandermerwe, 2000) in which customers are the ones who contribute knowledge of the market (Harland, 1996). Information integration is part of the business process; the

company commonly transfers files and information with its customers (Kulp et al., 2004), a crucial practice in developing new products and services (Lertsakthanakun et al., 2012). Moreover, since customers are closely involved in future developments, they contribute improvements, changes and modifications (Daft and Lengel, 1986). This way of working has led the company to establish confidentiality agreements as a way to protect the information transferred in key business processes.

The use of integrated solutions (ERP systems) is essential for the company, as they coordinate internal processes, manage customer information (Yen and Sheu, 2004) and store important information necessary for decision making (Bancroft et al., 1998; Holland and Light, 1999). The ERP system was technically customized to fit the company's processes, and the company's growth and coordination with partners were the most important reasons to do this (Luo and Strong, 2004; Davenport, 1998; Glass, 1998; Brehm et al., 2001). Bolt-on implementation has contributed to increasing the functionality of the ERP system in specific areas of the company where time and efficiency are critical (Caruso, 2005; Watts et al., 2008).

Results reveal that the company studied is highly committed to satisfying customer needs, essentially focusing intense effort on managing multiple customer profiles and key customer information using only traditional information modes of exchange (telephone, email and videoconference). Results also show that the company considers its ERP system to be more a managerial system than a strategic tool and that the customization processes was clearly more necessary than strategic. The company maintains traditional relationships with suppliers, not considering them as important partners in Supply Chain Management, and although the company has implemented Bolt-on extensions it is not clear about the functionality of improvements, even though it considers these extensions to be crucial for its business model.

Although the company is highly customer oriented in several areas, it could be said to be only halfway there. Fundamental improvements are definitely needed to address the challenge of a customer-oriented supply chain. This requires primarily establishing an integrative perspective. The company should understand the strategic potential of the ERP system in integrating the partner's information (Cohen et al., 2006;

Davies et al., 2006; Johnson et al., 2008). Moreover, CRM and SRM bolt-ons should be integrated into the ERP system to strengthen and facilitate customer and supplier integration (Dyer and Singh, 1988; Cannon and Homburg, 2001). Information on suppliers must be considered as important as information on customers in the development of new products and services (Herrmann and Hodgson, 2001), and new guiding principles, structures and processes should be defined (Oliva and Kallenberg, 2003; Brady et al., 2005).

3.1.3. The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance: Evidence from an Empirical Analysis

- **Antecedents of the Study**

The ability to integrate and automate businesses processes, share information in the whole firm and provide access to well-timed information has lead organizations toward the implementation of ERP systems, with the aim to guarantee successful operations in the global market (Nah et al., 2001; Madapusi and D'Souza, 2012). ERP systems are associated with improving firm performance in the form of expanded information capabilities, increased responsiveness to customers, and enhanced strategic initiatives (Sandoe et al., 2001; Mabert et al., 2003).

However, evidence suggests that these systems could lead to more significant and sustained benefits on diverse aspects of operations strategy competitiveness and operational performance (Cotteleer and Bendoly, 2006; Li et al., 2006; Quiescenti et al., 2006; Su and Yang, 2010; Bustinza et al., 2013). And this, according to Madapusi and D'Souza (2012) could be attributed to the embedded capacity of ERP systems to align with quality management strategies, augmenting the firm's ability to meet competitive operational challenges.

Over the years, the changes required by ERP have often proven to be overwhelming in many organizations, resulting in ERP project failures (Maguire et al., 2010; Ram et al., 2013; Galy and Sauceda, 2014). Nonetheless, literature suggests that they could be a consequence of mismatches on firms to meet the systematic planning of

operation changes, business process re-engineering, and the necessary paradigm shift for the operation and management (Weston, 2001; Kim et al., 2005; You et al., 2012).

Although an extensive literature exists describing the potential and practical benefits associated to ERP systems, comprehensive evidence about the relationship between ERP benefits and key performance measures have not been solidly confirmed (Stratman and Roth, 2002; Mabert et al., 2003; Hendricks et al., 2007). Once successfully implemented, ERP systems provide operational improvements (Ehie and Madsen, 2005; Huang et al., 2009). Therefore, there is a positive association between ERP systems investments and workers' productivity (Qutaishat et al., 2012). In the same manner, ERP systems can have a significant impact on organizational variables, thus contributing to obtaining competitive advantage (Lengnick-Hall et al., 2004; Seddon, 2005; Liang et al, 2007). Moreover, there is ample evidence indicating the influence of organizational factors on successful ERP systems implementation (Umble et al., 2003; Dezdar and Ainin, 2011), and these organizational factors could play a significant role on the benefits of ERP systems.

For this reason, this study analyzes the multiple benefits that ERP systems have demonstrated to provide and their true repercussions on firms. For such purposes, the study establishes a relationship between operational ERP benefits and key performance measures through the analysis of the role performed by competitive priorities. Such an approach is important because it fills a major gap in literature by providing a clear understanding of the impact of ERP systems implementation, beyond the traditional focus on material and information flows control (Kanet and Stößlein, 2010). Given that the correct alignment between firm structure and strategy has shown to have a positive effect on performance measures (Zott and Amit, 2008), it seems plausible to conclude that, since core competences of ERP systems underlie firms structure, the operational benefits of the system should affect firms' competitive capabilities and subsequently key performance measures.

In view of such research needs, this study presents the results of an empirical study that surveyed Spanish manufacturing firms selected from the SABI database. With responses obtained from 205 companies, SEM method was used to assess the

effect of ERP operational benefits over firms' key performance measures though the mediating role of competitive priorities. The study confirms the importance of pursuing multiple competitive priorities for improving firm performance, likewise, results reveal, that operational ERP benefits have a positive effect on both the firm's competitive priorities and key performance measures.

Figure 3.2. Provide a conceptual research framework of the study, including the key concepts comprised in it.

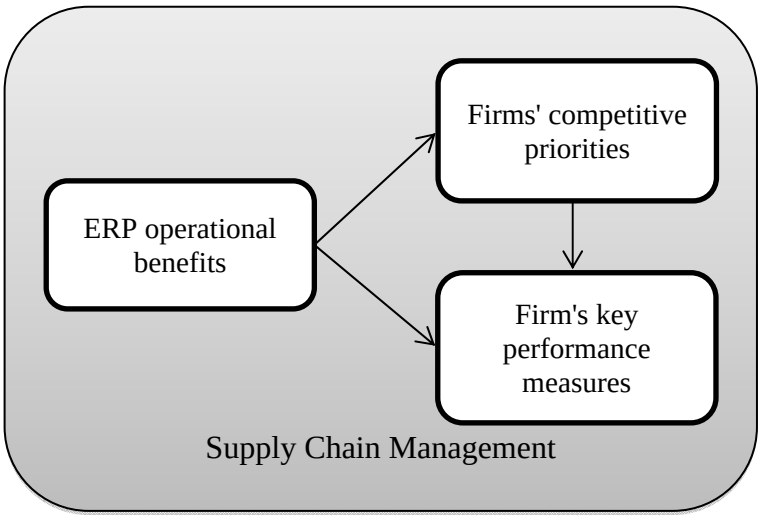

Figure 3.2. Conceptual research framework of the study

3.1.3.1. Research Framework, Model and Hypotheses of the Study

3.1.3.1.1. Competitive Priorities

The term "Competitive priority" has been widely embraced as the concept to describe the selection of competitive strategies that are considered essential in creating, developing and maintaining a competitive advantage in firms (Hayes and Pisano, 1996; Yen and Sheu, 2004; Thürer et al., 2013). Numerous studies have explored their role on business performance, indicating the existence of five major dimensions that make up

these competitive priorities—cost, time, degree of innovation, quality and flexibility (Leong et al., 1990; Ward et al., 1998; Kroes and Ghosh, 2010; Gonzalez et al., 2012).

Cost is referred to as the capacity of the firm to manage effectively production cost, including its related aspects such as overhead and inventory, and value-added (Phusavat and Kanchana, 2007). Still, while firms are steadily concerned about reducing costs, cost reduction, in most cases, is not in itself considered a competitive priority (Ward et al., 1998). The firm's delivery reliability is considered a time-based dimension, and it is founded on the ability of a firm to deliver products or services within the promised time (Kumar and Kumar, 2004). The firm's innovative capacity depends on factors such as technological experience and the training level of employees (Kroes and Ghosh, 2010). Design, production, distribution, marketing and services have been long used to measure firm quality (Ward et al., 1998; Zhang et al., 2012). Finally, flexibility improves the degree to which a firm effectively responds to changing circumstances in the environment (Hatum and Pettigrew, 2006; Bustinza, 2008; Gutierrez-Gutierrez and Fernandez Perez, 2010).

Although early studies focused on competitive advantages have consider these strategies as mutually exclusive options (Wheel-Wright, 1984; Skinner, 1996). Others, such as Boyer and Lewis (2002) established no significant relationship between quality and cost, but they do determine a significant relationship between the other competitive priorities. Alternatively, Pagell et al. (2000) findings identify simultaneous improvements in multiple competitive dimensions.

Various authors have attempted to reconcile these apparently opposed approaches by suggesting an integrative perspective (Lapré and Scudder, 2004), including the present study which also follows this integrative view. It's a well-known fact that firms can choose to pursue multiple competitive priorities simultaneously (Flynn et al., 1999). The emphasis on each of them will depend on its competitive orientation; this will determine the level of investment that a firm makes in each competitive priority (Kathuria et al., 2010).

Literature review indicates a close relationship between the benefits derived from ERP systems implementation and the firm's competitive strategy (Yen and Sheu, 2004). For this reason, we argue that operational ERP systems benefits have repercussions on the firm's competitive priorities enhancing firm's competitive capabilities (Figure 3.3). Consequently, the following hypothesis is proposed:

H1: Operational enterprise resource system (ERP) benefits has a positive effect on competitive priorities

Figure 3.3. Provide the model of relationship analized in the study.

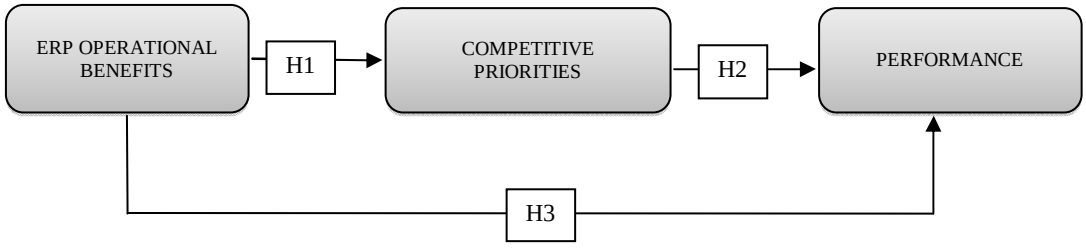

Figure 3.3. Model of relationship analyzed in the study

3.1.3.1.2. Key Performance Measures

Firm's results are defined by the degree to which firm's proposed goals are fulfilled. Measuring these results is a critical factor for tracking the firm's effectiveness, as it is impossible to improve something without having previously measured it (Arias-Aranda et al., 2011) . Authors like Beaumont et al. (2002), Brah et al. (2002), Koh and Ang (2007), or Bustinza et al. (2010) measure the firm's results by dividing them into two dimensions: operational performance and organisational performance. As to the relationship between performance and ERP, Kang et al. (2008) use operational performance for assessing the contribution of ERP systems to the firm's efficiency. Likewise, other researchers (Shin et al., 2000; Hu and Plant, 2001; Hitt et al., 2002;

Vemuri and Palvia, 2007) have studied the repercussions of IT investments on organisational performance.

This study provides a specific analysis on the relationship between operational benefits of ERP systems and firm performance; therefore, it becomes necessary to incorporate performance variables to examine the extent to which these ERP operational benefits may affect performance. For this purpose we use the set of measures proposed by Sila (2007), which establishes four key business areas that include human resource results, customer results, organizational efficiency, and financial and market results, as the basis to determine firm performance.

Human resources are considered to be a key factor for ERP systems success (Noudoostbeni et al., 2010). Equally, customer satisfaction levels are proven to deliver positive impacts on diverse areas of the firm such as sales, and customer loyalty (Das et al., 2000; Su and Yang, 2010). Moreover, ERP implementation influences the firm's ability to achieve organizational capabilities (HassabElnaby et al., 2012), as well as on enhancement of financial performance (Galy and Sauceda, 2014).

In regard to the theories justifying the relationship between operational ERP systems benefits and firm performance, authors such as Sila (2007) base their arguments on both institutional and contingency theory to study the relationship between Total Quality Management (TQM) practices and firm results. Lorca and De Andrés (2011) examine the influence of firm characteristics on the implementation of ERP systems from the contingency theory perspective. Moreover, Yang and Su (2009) and Uwizeyemungu and Raymond (2010) frame their study by using the Resource-based view and contingency theory to demonstrate empirically the close relationship between benefits derived from implementing ERP systems and benefits for Supply Chain Management. Finally, Kroes and Ghosh (2010) base their study in diverse theories—agency theory, transaction cost theory, knowledge-based theory, and the resource-based view—to demonstrate their key implication in firm results in terms of achieving a good fit between the reasons for using outsourcing and the firm's competitive priorities.

Given these extensive antecedents, it is possible to formulate a set of hypotheses that relate operational ERP systems benefits, competitive priorities, and key performance measures (Figure 3.3):

Hypotheses on competitive priorities and key performance measures

H2: Competitive priorities has a positive effect on performance

Hypotheses on ERP system benefits and key performance measures

H3: Operational enterprise resource system (ERP) benefits has a positive effect on performance

3.1.3.2. Research Design and Empirical Methodology

3.1.3.2.1. Sample

To test these hypotheses, an empirical study is carried out using the SABI database, which contains detailed information on the main firms operating in Spain. The firms were chosen from the manufacturing sector, since ERP systems are being used increasingly in Industry. From this database it was possible to obtain a total number of 1200 firms which had implemented ERP systems.

The chosen firms were contacted using a computer assisted telephone interviewing system (CATI). The survey was addressed to the person responsible for IT decisions, as well as the general director. The responses were collected by the end of 2012. The study obtained 205 valid surveys, achieving a response rate of 16.67%, similar to other studies in operations management (Bustinza et al., 2010). To ensure the validity of the respondents, the survey also requested information about their knowledge in the investigated areas, education level, job seniority, and seniority in the firm.

To evaluate non-response bias, the procedure developed by Armstrong and Overton (1977) and Podsakoff et al., (2003) was used. This procedure uses two-tailed t-tests to compare whether there are significant differences between early respondents

and late respondents based on a set of demographic variables. At a level of $p < 0.1$, no differences were found, thus, non-response bias was not considered to be a threat for this study.

3.1.3.3. Measures and Justification

3.1.3.3.1. ERP Operational Benefits

A 7-point Likert scale (from 1= disagree completely to 7=agree completely) was used to present the operational benefits of ERP systems (Shang and Seddon, 2007). These benefits involve cost reduction, improved productivity, quality, attention to the customer, etc.

A principal components analysis confirmed the existence of the dimension predicted for this construct. The Cronbach's alpha value was $\alpha_1 = 0.865$ for the operational ERP system benefits, being composite reliability CR= 0.942 and average variance extracted AVE=0.506. This values confirm the internal consistency of the scale (Cronbach, 1951), and thus validate its use.

3.1.3.3.2. Competitive Priorities

A 7-point Likert scale (from 1=disagree completely to 7=agree completely) was employed, according to the classification established by Kroes and Ghosh (2010). These authors link the alignment between firms outsourcing decisions and their competitive priorities as the basis for firm success.

A principal components analysis confirmed the existence of these five dimensions, producing Cronbach's alpha values of $\alpha_1 = 0.794$ for competitive priorities in cost, $\alpha_2 = 0.829$ for flexibility, $\alpha_3 = 0.908$ for innovation, $\alpha_4 = 0.831$ for quality, and $\alpha_5 = 0.867$ for time. CR was equal to 0.959 and AVE 0.519 demonstrating the internal consistency of the dimensions and their suitability to be used in the proposed model.

3.1.3.3.3. Key Performance Measures

A 7-point Likert scale (from 1=disagree completely to 7=agree completely) was utilized with the most representative measurements for this construct. These measurements have been proposed by Sila (2007), and include four key aspects of performance: human resources, customers, organizational efficiency, and financial and market results.

A principal component analysis (Hair et al., 2001) has determined that these four scales possess internal consistency, with the following Cronbach's alpha values: α_1 = 0.703 in the case of human resources, α_2 = 0.759 for efficiency, α_3 = 0.827 for customers, and finally α_4 = 0.873 for financial and market results. CR was 0.932 and AVE 0.514 (See Table 3.2.).

Table 3.2. Show the factorial loads and reliability analysis of the variables.

INDICATORS FOR THE VARIABLE "OPERATIONAL ERP BENEFITS"					
ITEM	**St.Factor Loading (t)**	**Reliability (R^2)**	**ITEM**	**St.Factor Loading (t)**	**Reliability (R^2)**
ERPB11	0.715 (10.777)	0.511	ERPB13	0.714 (10.924)	0.509
ERPB12	0.689 (11.151)	0.474	ERPB14	0.773 (12.355)	0.514
ERPB23	0.818 (11.452)	0.669		AVE 0.506	
ERPB15	0.717 (12.090)	0.908		Composite Reliability 0.942	
INDICATORS FOR THE VARIABLE "COMPETITIVE PRIORITIES"					
PRIO11	0.725 (11.517)	0.526	PRIO42	0.823 (9.202)	0.677
PRIO12	0.847 (11.680)	0.717	PRIO43	0.829 (10.552)	0.687
PRIO13	0.667 (10.896)	0.445	PRIO44	0.630 (9.585)	0.370
PRIO14	0.654 (9.502)	0.428	PRIO45	0.624 (9.117)	0.389
PRIO31	0.863 (10.646)	0.745	PRIO46	0.710 (10.857)	0.504
PRIO32	0.810 (12.195)	0.656	PRIO47	0.681 (9.908)	0.464
PRIO33	0.693 (9.199)	0.480	PRIO51	0.612 (10.426)	0.375
PRIO34	0.858 (11.850)	0.736	PRIO52	0.630 (11.829)	0.370
PRIO35	0.709 (9.213)	0.503	PRIO53	0.723 (10.801)	0.523
PRIO36	0.666 (9.367)	0.444	PRIO54	0.681 (10,914)	0.464
PRIO37	0.598 (9.453)	0.358		AVE 0.519	
PRIO41	0.644 (10.292)	0.415		Composite Reliability 0.959	

INDICATORS FOR THE VARIABLE "PERFORMANCE"					
PERF11	0.689 (0.759)	0.478	*PERF25*	*0.311*	*0.425*
PERF12	0.788 (9.075)	0.621	PERF26	0.664 (9.142)	0.441
PERF13	0.680 (10.291)	0.462	PERF41	0.712 (9.230)	0.507
PERF14	0.632 (9.121)	0.399	PERF42	0.741 (11.028)	0.549
PERF21	0.639 (10.298)	0.408	PERF43	0.802 (10.825)	0.643
PERF22	0.825 (10.068)	0.681	PERF44	0.858 (9.792	0.736
PERF23	0.818 (10.588)	0.669	PERF45	0.639 (9.555)	0.408
PERF24	0.761 (9.442)	0.579	AVE 0.514		C. Reliability 0.932

Table 3.2. Factorial loads and reliability analysis of the variables

3.1.3.4. Results

The proposed model is analyzed using, SEM (structural equations modelling). In the multiple regression analysis for which SPSS 20.0 software was used. The results of this analysis are included in Figure 3.4, which shows the set of relationships of the proposed model.

Figure 3.4. (Structural equation estimation) provides the analysis of relationships obtained in the study.

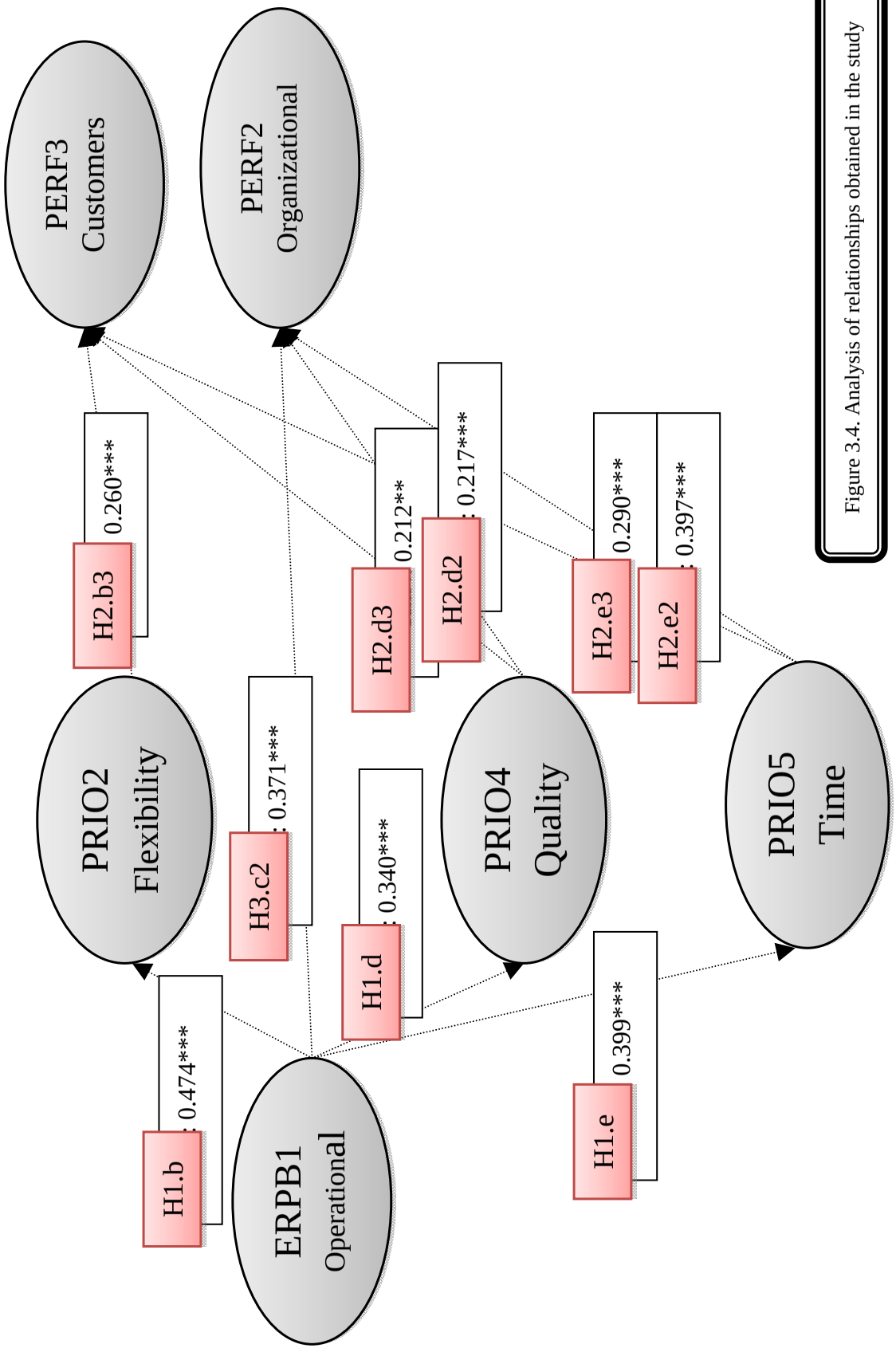

Figure 3.4. Analysis of relationships obtained in the study

3.1.3.4.1. The Effect of Operational ERP Benefits on Competitive Priorities: Hypotheses h1a to h1e

As can be seen in Figure 3.4, the values for the parameters used in the estimate of the relationship between operational ERP benefits and competitive priorities are only positive and significant in the case of impact on flexibility (λ_1=0.474, p<0.001), quality (λ_2=0.340, p<0.001) and time (λ_3=0.399, p<0.001), providing support for Hypotheses H1b, H1d and H1e, respectively.

The present study has analyzed the benefits expected from ERP systems implementation and the firm's competitive strategy represented in the five competitive priorities. The results show that there is a positive influence over three of the five ERP potential benefits. Accordingly, operational ERP benefits have a positive effect on the competitive priorities of flexibility, quality and time.

The results obtained reinforce existing theories in literature and included in this study, which confirms that ERP systems affect multiple competitive priorities, emphasizing the strategic relevance of the joint effect of these priorities, based on the competitive orientation pursued (Kathuria et al., 2010). Accordingly, the results of this study reflect that ERP benefits have no positive effect over some competitive priorities such as cost and innovation, in line with previous studies such as Gattiker and Goodhue (2004). One possible explanation for this finding is that ERP systems require a great degree of coordination and complex technological infrastructure that need for continued improvements and assessments to ensure the expected impacts, as ERP systems use evolves over time.

3.1.3.4.2. The Effect of Competitive Priorities on Performance Measures: Hypotheses h2.a1 to h2.e5

There is a positive and significant relationship, as also shown in Figure 3.4 between competitive priority of flexibility on customers, the analysis obtains (λ_4=0.260, p<0.001), supporting Hypothesis H2.b3.

The competitive priority of quality is significantly and positively related to organisational efficiency (λ_5=0.217, p<0.01), and customer management performance (λ_6=0.212, p<0.001), supporting Hypotheses H2.d2, and H2d3, respectively.

Finally, the competitive priority of time has a positive effect on organisational efficiency (λ_7=0.397, p<0.001), and customer management performance (λ_8=0.290, p<0.001), supporting Hypotheses H2e2, and H2e3, respectively.

3.1.3.4.3. The Effect of Operational ERP Benefits on Key Performance Measures: Hypotheses hb to he and the Mediating Effect of Competitive Priorities

Figure 3.4. Show that operational ERP benefits have a positive and significant effect on organisational efficiency (λ_7=0.371, p<0.001), supporting Hypothesis H3c2. Nevertheless, the influence of operational ERP benefits on organisational efficiency is not direct, but by the mediating effect of quality and time priorities.

In order to analysis this mediation effect, structural equations modelling (SEM) has been employed through EQS 6.2 software. The results (Figure 3.5.) suggest that there exist a total mediation, principally, in the case of the relationship between operational ERP benefits and organisational efficiency through the mediation of quality and time priorities (λ7=0.371, p<0.001 to λ7*=0.008, p<0.001), which means that the effect of operational ERP benefits fully corresponds to the mediating effect of an increase in quality and time.

Figure 3.5. Provide the mediation effect among ERP benefits, competitive priorities and key performance measures.

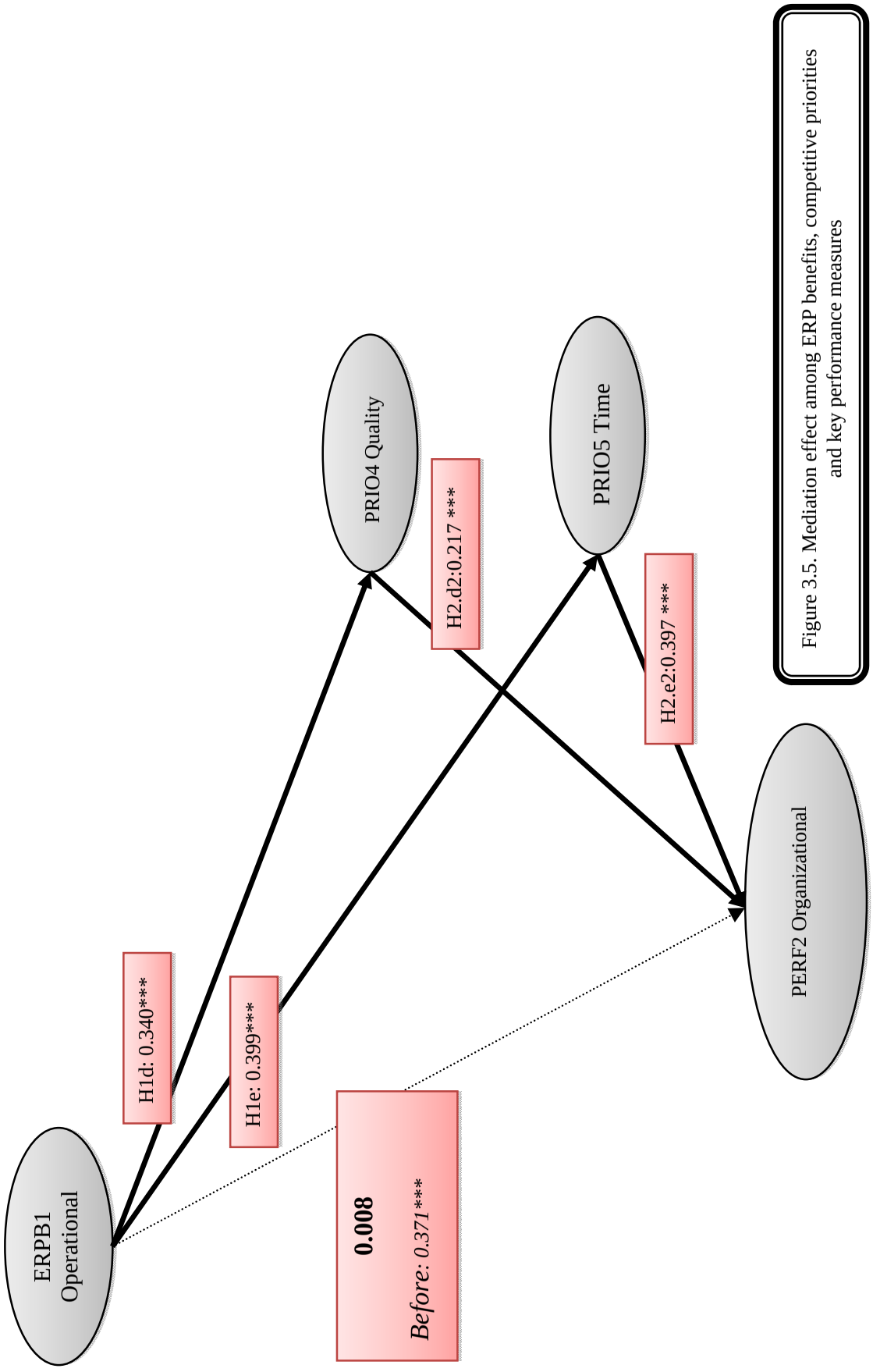

Figure 3.5. Mediation effect among ERP benefits, competitive priorities and key performance measures

The relationship is shown in Figure 3.5, and the SEM values for the different constructs and fit indices are included in Table 3.3. This analysis enables to confirm that operational ERP benefits do not affect firm performance measures directly; rather, this effect is produced solely by the mediating effect generated by quality and time competitive priorities.

Table 3.3. Provide the goodness-of-fit indicators.

TYPE OF FIT	INDICATOR	NOMEN	ACCEPTANCE RANGE	MODEL
ABSOLUTE	Chi-Square Likelihood	CMIN	Offers signific test	1681.672 (p=0.251)
	Goodness-of-Fit Index	GFI	> 0.900	0.954
	Root Mean Square Error	RMSEA	0.050-0.080	0.061
	Root Mean Residual	RMR	< 0.050	0.045
INCREMEN	Compared Fit Index	CFI	> 0.900	0.932
	Normed Fit Index	NFI	> 0.900	0.921
	Tucker-Lewis Index	NNFI	> 0.900	0.945
	Adjusted Goodness Fit	AGFI	> 0.900	0.923
PARSIMONY	Normed Chi-square	CMINDF	Range (1-5)	1.786

Table 3.3. Goodness-of-fit indicators.

3.1.4. A Roadmap towards Smart Services in Healthcare: Taxonomy of Technologies for Services Generation

- **Antecedents of the study**

During the last decades healthcare systems are facing a complicated global health care landscape aggravated by constantly increasing operational costs, a growing burden of chronic diseases, an increasing aging society, and a declining number of healthcare professionals (Solanas et al., 2014). This convoluted scenario is having considerable influence on the organization and delivery of healthcare services (Joshi et

al., 2014; Tsirbas et al., 2010). As a response, In the face of all these challenges, healthcare institutions rely on the implementation of Information and Communication Technologies (ICT) to support, innovate and extend health care services that impact the way in which a person's health is managed. Technically, the adoption of ICT within the healthcare sector led to the concept of electronic health or e-health (Solanas et al., 2014). This concept refers to the processes by which healthcare services can be more effectively delivered through the innovative use of ICT (Roberts et al., 2010), assuring effective communication and collaboration between patients and healthcare providers in a more efficient and cost-effective manner.

At present, e-health is redefining the way healthcare has been delivered for decades by adopting emerging technological advancements such as the Internet of Things (IoT) and Pervasive and Ubiquitous Computing, equipped with intelligence, sensing, and wireless communications capabilities. These advancements augment the existing e-health scope through continuous and remote monitoring of patient's health, enabling real-time acquisition of vital data (Stankovic et al., 2005). Then, data collected is stored, organized, and analyze in a Cloud computing infrastructure making it available 24/7/365 to healthcare communities without restrictions of time and space (Lounis et al., 2013).

The resulting technological integration allows unprecedented diagnostic services capable of transforming the current hospital centralized treatment-based mode into a decentralized continuous-care mode with an individualized patient-centered orientation in which hospitals, healthcare communities, and patients are closely involved and implicated across the healthcare process. This profound transition demands from health care providers to embrace new advances in ICT that offer new and more reliable ways of providing care and support, and thus expanding the provision of services into new domains (Belvedere et al., 2013).

The purpose of this study is twofold. Firstly, it attempts to provide a technology roadmap toward Smart services provision in healthcare. To this aim the study provides an application of taxonomy (Eris et al., 2015; Kim et al., 2015) of new advancements within the field of ICT structured around a new technological paradigm called the

Internet of Things (IoT). Secondly, it intends to clarify the scope of Smart services in healthcare by presenting relevant features and potentialities.

Figure 3.6. Provide a conceptual research framework of the study, including the key concepts comprised in it.

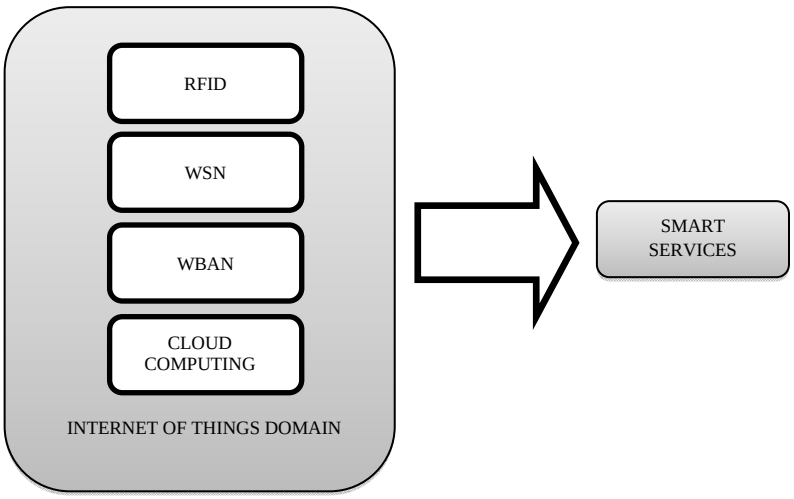

Figure 3.6. Conceptual research framework of the study

3.1.4.1. Research Framework

3.1.4.1.1. ICT Supporting Healthcare

The adoption, utilization, and proliferation of ICT has benefited, transformed, and revolutionized several industries throughout the world including healthcare practice (Buntin et al., 2011). In healthcare domains ICT adoption has been seen worldwide as one method to mitigate the widening health care demand and supply gap (Ludwick and Doucette, 2009). its progressive development within the healthcare sector along with the irruption of Internet, has resulted into e-health or e-healthcare; an innovative concept that defines "a new field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced

through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology" (Eysenbach, 2001).

On this topic, much of the existing literature identifies two lines of communication competencies; on the one hand, some studies (Pirnejad et al., 2008), report that e-health facilitates intra-organizational collaboration due to quicker exchange of communication, reducing pitfalls and generating an appropriated feedback for the creation and fast dissemination of innovative healthcare practices and treatments. On the other hand, further studies (Grimson et al., 2000; Roberts et al., 2010) state that e-health promote inter-organizational communication in medical practice through fast generation and dissemination of health related information such as Electronic Health Records (EHR), enabling instant and collaborative communication among healthcare institutions. Ultimately, over the course of the years its implementation has become progressively more important for high quality and cost-effective healthcare services, prevention of medical errors, improvements in healthcare staff performance and physician efficiency, and a better physician-patient relationship (Piontek et al., 2010; Buntin et al., 2011).

Nevertheless, latest technological advances on e-health are mainly focused on the integration and interconnectivity between specialized pervasive computing technologies, particularly small sensing devices capable to communicate with one another and co-exist with an organization's infrastructure, around a new emerging technology denominated the Internet of Things (Tsirbas et al., 2010; Laranjo et al, 2012; Joshi et al., 2014).

3.1.4.1.2. Pervasive and Ubiquitous Computing Technologies

As we previously described, IoT is a combination of aspects and technologies coming from innovative developments and diverse technological approaches unified to create an ecosystem capable to generate customized services in multiple application domains. However, the essence of these technology approaches incorporate principles coming from Pervasive and Ubiquitous Computing such as : (1) Ubiquitous Communication/Connectivity, i.e., the general capability of objects to communicate (anywhere and anytime), (2) Pervasive Computing, i.e., the enhancement of objects with processing power (the environment around us becomes the computer), and (3) Ambient Intelligence (AmI), i.e., the capability of objects to register changes in the physical environment and thus actively interact in a process (context-aware environments) (Kopetz, 2011). These three main principles play a key role to come to the IoT implementation, principally by incorporating wireless and unobtrusive sensing technologies in "everyday objects" so they can communicate information. Technically, objects augmented with these technologies within the IoT scenario are called "Smart objects" (Miorandi et al., 2012; Gubbi et al., 2013; Borgia, 2014). Hence, IoT can be described as an Internet model used for interconnecting "Smart objects" that communicate among each other under a network built by things, the so called Internet of Things.

Smart objects can be considered the building block in enabling the IoT. Principally, due to four characteristic technological attributes (including the typical attributes of Ubiquitous Communication, Pervasive Computing and Ambient Intelligence): (A) Identification, (B) Location, (C) Sensing, and (D) Connectivity (Dohr et al., 2010). These characteristics enable smart objects to provide data about an object's identity and its surroundings in a in a timely manner through wireless communication (Gubbi et al., 2013). Consequently, IoT proliferation will not only facilitate, but it will also boost the widespread adoption of smart objects, increasing the use of remote monitoring technology in several industries.

Particularly, in healthcare domain it will bring a wide range of opportunities and benefits. A vast range of Smart objects will make possible to collect data anywhere and

anytime trough real-time monitoring of medical parameters (e.g., temperature, blood pressure, heart rate, cholesterol level, etc.) facilitating medical diagnosis and control of patients' health without the need of a physically present physician (Miorandi et al., 2012), Introducing several advantages for specific categories of people with a strong need for home care, such as: elderly people, disabled population, and people with special needs. A particular part of the population that suffers from chronic diseases, long-term conditions, and physical impairments that prevents them from taking a full and active role in society (Laranjo et al., 2012; Borgia, 2014). Below, we discuss major technological advances which enable smart objects contribution in healthcare to become a reality.

3.1.4.1.3. Radio Frequency Identification (RFID)

RFID is a wireless tracking technology which utilizes microchips and radio waves to automatically identify tagged items and transfer data acting as an electronic barcode (Atzori et al., 2010). The basic RFID composition consists in readers (beacons), tags (transponders), and end servers that process the collected data from the tags (Mattern and Floerkemeier, 2010). Basically, this technology allows any tagged device to be mobile, intelligent and able to communicate with an organization's ICT infrastructure (Curtin et al., 2007).

This technology has been widely adopted on the Supply Chain Management (SCM) domains mostly for logistic services (Chen et al., 2010). It was primarily adopted by healthcare institutions for the elimination of paper-based mechanisms, reduction of medical errors, and patient waiting time (Chowdhury and Khosla, 2007). Over time, its implementation was propagated towards new services such as inpatient drug delivery, blood identification, and equipment tracking (Mattern and Floerkemeier, 2010). Throughout the years benefits such as: information quality improvements, reliability and time savings, and improved alignment of information exchanged with customers and suppliers have influenced its implementation in diverse service sectors (Atzori et al., 2010; Gubbi et al., 2013).

3.1.4.1.4. Wireless Sensor Networks (WSN)

WSN are wireless intelligent network application systems that autonomously collect, integrate and transmit data by incorporating the latest technological achievements in micro-electronics, network and communications (Borgia, 2014). Basically, the concept of a network comes from the interconnection of spatially distributed sensor nodes. By nodes we refer to unobtrusive, wireless, lightweight and miniaturized embedded hardware capable of sensing, processing and communicating multiple data over a specific area of interest (Lounis et al., 2013). Additionally, these sensor nodes are able to network with other sensor systems, and based on some local decision process; exchange the sensed data with external users (Yick et al., 2008).

WSN technology have been adopted for a variety of applications, including wireless data acquisition, machine monitoring and maintenance, smart buildings and highways, environmental monitoring, site security, automated on-site tracking of expensive materials, safety management, and in many other areas (Akyildiz et al., 2002). In healthcare practice, every single node in a WSN plays a different role in the network, sensing different patients' health parameters simultaneously (e.g. sound, pressure, temperature, humidity, etc.) and in a continued manner, in medical practice, these parameters refer to vital health data that provide physicians' insights into environmental, physiological, and physical health signals that are critical for timely detection, diagnosis and treatment of health related problems (Atzori et al., 2010; Gubbi et al., 2013; Borgia, 2014).

3.1.4.1.5. Wireless Body Area Network (WBAN)

WBAN is a wearable wireless-sensor network that incorporates different technological advances in integrated circuits, wireless communication, and sensing technologies to enable health monitoring systems (Borgia, 2014). Similarly to a traditional WSN, a WBAN consists of multiple sensor nodes. Each node is typically capable of (1) sensing physiological signals, (2) processing these signals, (3) storing the processed data, and (4) transmitting the data to other nodes and/or a WBAN server

(Jovanov et al., 2005). Its implementation has been adopted in a wide variety of settings: from healthy outdoor enthusiasts who would like to track their fitness level during exercise, to users with impeding medical conditions or patients undergoing rehabilitation processes (Otto et al., 2006).

Since not all patients require data about the same physiological parameters for diagnosis, a WBAN is commonly developed based on the patient health condition characteristics. The progressive implementation of WBAN technology in medical settings imply a significant advance towards the overcoming of current demographic, social, and economic challenges of global health care, nowadays is possible to use smartphones with sensor capabilities as a platform for monitoring of several medical parameters, a new technological branch of e-health now commonly referred to as m-health (Eriksén et al., 2014), an unprecedented step into the decentralization of healthcare services.

3.1.4.1.6. Cloud Computing

Cloud computing cannot be sufficiently understood as a standalone phenomenon in the ICT market, but rather as a core ingredient of a larger transformation of the ICT industry that impacts the entire ICT ecosystem (Oredo and Njihia, 2014). This new paradigm is transforming rapidly the way ICT infrastructure is being delivered and consumed offering users and businesses computing resources designed and governed in the form of services, reclassifying IT from an expensive "capital expenditure" to a pay-as-you-go "operating expenditure" (Venters and Whitley, 2012), where a cloud service provider (CSP) is the one who maintain and manage all the computing resources that are offered to the end user in the form of services, relieving end-users from acquiring and hosting hardware and software resources. Cloud services are classified in three main categories,

Figure 3.7. Summary of Cloud service models.

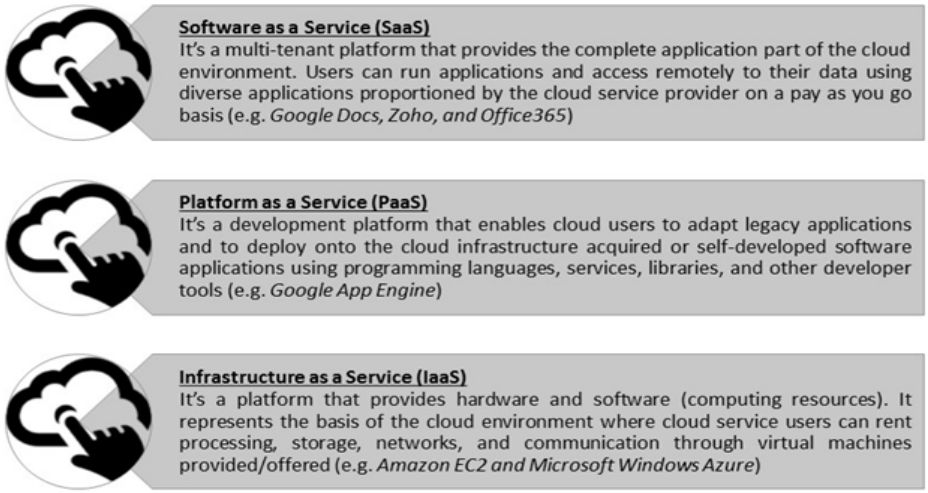

Figure 3.7. Cloud service models

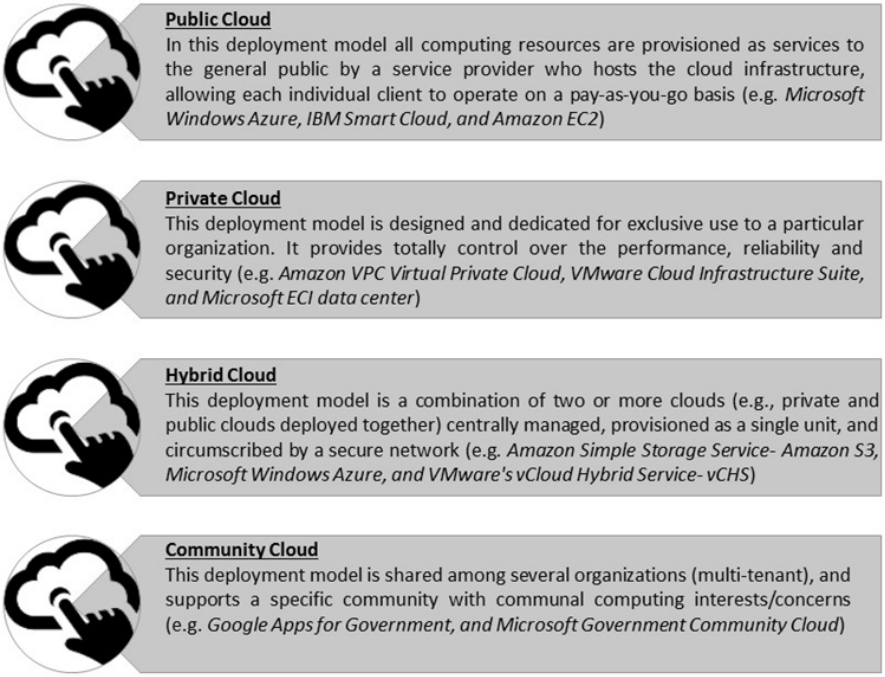

Figure 3.8. Cloud deployment models

All the afore-described cloud service models are negotiated between cloud providers and users according to the contractual Service-Level Agreement (SLA) to ensure quality of service (QoS) (Wu et al., 2014). Moreover, depending on organizational structure and the provisioning location, four different deployment models for implementing cloud technology have been established (Mell and Grance, 2011). Figure 3.8. Summarizes cloud deployment models.

By adopting Cloud computing healthcare institutions may focus more on increasing quality of delivered healthcare instead of managing their own ICT, reducing or even eliminating the high-cost of technical departments to support and operate the in-house infrastructures (Stantchev et al., 2014). E-healthcare in the cloud environment may introduce several opportunities to healthcare service delivery, this means data storage, and software solutions that facilitate the daily routines and procedures of healthcare operations in a flexible and scalable way (Wu et al., 2014). Additionally, due to its conjunction with Big Data, a cloud infrastructure can serve as an effective platform to address the data storage required to perform complex data analytics in healthcare; managing massive volume, variety, and velocity of sensitive data collected from patients (Hashem et al., 2015). These are considerable benefits for smaller hospitals, community care and physician practices, which can now implement advanced ICT infrastructures and cloud-based data services to support their healthcare operations without facing high initial and operational costs, facilitating information sharing (internally and externally) and providing anywhere/anytime access to medical data among healthcare institutions involved in the care process (Lounis et al., 2013).

3.1.4.2. Results

3.1.4.2.1. Smart Services in Healthcare

Smart services in healthcare can be defined as:

"The process of measuring patients' living conditions and health status remotely, using small sensing devices for collecting their vital data under daily life."

These services allow people to live their lives normally while receiving appropriate, timely and high-quality ubiquitous and pervasive health care without the constraints of time and space. The main goal of these services is to provide health data in real time for supporting health care professionals. Thus, with this information doctors are capable to get a timely assessment of a patient's health and provide prompt medical attention.

For this purpose, different sensing technologies (e.g. RFID, WSN, WBAN) comprised in the form of "smart objects" are deployed (anywhere/on any object/or human body) to collect sensitive patient's biomedical, physical, and environmental data. Once collected, healthcare institutions may use this data to provide these afore-defined services across all the applications within their Cloud-based healthcare platform. These applications shape an innovative healthcare process designed to offer smart services through each stage of it.

Figure 3.9. Depict applications compounding a new healthcare process.

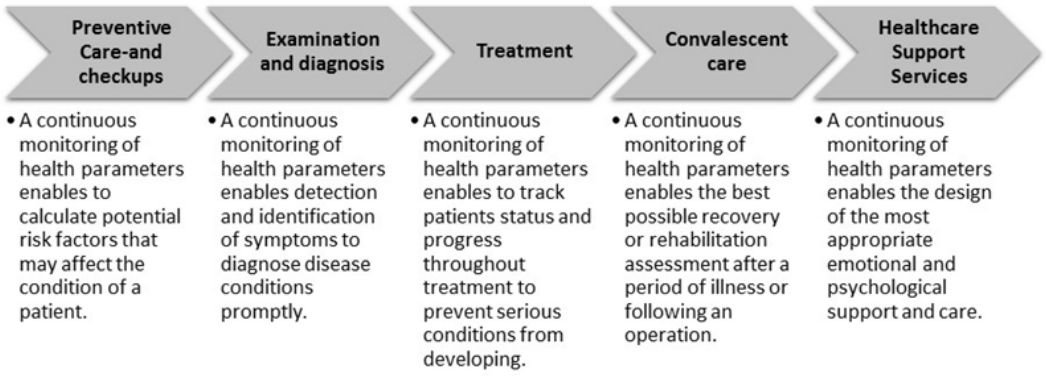

Figure 3.9 applications compounding a new healthcare process.

This process represents a continuous healthcare cycle divided in five stages of care; each stage represents an independent objective for smart services provision: (1) Preventive care and checkups i.e. a continuous monitoring of health parameters enables to calculate potential risk factors that may affect the condition of a patient, (2) Examination and diagnosis i.e. a continuous monitoring of health parameters enable

identification of risk factors and symptoms to diagnose a disease conditions promptly, (3) Treatment .i.e. a continuous monitoring of health parameters enables to monitor patient state and progress throughout treatment that may prevent serious disease from developing. (4) Convalescent care i.e. a continuous monitoring of health parameters enables the best possible recovery or rehabilitation after a period of illness or following an operation, and (5) Healthcare support services i.e. a continuous monitoring of health parameters enables the design of the most suitable emotional and psychological support and care.

One key capability of these services lies on their capacity to extract value from the data that is collected. Smart services allow healthcare institutions to collect huge streams of data generated by patients anytime-anywhere. This data provide important insights and guidelines for service deployment, design, and redesign of existing services aimed on patient's care. Thus, smart services have the capacity to transform data into "continuous adaptive information" capable to create new service offerings that could be continuously adapted to the patient's needs in each stage of the healthcare process, following a continued customization process.

Figure 3.10. Elucidate smart services customization process.

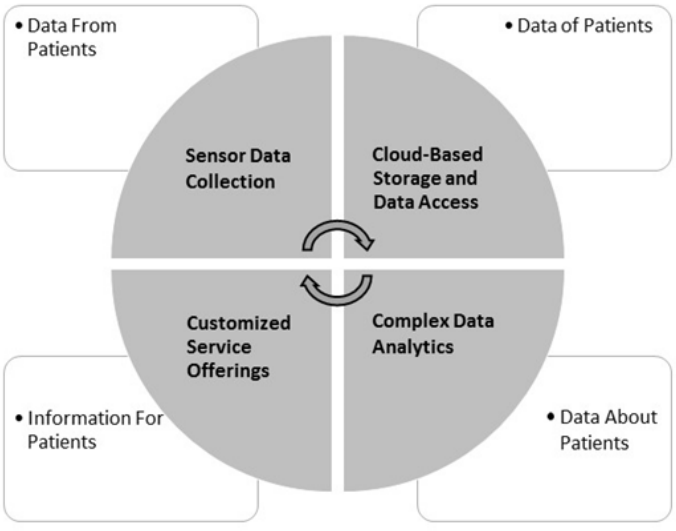

Figure 3.10 Smart services customization process.

In this process, data streams collected and transmitted through different sensing technologies allows the extraction of high quality medical data from patients, that once in power of healthcare institutions is stored, organized, and analyzed in the cloud (using Big data analytics) to discover patterns and useful information for decision making. Hence, healthcare institutions may use this data not only for improving offered services across the health care process, but also for discovering changes in health behavior and habits (e.g. early detection of patient deterioration), to identify changes in health patterns (e.g. prevent serious disease from developing), and modeling patient activities for predictive care (e.g. modeling patient progress throughout the treatment stage will give insights to develop the most accurate services to be offered in the convalescent care stage).Thus, data initially generated by a patient can be returned back to that patient in the form of a new service, this time customized in order to satisfy his/her specific requirements (e.g. recommending personalized suggestions related to health behaviors, food intake, treatment regimes, changes in medication routines, or in a treatment plan).

Thereby, it is expected from Smart services to generate a new model for healthcare provision, capable of transforming the way healthcare has been delivered to this day; empowering medical institutions and professionals to deliver better services (highly patient-oriented), extending patient's services beyond healthcare institutions, and accelerating service innovation. This transformation represents a radical advance towards the democratization and decentralization of the healthcare system; offering substantial advantages in terms of lower cost of care, better-quality of patient care, ensuring appropriate patient care, and improving patient's comfort. Undoubtedly, important advantages capable of improving worldwide patients' quality of life.

In order to clarify the role of the above-defined technologies and concepts in this study, next, Figure 3.11. Propose an IoT-Cloud platform including the conceptual integration of these technologies.

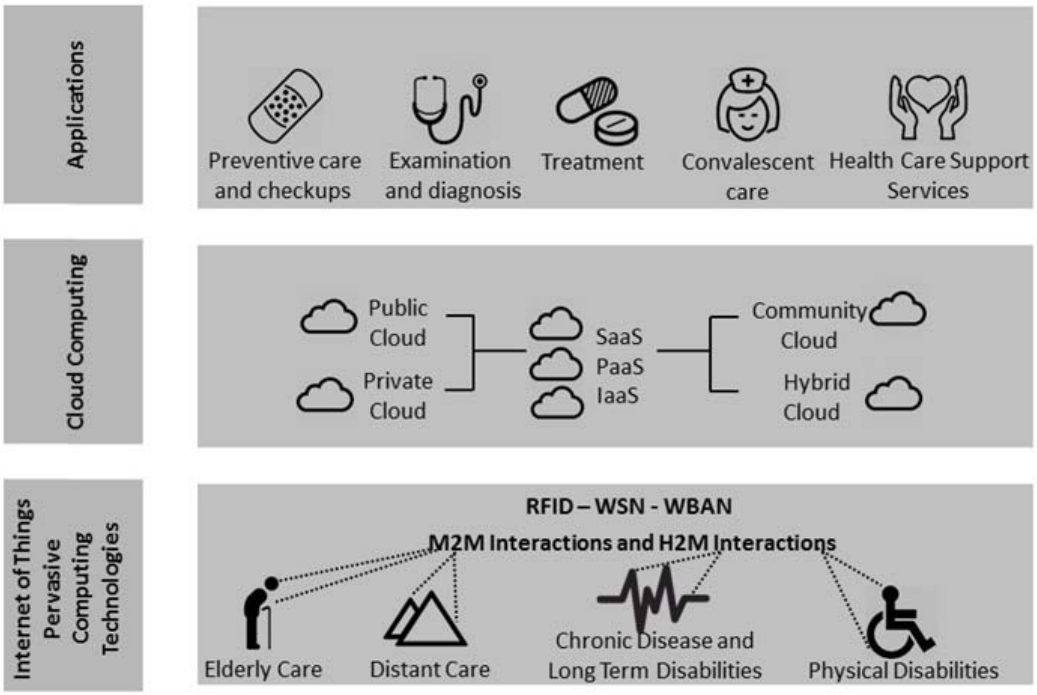

Figure 3.11. Conceptual platform for Smart services in healthcare

Chapter 4

General Conclusions

4.1. Conclusions, Implications and Limitations of the Study and Future Research Lines

4.1.1. Introduction

The present thesis has analyzed the role played by ICT within the supply chain scope, as a tool for enhancing supply chain management and developing innovative firm strategies. Following that overall objective, the chapter one of the thesis introduces and contextualizes the importance of the research topic, the scope of the research, and the objectives expected to be covered through its development. Further, in chapter two the thesis presents a vast and detailed theoretical framework including all the main concepts and their relationship in the study. Principally the chapter analyzes widely the concepts of Supply Chain Management (SCM), Information and Communication Technologies (ICT), and ICT-enabled firm strategies, three fundamental subjects that represent the backbone of this study. In chapter three, the thesis present the research methodologies used to conduct three individual studies and the significant results obtained from them. These studies have been elaborated to explore the relevance of ICT in supply chain and firm strategy. To conclude, the present chapter outlines the main conclusions, implications and limitations derived from this thesis, as well, provides some recommendations for further research directions.

4.1.2. General Conclusions of the Study

The main conclusions that emerged from this thesis focus on the potential of ICT to deliver high value enabling companies to improve their efficiency, productivity, flexibility and responsiveness to meet the ever changing market requirements (Gunasekaran and Ngai, 2004). To obtain such benefits, this thesis establishes the strategical importance of partners in supply chain initiatives, setting as a key factor for competitive positioning the integration of suppliers and customer's information into the overall value chain processes (Prajogo and Olhager, 2012).

The main objective behind this integration process is to reduce Supply Chain Management (SCM) uncertainty and facilitate decision making and market actions (Bensaou and Venkatraman, 1995). To that aim, the study highlights the relevance of ICT, particularly Enterprise Resource Planning (ERP) systems and Internet of Things (IoT) as the tools capable to integrate, store and manage sensitive supplier/customer information fundamental in organizations for achieving objectives and promoting improvements in performance (Kallunki et al., 2011).

Therefore, the study stablishes that one of the main effects of ICT in SCM is the capacity of sharing large amounts of information from partners along the supply chain in real time, extending the value creation process beyond the boundaries of the firm (Tan et al., 1998). Nevertheless, such, strategic objectives require the extension of the traditional scope of ERP systems, to gather and integrate seamlessly the information transferred by customers and suppliers. However, this extension or adaptation must be carried out selecting the best type of customization (adaptation). On this matter, it is presented one innovative solution for organizations' dealing with customization or adaptation; this is the adoption of Bolt-ons extensions or specialized external extensions that complement generic ERP package functionalities.

Thus, it is proposed that organizations that strengthen ERP systems with Bolt-on extensions will allow the interconnection of internal operations in a company with suppliers and customers in the supply chain structure. Such integration will allow companies, from customer's side, to direct their efforts to "what is demanded", and, from the supplier's side, to agree on competitive costs and high-quality components to develop future products and services. In this way, companies can aim to fulfil customers' needs and requirements according to their specific demands, to "satisfy what is demanded" by reorienting the traditional supply chain into a customer-oriented supply chain.

An important contribution contained in this thesis is the introduction of a technological breakthrough denominated the Internet of Things (IoT), a global network platform of interconnected objects with the capacity to gather information from the environment and interact with the physical world around them, and which by using

Internet standards provide services for information transfer, analytics, applications, and communications (Gubbi et al., 2013). This new advancement in ICT allows information access from the physical world accelerating the generation of multiple business opportunities and introducing novel business models capable of delivering substantial economic and social benefits (Mattern and Floerkemeier, 2010).

Furthermore, the growing capacity of ICT to gather, store and distribute sensitive information into strategic business initiatives will give rise to a wide innovative highly technologically enabled business strategies. On this matter, the study introduces the concepts of:

- Servitization, a novel business strategy that involves the innovation of an organization's capabilities and processes to shift from selling products to selling integrated product and service offerings (or "solutions") that delivers value-in-use (Baines et al., 2007).

- Smart services, an ICT-based service strategy aimed at extracting meaning from the data initially collected from a customer/end-users and return back that meaning in the form of a service—a Smart Service—capable to meet customized needs, requirements, and provide suggestions.

Both business strategies represent a new frontier for value generation and recognition of new opportunities for innovation driven by collaboration and participation with partners/users.

Overall, the thesis has been developed with a robust theoretical framework. In this sense, every chapter provides detailed insights to understand the concepts presented, offering to the reader a comprehensive and coherent reading to assure a clear understanding of the main concepts supporting the study. Therefore, this thesis attempts to contribute to the future development of Management and Information and Communication Technology (ICT) scientific literature.

4.1.3. Particular Conclusions, Implications, Limitations and Future Research Lines

The particular or individualized conclusions of this thesis are provided from the individual studies included in chapter three.

The first of these studies is called *"The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain: Evidence from a Single Case Study"*, which reviews the route toward a customer-oriented supply chain, exploring the requirements needed to achieve it.

The study describes an ERP system customization, specifically; a technical customization that adapts the ERP system to fit processes. The study also highlight the importance and the benefits of CRM and SRM bolt-on extension for companies adopting customer orientation as a new strategy for achieving competitive advantage.

Main conclusions arising from this study focus on proposing a new integrative perspective in which the strategic potential of an ERP system integrating the partner's information should be understood, the use of CRM and SRM bolt-on extensions should be considered to integrate partners' information, supplier information should be perceived as an important source of information in product and service designs, and a new guiding strategy should be defined to lead the company into a totally customer-oriented supply chain (Barnett et al., 2013).

The implications of this study are intended to be useful in two ways, to both the academic and the practitioner communities. It is hoped that the findings will open a debate on the use of bolt-on extensions in orienting traditional supply chains toward customer-oriented supply chains so that future research begins to build a body of theory that addresses the current gap in the literature.

Furthermore, practitioners should consider the experience of the company case study presented here, focusing in particular on the challenges that may be expected during the transition to a customer-oriented supply chain. This study will enable

practitioners to consider ERP systems and bolt-on extensions as strategic and essential tools during the journey of transformation.

The main limitation of this research is associated with the use of the single-case study method. Therefore, the findings presented cannot be used as predictive tools. Other limitations are the possible bias of the researchers and limited generalization from the findings. Nevertheless, the findings of the study could lead us to tentative proposals for future research in this area, where a multiple case approach, followed by a survey, should be performed in the future to find statistical generalizations.

The second study included in this thesis is denominated *"The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance: Evidence from an Empirical Analysis"*, which examine the effect of operational ERP benefits over firm's competitive priorities, and in firm's performance.

Main conclusions emerged from the study confirm that ERP systems are designed to integrate and optimize the complete range of business processes and functions, facilitating the coordination of activities across the firm to develop more efficient operations (Bradford and Florin, 2003). This in turn may have a significant influence on the firm's competitive strategy, as determined the establishment of competitive priorities in terms of cost, flexibility, innovation, quality and time.

From the set of ERP benefits included in literature, this study is able to confirm that ERP benefits in operations support and influence competitive priorities, and this consequently have an impact on firm performance. Results reveal that ERP systems facilitate the automation of firm's multifunctional processes, enabling better planning, production and resources management, all of which have a positive influence on firm flexibility (Ng et al., 1999; Klaus et al., 2000). Further, ERP systems enable direct communication channels to different functional areas within the organization (Li et al., 2008; Stratman and Roth, 2002), facilitating the coordination of activities and increasing organization's efficiency, since they affect quality and time associated with improved products, and rapid response to customer (Lin et al., 2011).

One significant implication of this study is that confirms the importance of developing firm's competitive priorities for improving firm performance, depending on the competitive strategy pursued. With respect to the strategic orientation for improving organizational performance; results disclose that time and quality competitive priorities affect performance measures through greater organizational efficiency, however, this effect is supported by the capacity of ERP systems to generate operational benefits (Cotteleer and Bendoly, 2006; Federici, 2009; Ram, et al., 2013). Finally, the effect of quality competitive priority on organizational performance reflects that ERP systems positively affect firms' performance when the system implementation directly interacts with other resources focused on quality improvements (Laframboise and Reyes, 2005).

Among the limitations of this study the authors highlight its exploratory character, which attempts to determine relationships between the variables proposed. The study thus provides a static analysis and may omit other important factors that play an important role in the context of operational ERP benefits, even though significant relationships between the variables have been found.

A future research should include all ERP system benefits as a way to compare the relevance of operational benefits among the rest, as well as to individualize the effect of each of them on firm performance. Moreover, a future research line that holds much promise consists in studying the joint effect of the functioning of an ERP system and a lean production system, as this could bring to light transcendent relationships between strategic and managerial ERP benefits and competitive strategy. Moreover, this analysis between strategic and managerial benefits must include issues related to organizational learning. Thus, it could be concluded that future research lines should study the role that organizational learning plays as a construct in the relationship between ERP benefits, competitive priorities, and firm performance.

The third study included in this thesis is denominated *"A Roadmap Towards Smart Services in Healthcare: Taxonomy of Technologies for Services Generation"*, which attempts to illustrate fundamental technological requirements that guide healthcare institutions

toward smart services provision, based on emerging technologies led by the Internet-of-Things (IoT) paradigm.

The main conclusion that emerge from this study confirms that present technological advancements explored in this study have the potential to transform how health care is provided now and in future, enabling a wide range of new promising possibilities for health care provision and, thus, unprecedented benefits never experienced in this sector before.

Main implications emerged from this study refers to the transformation and democratization of healthcare services through the inclusion of smart services.

From patient's perspective: allowing them to be monitored by unobtrusive sensing technologies capable to communicate physiological signs anywhere, anytime on a timely basis in a comfortable way, allowing them to lead a normal life.

From the perspective of healthcare personnel, empowering professionals to deliver better services enabling the supervision of patients' health remotely, that is at home instead of at hospital facilities and without the physical presence of health care staff, reducing substantially time and financial cost from patients and health- care providers. Furthermore, the continuous monitoring provides timely and accurate information that facilitates better decision-making capabilities focused on empowering patients in prevention and treatment of disease, thereby achieving a high patient-centered orientation as well as treatment efficiency.

The main limitation of the present study is that relies largely on a qualitative exploratory analysis, which can be considered restrictive; therefore, the results obtained should not be generalized, rather considered as a starting framework for future research lines.

Future research directions should investigate in detail the impact of these services in healthcare institutions and categorize benefits derived from their implementation, as well, new research directions should be opened for smart services in diverse settings. Particularly, it should be investigated the impact of Internet-of-things and its transformational power in Supply Chain Management (SCM) and firm strategy.

To conclude, the present thesis has reviewed the role of ICT in supply chain and firm strategy providing a concise methodological approach over important topics for firms in today's competitive landscape. Moreover, it provides important insights on the concepts included in every chapter offering to the reader a logical path to understand the scope and the objective of the thesis. In this way, it is expected that researchers, practitioners and academics take into consideration the present study as a starting point for future research or/and initiatives on supply chain settings, where the transformative role of ICT is the key starting point for future supply chains.

Capítulo 5

Conclusiones del Estudio

5.1. Conclusiones, Implicaciones, Limitaciones y Futuras Líneas de Investigación

5.1.1. Introducción

La presente tesis ha analizado el papel que desempeñan las Tecnologías de la Información y Comunicación (TIC) en el contexto de la cadena de suministro, como una herramienta para mejorar su gestión y desarrollar estrategias empresariales innovadoras. En el primer capítulo de esta tesis se presenta y contextualiza la importancia del tema de investigación, el alcance de la investigación, así como los objetivos que se esperan cubrir a través del desarrollo de la misma.

Así mismo, en el capítulo dos de esta tesis se presenta un vasto y detallado marco teórico que incluye todos los conceptos principales y sus relaciones a lo largo del estudio. En concreto, el capítulo analiza ampliamente los conceptos sobre la Gestión de la Cadena de Suministro (GCS), las Tecnologías de la Información y Comunicación (TIC), y distintas estrategias empresariales basadas en el soporte de las TIC; tres conceptos fundamentales que representan la columna vertebral de este estudio.

En el capítulo tres de la presente tesis se introducen las metodologías de investigación y los resultados obtenidos a partir de tres estudios individuales, orientados a explorar el papel de las TIC en la cadena de suministro y la estrategia empresarial. Finalmente, El presente capítulo expone las principales conclusiones, implicaciones y limitaciones de esta tesis y proporciona recomendaciones para futuras líneas de investigación.

5.1.2. Conclusiones Generales del Estudio

Las principales conclusiones que han surgido de esta tesis se centran en el potencial de las TIC para generar un alto valor competitivo, permitiéndole a las empresas mejorar su eficiencia, productividad, flexibilidad y capacidad de respuesta ante las peticiones y necesidades de un mercado en constante cambio (Gunasekaran y

Ngai, 2004). A tales fines, esta tesis establece la importancia estratégica de los socios en las iniciativas dirigidas a la Cadena de suministro, estableciendo como un factor clave del posicionamiento competitivo la integración de la información de proveedores y clientes en los procesos de la Cadena de valor (Prajogo y Olhager, 2012).

El objetivo principal en este proceso de integración es reducir la incertidumbre en la gestión de la Cadena de suministro y facilitar la toma de decisiones orientadas al mercado (Bensaou y Venkatraman, 1995). Ante tal objetivo, el estudio pone de relieve la importancia de los sistemas ERP y del Internet-de-las-Cosas (IdC), estableciéndolas como las herramientas capaces de integrar, almacenar y gestionar la información tanto de clientes como proveedores, un proceso fundamental para el logro de objetivos y mejoras en el rendimiento (Kallunki et al., 2011).

En consecuencia, el estudio establece que uno de los principales efectos de las TIC en la GCS es la capacidad de compartir grandes cantidades de información de los socios a lo largo de la cadena en tiempo real, ampliando el proceso de creación de valor más allá de los límites de la organización (Tan et al., 1998). Sin embargo, estos objetivos estratégicos, requieren la ampliación del alcance tradicional de los sistemas ERP, con el fin de reunir e integrar sin problemas la información transferida por los clientes y proveedores. No obstante, dicha ampliación o extensión del sistema debe llevarse a cabo seleccionando el adecuado tipo de Customización (adaptación). En esta tesis, se presenta una solución innovadora, orientada a satisfacer la alta demanda por parte de las organizaciones hacia la Customización o adaptación; esta es la adopción de las extensiones Bolt-ons o extensiones externas especializadas que complementan las funcionalidades de los sistemas ERP genéricos.

De este modo, se establece que las organizaciones que fortalecen sus sistemas ERP con extensiones Bolt-ons agilizan la interconexión de las operaciones internas de una empresa con sus proveedores y clientes a lo largo de la Cadena de suministro. Esta integración permitirá a las empresas, desde la perspectiva del cliente, dirigir sus esfuerzos hacia "lo que realmente se demanda", y, por el lado del proveedor, facilitará la elección de costos competitivos y componentes de alta calidad para el desarrollo de futuros productos y servicios. De esta manera, las empresas se centran solo en

satisfacer las necesidades y requerimientos de los clientes de acuerdo a sus demandas específicas, reorientando la Cadena de suministro tradicional hacia una cadena de suministro orientada al cliente.

Una contribución importante incluida en esta tesis es la introducción de un avance tecnológico denominado Internet-de-las-Cosas (IdC), una plataforma de red global de objetos interconectados con la capacidad para recopilar información del entorno e interactuar con el mundo físico que les rodea y que mediante el uso de normas de Internet (protocolos) permite suministrar servicios de transferencia de información, análisis, aplicaciones y comunicaciones (Gubbi et al., 2013). Este nuevo avance en las TIC permite el acceso a la información del mundo físico acelerando la generación de múltiples oportunidades estratégicas y la introducción de nuevos modelos de negocio capaces de proporcionar sustanciales ventajas económicas y sociales (Mattern y Floerkemeier, 2010).

A su vez, la creciente capacidad de las TIC para recopilar, almacenar y distribuir información relevante e integrarla en iniciativas estratégicas o de negocios dará lugar a una amplia innovadoras gama de estrategias empresariales basadas íntegramente en el soporte de las TIC. En este sentido, la actual tesis introduce los conceptos de:

• Servitization, una nueva estrategia de negocio que implica la innovación de las capacidades y los procesos de una organización con el fin de avanzar de la venta de productos a la venta de productos y ofertas de servicios integrados (o "soluciones"), las cuales ofrecen un valor en uso (Baines et al., 2007) .

• Servicios inteligentes, una estrategia de servicios basados en las TIC dirigida a determinar el significado de los datos recogidos de un cliente / usuario y retornar o devolver estos datos a dicho cliente / usuario, esta vez en forma de un servicio o de un “Servicio inteligente” capaz de satisfacer las necesidades y requisitos de forma personalizada y proporcionar sugerencias que generan un alto valor en uso.

Ambas estrategias representan una nueva frontera para la generación de valor y el reconocimiento de nuevas e innovadoras oportunidades, impulsadas por la colaboración y participación de socios / usuarios.

En general, la presente tesis se ha desarrollado bajo un robusto marco teórico. En este sentido, cada capítulo ofrece una detallada elaboración con el fin de dar a conocer de forma concreta los conceptos presentados, ofreciendo al lector una lectura coherente que asegure la comprensión clara de los principales conceptos que soportan este estudio. En consecuencia, esta tesis pretende ser una contribución al desarrollo futuro de la literatura científica, en las áreas de la Organización de Empresas y las Tecnologías de Información y Comunicación (TIC).

5.1.3. Conclusiones, Implicaciones y Limitaciones Particulares, y Futuras Líneas de Investigación

Las conclusiones particulares de esta tesis se desarrollan a partir de los estudios individuales incluidos en el capítulo tres.

El primero de estos estudios se denomina *"The Role of ERP Bolt-on Extensions in Supply Chain Management; Toward a Customer-Oriented Supply Chain: Evidence from a Single Case Study*", el cual examina la ruta hacia una cadena de suministro orientada al cliente y explora los requisitos necesarios para lograrlo.

El estudio describe una adaptación o Customización del sistema ERP, específicamente; una adaptación técnica, la cual permite que el sistema ERP se adapte o customize de acuerdo a los procesos de una empresa. Este estudio resalta la importancia y los beneficios de la implementación de las extensiones especializadas o Bolt-ons orientadas a la gestión de clientes (CRM) y proveedores (SRM) para aquellas empresas que adoptan la orientación al cliente como una nueva estrategia para conseguir una ventaja competitiva.

Las principales conclusiones derivadas de este estudio se centran en proponer una nueva perspectiva integradora, la cual considere el potencial estratégico del sistema ERP e incluya el uso de estas extensiones especializadas (Bolt-ons), con el fin de integrar la información de clientes y proveedores. Concretamente, el estudio establece que tanto la información de proveedores como de clientes debe considerarse una importante fuente de conocimiento en el diseño y rediseño de productos y servicios,

siendo este el primer paso hacia una cadena de suministro totalmente orientada al cliente (Barnett et al., 2013).

Las implicaciones del estudio se dirigen principalmente a los profesionales del área, los cuales deben considerar la experiencia de la empresa objeto de estudio que aquí se presenta, centrándose particularmente en los desafíos a los que deben hacer frente durante la transición hacia una cadena de suministro orientada al cliente. Consecuentemente, este estudio permitirá a los profesionales conocer el potencial de los sistemas ERP y las extensiones especializadas (Bolt-ons) como herramientas estratégicas y esenciales durante el viaje de transformación.

La principal limitación de este estudio tiene relación con el método de estudio utilizado, estudio de caso único o Single-case study. En consecuencia, los resultados presentados no se pueden utilizar como herramientas de predicción. Otras limitaciones son la posible parcialidad analítica de los investigadores y la generalización de los resultados obtenidos. Sin embargo, los resultados del estudio pueden establecerse como un punto de partida y dar lugar a propuestas tentativas que sirvan de base para futuras investigaciones en esta área,

Se espera que los resultados abran un debate sobre el uso de las extensiones especializadas (Bolt-ons) en el proceso de re-orientación de una Cadena de suministro tradicional hacia una cadena de suministro orientada al cliente, y que de esta manera futuras investigaciones aborden la brecha existente en la literatura.

Futuras líneas de investigación deben abordar el impacto de las extensiones especializadas (Bolt-ons) y sus posibles beneficios en las medidas de rendimiento de la empresa, principalmente, mediante un enfoque de múltiples casos, seguido de una encuesta, con el fin de establecer generalizaciones estadísticas.

El segundo estudio incluido en esta tesis se denomina "*The Impact of ERP Operational Benefits on Firm Competitive Priorities and Firm Performance: Evidence from an Empirical Analysis*", el cual examina el efecto de los beneficios operativos de un sistema ERP sobre las prioridades competitivas y las medidas de rendimiento de la empresa.

Las principales conclusiones del estudio confirman que los sistemas ERP están diseñados para integrar y optimizar una amplia gama de procesos de negocio y funciones, facilitando la coordinación de actividades a lo largo de la empresa orientadas a un desarrollo operacional más eficientes (Bradford y Florin, 2003). Esto a su vez tiene una influencia significativa en la estrategia competitiva de la empresa, la cual está determinada por el establecimiento de las prioridades competitivas en términos de coste, flexibilidad, innovación, calidad y tiempo.

Del conjunto de beneficios establecidos en la literatura, este estudio confirma que los beneficios operacionales del sistema ERP soportan e influencian las prioridades competitivas establecidas por la empresa, y esto, en consecuencia tiene un impacto en los resultados empresariales. Los resultados revelan que los sistemas ERP facilitan la automatización de procesos multifuncionales, lo que permite una mejor planificación, producción y gestión de los recursos, lo que redunda positivamente en la flexibilidad de la empresa (Ng et al., 1999; Klaus, Rosemann y Gable, 2000). Además, los sistemas ERP permiten canales de comunicación directos con las diferentes áreas funcionales dentro de la organización (Li et al, 2008;. Stratman y Roth, 2002), lo que facilita la coordinación de las actividades y aumenta la eficiencia de la organización, ya que afectan a la calidad y al tiempo asociado con la mejora de productos y servicios, así como también a la respuesta rápida a los clientes (Lin et al., 2011).

Una de las conclusiones relevantes de este estudio es que confirma la importancia de establecer prioridades competitivas orientadas a la mejora del rendimiento, en función de la estrategia competitiva que se decida perseguir. Con respecto a la orientación estratégica y su impacto en la mejora del rendimiento de la empresa; los resultados revelan que las prioridades competitivas de tiempo y la calidad afectan a las medidas de rendimiento a través de una mayor eficiencia organizacional, sin embargo, este efecto es apoyado por la capacidad de los sistemas ERP para generar beneficios operacionales (Cotteleer y Bendoly, 2006; Federici, 2009;. Ram, et al, 2013). Por último, el efecto de la prioridad competitiva de calidad sobre el rendimiento organizacional refleja que los sistemas ERP afectan positivamente el rendimiento de las empresas

cuando este sistema interactúa directamente con otros recursos centrados en las mejoras de calidad (Laframboise y Reyes, 2005).

Entre las limitaciones de este estudio, se debe poner de relieve su carácter exploratorio, el cual intenta determinar las relaciones entre las variables propuestas. Así, el estudio proporciona un análisis estático y puede omitir otros factores relevantes que jueguen un papel importante en el contexto de los beneficios operacionales del sistema ERP, a pesar de relaciones significativas que se han encontrado entre las variables.

Una futura línea de investigación debe incluir todos los beneficios del sistema ERP con el fin de comparar la relevancia de los beneficios operacionales con el resto de beneficios, así como para individualizar el efecto de cada uno de ellos sobre los resultados empresariales. Por otra parte, una futura línea de investigación que es muy prometedora consiste en estudiar el efecto conjunto del funcionamiento de un sistema ERP y un sistema de producción ajustada (Lean), ya que esto podría traer a la luz relaciones trascendentes entre los beneficios estratégicos y de gestión del sistema ERP y la estrategia competitiva de una empresa. Por otra parte, el análisis entre los beneficios estratégicos y de gestión debe incluir los temas relacionados con el aprendizaje organizacional. Por lo tanto, se podría concluir que las futuras líneas de investigación deben estudiar el papel que juega el aprendizaje organizacional como un constructo en la relación entre los beneficios del sistema ERP, las prioridades competitivas y resultados de la empresa.

El tercer estudio incluido en esta tesis se denomina *"A Roadmap towards Smart Services in Healthcare: Taxonomy of Technologies for Services Generation"*, el cual establece los requerimientos tecnológicos fundamentales que guían a las instituciones de salud hacia la prestación de servicios inteligentes, basados en tecnologías emergentes y lideradas por el nuevo paradigma tecnológico llamado Internet-de-las-Cosas (IdC). La principal conclusión que emerge de esta investigación se centra en establecer que los actuales avances tecnológicos analizados a lo largo del presente estudio tienen el potencial de transformar la forma en que se proporciona la asistencia sanitaria, tanto en la actualidad como en el futuro, permitiendo a su paso una amplia gama de nuevas

posibilidades orientadas a la mejora de la gestión sanitaria y, por lo tanto, múltiples beneficios nunca experimentados anteriormente en este sector.

Desde la perspectiva del paciente: los servicios inteligentes o "Smart" les permiten ser monitorizados por tecnologías de sensores discretos capaces de comunicar señales fisiológicas en cualquier lugar, en cualquier momento de manera oportuna y cómoda, lo que facilita a los usuarios llevar su vida con total normalidad.

Desde el punto de vista del personal de salud: los servicios inteligentes facilitan la gestión sanitaria, introduciendo una amplia variedad de servicios orientados a la supervisión o monitorización de los parámetros de salud de los pacientes, de forma remota o a distancia, es decir, desde cualquier lugar, sin necesidad de encontrarse en las instalaciones hospitalarias y sin la necesidad de la presencia física del personal de salud, lo que reduce sustancialmente tanto el tiempo como el costo financiero de los pacientes y de los proveedores de los servicios de salud.

A su vez, el seguimiento continuo proporciona una gran fuente de información oportuna y precisa que agiliza y facilita la capacidad de toma de decisiones, además mediante la cooperación de datos relevantes, se logra implicar a los pacientes en la prevención y tratamiento de una condición o enfermedad, lo que consigue una alta orientación centrada en el paciente, así como la eficiencia del tratamiento.

El presente estudio se basa en gran medida en un análisis cualitativo exploratorio, Por lo tanto, los resultados obtenidos no deben ser generalizados, sino más bien, deben considerarse como un marco de referencia para futuras líneas de investigación.

Futuras líneas de investigación deben analizar en detalle el impacto de estos servicios en las instituciones de salud y clasificar los beneficios derivados de su aplicación o implementación, además, se deben abrir nuevas líneas de investigación sobre los Servicios inteligentes en diversos entornos. En particular, se debe investigar el impacto del Internet-de-Cosas y su poder de transformación en la gestión de la cadena de suministro y la estrategia empresarial.

Para concluir, la presente tesis ha explorado el papel de las TIC en la Gestión de la Cadena de Suministro (GCS) y la estrategia empresarial, proporcionando un enfoque

metodológico conciso sobre temas relevantes para el entorno competitivo de hoy en día. Al mismo tiempo, proporciona información sustancial sobre cada uno de los conceptos que se incluyen en cada capítulo, ofreciéndole al lector un camino lógico para entender tanto el alcance como el objetivo de la tesis. Finalmente, se espera que investigadores, profesionales y académicos tomen en consideración el presente estudio como punto de partida para futuras investigaciones y/o iniciativas en el marco de la de la Cadena de suministro, en los cuales el papel transformador de las TIC sea la piedra angular.

Chapter 6

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