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The impact of Information Technology on the development of Supply Chain Competitive Advantage

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Abstract

This paper explores the impact of Information Technology (IT) practices on building competitive advantage throughout the supply chain. A competitive advantage is based on capabilities that provide the necessary grounds of an organization to differentiate itself from its competitors. The majority of the relevant empirical literature identified price/cost, quality, delivery dependability, product innovation, and time to market as the most decisive sources of competitive advantage. As far as the standards in the economic environment are changing and global competition is fiercer, organizations realize that they have to re-evaluate their enterprise business model in order to gain supply chain efficiencies. To meet these challenges and improve their competitive advantage, companies need to both support their internal functions and exchange information with supply chain partners in an effective way. Therefore, companies must exploit IT including enterprise applications such as ERP and CRM, as well as e-procurement and e-commerce. The empirical findings from a survey of 76 manufacturing firms in Greece confirmed the crucial role of IT practices and techniques on the establishment of a sustainable competitive advantage based on Supply Chain Management. Managerial implications are discussed.

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Keywords: *information technology; supply chain; competitive advantage*

1. Introduction

New technologies, global competition, and increased customer demands are forcing organizations to reconsider how they can take advantage of Information Technology (IT) capabilities to better manage their supply chains. Traditionally, Supply Chain Management (SCM) is mainly considered a process for obtaining and moving goods

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and services. Modern aspects focus on strategic SCM, where supply chains are used as a means to create competitive advantages and enhance firm performance (Ketchen et al., 2008). IT practices and techniques are used to enable information sharing across supply chain partners, by integrating both internal and external business functions. In addition, the alignment of IT goals and objectives with strategic SCM can increase efficiency, productivity, and profitability.

In this paper, we explore the impact of information technology (IT) on the development of competitive advantage throughout the supply chain. We present the methodology and findings of a field research that was conducted in 2013, in 76 manufacturing firms at the region of Central Greece. The aim of this survey is the investigation of the impact of several IT techniques and methods on SCM competitive advantage. A structured questionnaire was built by adapting existing scales in the IT & Supply Chain Management literature measuring IT techniques and methods, as well as Supply Chain competitive advantage. The results confirm the crucial role of IT techniques and methods on the establishment of a sustainable competitive advantage based on Supply Chain Management.

The rest of the paper is organized as follows: Section 2 discusses issues concerning the application of IT for SCM. Section 3 presents the methodology of the field research that was conducted. Section 4 describes the data analysis and the results that were revealed. Finally, Section 5 concludes the paper.

2. Information Technologies for Supply Chain Management

A supply chain is a network that consists of suppliers, manufacturers, warehouses, distributors and retailers who coordinate their plans and activities in order to convert raw materials to finished goods (Chandra and Grabis, 2007). The required materials and products must be provided to customers in the right quantities and best quality, at the right location, at the right time and at the lowest cost. The most important supply chain processes include product development, procurement, manufacturing, physical distribution, customer relationship management and performance measurement (Olson, 2012). SCM aims to support the organization providing the means to link technology and people and trying to align the technology with the capabilities of the organization and among its trading partners (Shaik and Abdul-Kader, 2013). SCM enables trading partners to coordinate their processes through information sharing to facilitate supplier-customer interactions and minimize transaction cost.

Competitive advantage is the extent to which an organization has the competency to create a defensible position over its competitors as a result of critical management decisions, which differentiates itself from its rivals. Although empirical research has indicated cost, quality, delivery, and flexibility as important competitive capabilities (Ketchen et al., 2008), recently time and innovation have been identified as the next sources of competitive advantage. Nelson (2001) stresses the importance of gaining sustainable competitive advantage from Information Technology. Moreover, Ketchen et al. (2008) determine supply chain information systems as one of the key areas where best value supply chain differ from traditional supply chains. Therefore, the development of IT systems for SCM that support and speed up all business activities, improving decision making and productivity, can build competitive advantage throughout the supply chain. This is accomplished through the exploitation of IT for internal and external integration of business processes.

First, companies need IT techniques and methods to enable the integration of their internal business functions. This can help companies to become efficient, improve their productivity, and respond rapidly to customer needs. SCM systems are information systems for logistics management, transportation management, strategic planning, warehousing, inventory, manufacturing, supplier management, and customer management (Turek, 2013). Enterprise Resource Planning (ERP) systems are included as part of the broader SCM software. ERP systems are employed to integrate business processes, by organizing, codifying and standardizing business processes and data (Norris et al., 2000). They enable employees to access the common database and manage data in a uniform way, preventing the expense on transportation of data from one department to another. Data integration ensures the accuracy of data and prevents data redundancy and repetitions of data. Moreover, ERP reports can be used to forecast production and make decisions. Another key supply chain process is Customer Relationship Management (CRM), which is the management of relationships between the organization and its customers. A critical issue for internal integration of business processes is the integration of ERP with CRM. Recently, many ERP vendors provide an ERP-CRM integration package, since many enterprises have expressed an interest in integrating a new CRM system with their legacy ERP system. Moreover, the establishment of ERP and CRM systems should be a primary concern of an enterprise that is interested in embarking on e-business (Yanjing, 2009).

Then, companies can exploit the advances in IT techniques and methods to enable the integration of their external business functions. Companies can become "extended" by enabling connectivity to business partners, suppliers, and customers. Norris et al. (2000, p.6) reported "In the future companies will work together in extended value chains. Those that are able to plug their internal information systems into the information chain that parallels the physical-goods chain will prosper". Companies need to exchange critical information such as demand forecasts, actual orders, and inventory levels in an efficient way (Marakas, 2003), while protecting each company's proprietary data (Ketchen et al., 2008). The adoption of interorganizational information systems (IOS) for Supply Chain Management has been proposed to enable external integration (Premkumar, 2000; Grover & Saeed, 2007; Shaik and Abdul-Kader, 2013). The IOS include Electronic Data Interchange (EDI) networks, extranets, customer-oriented strategic systems, electronic commerce (e-commerce) and electronic markets. In order to implement IOS, software companies provide applications, platforms and services such as Internet Web services, Application Programming Interfaces (APIs), software-as-a-service (SaaS) development platforms, and Software Development Kits (SDKs) (Turek, 2013).

In order to take advantage of the application of ITs for SCM, organizations have also to understand that the design and implementation of their own IT techniques and methods must be compatible with those of their supply chain partners and that the level of automation between partners must be synchronized. Otherwise, the organization will be "isolated", or face "gaps" in supply chain visibility (Jeyaraj and Seth, 2010). Therefore, companies need to comply with standards and legal frameworks for the application of ITs in SCM (Gunasekaran and Ngai, 2004; Jeyaraj and Seth, 2010). For example, the Supply Chain Council has developed the Supply Chain Operations Reference (SCOR®) world standard for supply chain management. This is a model that provides a unique framework for defining and linking performance metrics, processes, best practices, and people into a unified structure (Supply Chain Council, 2013). Companies can use this or other similar models to monitor supply chain performance and rapidly detect and correct deviations.

Furthermore, organizations have to concentrate on the strategic business alignment with IT goals and objectives, in order to maximize IT investments and achieve harmony with business strategies and plans (Papp, 2001). This alignment is a prerequisite for a business to survive in the fierce global competition and the digital era. The strategic point of alignment is the value creation that enables a company to develop a strong competitive advantage and thus not only to survive, but also to become a leader in the market (Marinagi et al., 2011). Also, a recent study (Torabizadeh et al., 2012), consider aligning Information Systems with SCM strategies and demonstrate their impact on supply chain and firm performance.

3. Methodology

3.1. Questionnaire design

The field research was based on a structured questionnaire. It was built by adapting existing scales in the IT & Supply Chain Management literature measuring IT techniques and methods, as well as Supply Chain competitive advantage.

After an extensive review of IT research, we concluded to 19 IT techniques and methods. This list was enriched with aspects which can also be traced in SCM. A number of researchers have also adopted these IT techniques and methods. A review of past research on SCM also indicates that there have been variations in measuring competitive advantage stemming from SCM of organizations.

For the purpose of comprehensively capturing the aspects of Supply Chain Management competitive advantage, our construct was built on the basis of several criteria which are conceptualized and used in previous empirical studies (Li et al., 2006). SCM competitive advantage scale consists of 8 items, specified in a 7-point Likert scale and has been validated in similar contexts to those in our study.

Principal Component Analysis (PCA) with normalized varimax rotation was performed and one factor was extracted from the SCM competitive advantage measure, explaining approximately 72% of the overall variance. Preceding PCA, the Bartlett sphericity testing on the degree of correlation between the variables ($p<0.001$) and the Kaiser–Meyer–Olkin (KMO) index verified the appropriateness of the sample. Cronbach's coefficient alpha was calculated to test internal reliability (0.942), as recommended by Flynn et al. (1990), and it proved to be well over the minimum acceptable reliability level of 0.7.

3.2. Sampling

The field research was conducted in 2013, using a structured questionnaire in order to test the impact of several IT techniques and methods on SCM competitive advantage, in a cross-sectional sample of firms at the region of Central Greece. Our sample aims at manufacturing industries and the firms have been selected from ICAP database (The Greek Financial Directory). The final sample consisted from 300 manufacturing SMEs with 10 to 250 employees.

The questionnaire was tested twice before it was released, by ten logistics managers from different companies and by academics for in depth discussions. They confirmed the cognitive relevance of the questionnaire to the Supply Chain of manufacturing firms. The resulting questionnaires were distributed to logistics managers or top executives since they are the ultimate decision makers and key informants to answer with a wider view of their business internal and external environment. From the initial sample of 300 enterprises, 76 firms responded achieving a response rate of 25.3 %, which is considered to be satisfactory for this type of empirical research.

4. Data analysis and findings

Table 1 provides the mean scores, standard deviations and t-test results of the differences between the mean and mid-point (at a 7-point Likert scale, mid-point=4). The standard deviations for each of the scores indicate that respondents' views varied considerably across the sample. Overall, the difference between the mean scores and the mid-point indicates that respondents perceived that they extensively use internet for procurement (mean diff.= 1.197, $p<0.001$), as well as intranet within organization's boundaries (mean diff.= 0.918, $p<0.001$). However, they do not have electronic interconnection with suppliers (mean diff.= -0.859, $p<0.001$), they do not apply SCM systems (mean diff.= -0.529, $p<0.05$), nor any RFID (mean diff.= -0.913, $p<0.001$), picking by light (mean diff.= -1.563, $p<0.001$), picking by voice (mean diff.= -2.141, $p<0.001$) technologies.

Moreover, correlation analysis was conducted. Table 1 shows the bi-variate relationships (Spearman's Rho) between the various IT methods and techniques and Supply Chain Management competitive advantage. The results show that the use of electronic prototypes (EDI, XML, other) for data exchange, ($r=0.480$, $p<0.001$, $r=0.514$, $p<0.001$, $r=0.467$, $p<0.001$, respectively), e-invoicing ($r=0.398$, $p<0.001$), CRM ($r=0.379$, $p<0.001$), and SCM ($r=0.397$, $p<0.001$) systems have significant influence on the development of SCM competitive advantage. A similar pattern of findings is reported for internet usage ($r=0.262$, $p<0.05$), extranet usage ($r=0.263$, $p<0.05$), online shopping ($r=0.286$, $p<0.01$), electronic interconnection with suppliers ($r=0.283$, $p<0.05$), and the extensive usage of barcodes ($r=0.258$, $p<0.05$).

Table 1. Descriptive statistics, t-test analysis and correlation analysis

	Mean	Std. Deviation	Mean difference	Spearman's rho
The extent of usage of EDI in our firm	3.70	1.897	-0.303	0.480***
The extent of usage of XML in our firm	3.55	2.024	-0.455	0.514***
The extent of usage of other electronic prototype (except EFT, XML) in our firm	3.65	1.981	-0.348	0.467***
The extent of usage of EFT in our firm	4.28	1.947	0.281	0.166
The extent of usage of Internet in our firm	5.20	1.864	1.197***	0.262*
The extent of usage of Intranet in our firm	4.92	1.920	0.918***	0.213
The extent of usage of Extranet in our firm	4.02	2.012	0.015	0.263*
The provision of online shopping in our firm	3.69	2.171	-0.314	0.286**
The extent of usage of e-invoicing in our firm	3.81	2.060	-0.194	0.398***
Our firm is electronically interconnected with some suppliers	3.14	2.113	-0.859***	0.283*
The extent of usage of ERP in our firm	4.49	2.390	0.493	0.191
The extent of usage of CRM in our firm	3.79	2.153	-0.214	0.379***

The extent of usage of SCM in our firm	3.47	2.165	-0.529*	0.397***
The extent of usage of barcodes in our firm	4.40	2.401	0.403	0.258*
The extent of usage of RFID in our firm	3.09	2.161	-0.913***	0.062
The extent of usage of mobile devices in our firm for e-ordering	3.57	2.387	-0.429	0.122
The extent of usage of mobile devices in our firm for inventory	3.80	2.441	-0.200	0.228
The extent of usage of picking by light in our firm	2.44	2.092	-1.563***	0.04
The extent of usage of picking by voice in our firm	1.86	1.562	-2.141***	0.047

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

5. Conclusion

Nowadays, Supply Chain Management (SCM) has to deal with increased customer demands and global competition at the same time. The evolution of Information Technology (IT) practices and techniques is a factor that enabled the integration of supply chains into value systems.

In order to assess the competitive value of IT techniques and methods for SCM, we have conducted a field research in 2013, in a cross-sectional sample of firms at the region of Central Greece. The field research was based on a structured questionnaire which was built on the basis of several criteria used in previous empirical studies. The results confirm the crucial role of IT practices and techniques on the establishment of a sustainable competitive advantage based on Supply Chain Management. Therefore, maximizing IT investment could lead firms to higher profitability and effectiveness.

For the future, our conceptual framework may also be replicated in other regions of Greece, in order to compare our findings with these of the current research. In addition, the impact of contextual factors such as business environment, on the link between IT and SCM competitive advantage should be explored.

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