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EXECUTIVE SUMMARY

Organizations invest in ICT to achieve competitive advantage in their supply chains, at both the inter-organizational and organizational levels. To better understand how ICT capabilities influence organizational performance, this work develops an evaluation framework that is based on a process perspective of the relationships between ICT capabilities, operational effects in Supply Chain Management (SCM), and strategic effects. The primary ICT capabilities addressed in the evaluation framework are those most associated with *ComVantage*: Linked Data, mobile applications, and Web-based software and services. Therefore, the framework describes the potential organizational effects of ICT capabilities associated with *ComVantage*. Following the introduction, this document describes the roadmap for the evaluation process, the methodology used to develop the evaluation framework and the resulting framework, and the next steps planned for the testing, validation, and estimation of the identified constructs and the relationships among them.

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1. INTRODUCTION

Organizations invest in ICT to achieve competitive advantage, as well as to improve innovation (Bajenaru 2010) and efficiency in their supply chains, at both the inter-organizational and organizational levels (Ngai, Chau & Chan 2011). These investments and the benefits they deliver have been investigated in numerous studies in the past decade (e.g. Ranganathana et al. 2011, Shang and Seddon 2002, Melville et al. 2004, Candan et al. 2011). Shang and Seddon (2002) as well as Irani and Love (2001) identified various benefits of enterprise systems ranging from operational improvements to decision making and strategy enhancements. Ranganathan, Thompson and Jasbir (2011) and Barney, Tan and Hackney (2010) studied the impacts of Web technologies on organizational performance. Others explored the influence of ICT on buyer-supplier relationships, inter-dependencies, coordination and integration (Zhao et al. 2008; Grover, Teng & Fiedler 2002; Porterfield, Bailey & Evers 2010; Angeles 2009; Rai, Patnayakuni & Patnayakuni 2006).

Most of the these studies were case studies and only a few employed a quantitative methodology, which supports the observation of Zhu and Kraemer (2005) that in the existing literature there is a "black box" regarding the relationship between the use of Web technologies and organizational performance. Moreover, Barney, Tan and Hackney (2010) described a gap in the understanding of how Web-based technology can boost organizational performance.

In order to narrow this gap and contribute to the understanding of how Web-based ICT capabilities influence organizational performance, this work develops an evaluation framework that is based on a process perspective of the relationships between ICT capabilities, operational effects in Supply Chain Management (e.g., improve customer service, reduce production cost, and improve efficiency) and strategic effects (e.g., higher profit margin, higher market share, increased agility). This evaluation framework will provide the theoretical and conceptual foundation for analyses of how organizational performance is affected by *ComVantage* in particular, and by Web-based ICT capabilities in general. The framework will facilitate the understanding of the added-value of the *ComVantage* project to the European industry.

The academic literature provides several examples of theoretical frameworks that account for the organizational effects of ICT capabilities in the context of supply chain processes: Nagai, Chau and Chain (2011) constructed a research framework to identify how supply chain components impact agility and competitive advantage; Ranganathana, Teo and Dhaliwalc (2011) constructed a research model to identify how Web-enabled SCM impacts organizational performances by identifying key antecedents; and Stevenson and Spring (2009) and Sa´nchez and Pe´rez (2005) used a research model for understanding how flexibility impacts organizational performance.

The methodology used to create our evaluation framework for *ComVantage* was adapted from Shang and Seddon (2002) who investigated the benefits of enterprise information systems from a managerial perspective. The construction of the evaluation framework consisted of the following steps. First, popular papers and Websites were reviewed in order to gain a general understanding of the relevant ICT capabilities. These capabilities were examined and analysed through the perspective of *ComVantage* use cases. As a consequence of this step, three emerging Web-based technologies were identified: Linked Data, mobile applications, and Web-based software and services. These ICT capabilities were the focus of the literature review that followed. The second step involved a comprehensive review of the academic literature on the organizational effects of the identified ICT capabilities, taking the perspective of the *ComVantage* use cases and settings (plant engineering and commissioning, mobile maintenance, and customer oriented production). The SCM operational effects that were found in the literature were categorized into six theoretical constructs. Subsequently, these constructs were associated with relevant SCM strategic effects, which were constructed through a similar process – identifying and categorizing the main effects found in the academic literature. The constructs and their inter-relationship were framed and formalized in a process of three cycles of brainstorming with academic experts in the fields of supply chain and business value, members of the *ComVantage* project. The sessions were focused on identifying the most prominent operational and strategic effect and on categorizing the various processes outlined in the academic literature to common effects and interrelationships. The resulting evaluation framework is presented in this document.

The next chapter presents a roadmap for the evaluation process that will guide the efforts of Work Package 9 throughout the project. In the chapter that follows the roadmap, the evaluation framework is presented, including ICT capabilities and SCM effects, followed by a discussion of the next steps planned for its validation.

2. EVALUATION PROCESS ROADMAP

The purpose of this section is to describe the roadmap of the evaluation process planned for the duration of the project.

The evaluation process is composed of three major parts (see Figure 1). Phase 1, the development of the framework, will be conducted in two consecutive steps, whereas the use of the framework to analyse and evaluate the *ComVantage* project in Phase 2 will use three different methodologies in parallel. Phase 3, the final stage, will involve composing guidelines for implementation, resulting from the evaluation process. These three major activities will be outlined next.

The evaluation process began with the construction of a general conceptual framework based on a multidisciplinary review of the academic literature. The purpose of this stage was to gain a broad perspective of the previously examined impacts of the technologies involved in the *ComVantage* project on individual components in the supply chain (production, service, etc.) and the resulting strategic effects. The present deliverable (9.1) details the methodology used and the resulting framework.

Next, the theoretical constructs in the evaluation framework will be deconstructed into metrics by defining a measurable aspect/s for each relevant impact identified in the previous stage. This process will use two methodologies. The first methodology will be, once again, based on a review of the academic literature, insuring a strong foundation and a wide perspective, detailing supply chain processes that should contribute to the operational effects and identifying measurable scale/s for each process. The second methodology is based on interviews with various stakeholders to validate the framework and metric set. These two methodologies will support the general as well as specific understanding of the impact of ICT on the competitive advantage of the supply chain in the context of the various system use cases. The product of this stage will be a metric set of the potential organizational and inter-organizational impacts of the ICT capabilities associated with *ComVantage*. The metric set and its development process will be presented in two consecutive deliverables - 9.2.1 and 9.2.2.

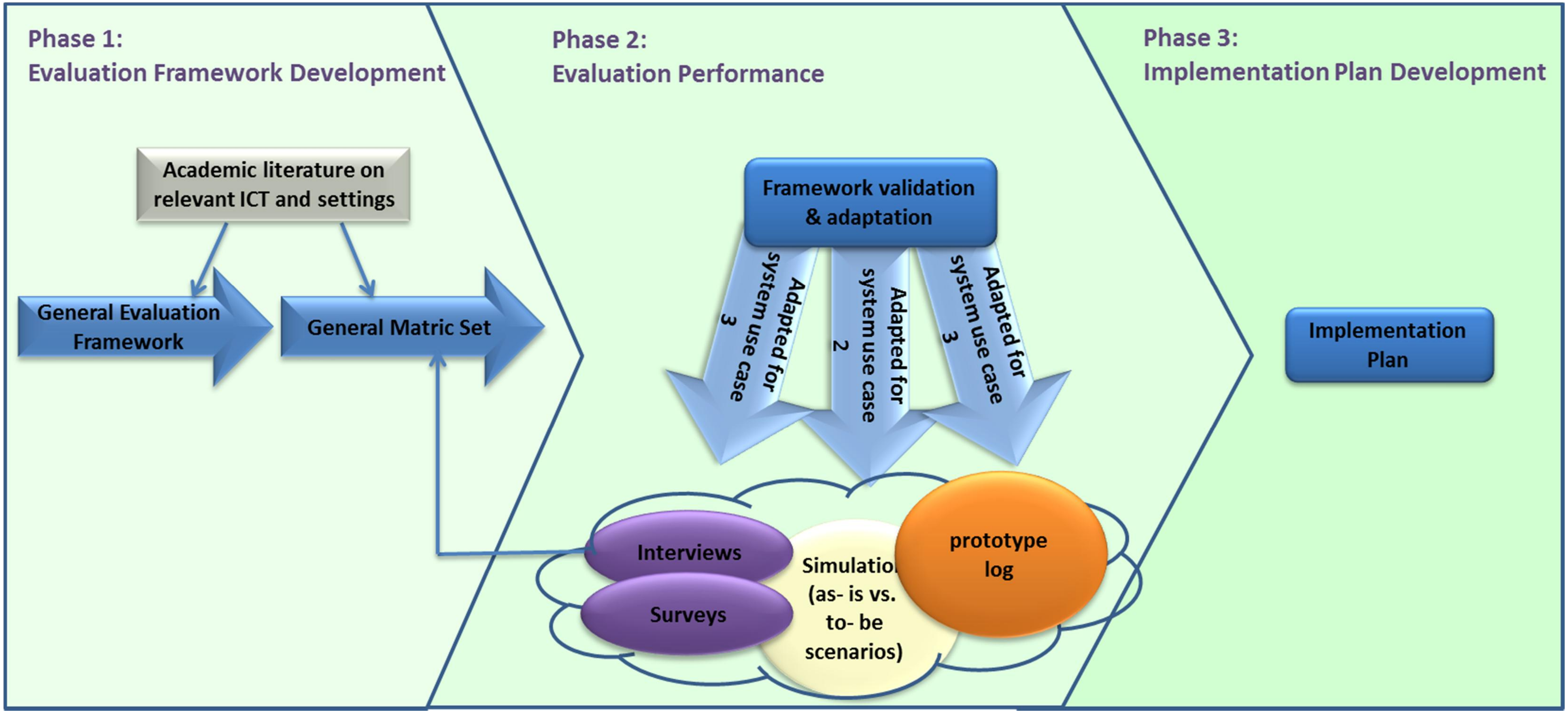

Figure 1: Evaluation process roadmap

The results of these activities (Phase 1) will be the baseline for the evaluation itself (Phase 2), which will focus on the three system use cases of the project (plant engineering and commissioning, customer-oriented production, and mobile maintenance), and performed in parallel using three complementary methodologies, as detailed next.

- Simulation model for comparing alternative *ComVantage* processes – A simulation model for one of the system use cases will be developed and explored with its existing processes (as- is scenarios) as well as alternative ones (to- be scenarios), generating objective data to facilitate the comparison of the pre and post project implementation processes. The analysis of the data will promote the understanding of the contribution of the project, as well as the validity of the evaluation framework and metric set. The process and its outcomes will be detailed in deliverables 9.3.1 and 9.3.2.
- Empirical assessment of the attitudes of various *ComVantage* stakeholders – This evaluation activity will be performed in two steps. First, interviews based on the evaluation framework and metric set will be conducted to gain a basic understanding of the attitudes of various stakeholders in the project regarding each of the system use cases. This preliminary step will assist in the examination of the validity of the framework and contribute to the development and refinement of the metric set. It will also contribute to the design of subjective data collection and analysis in the following step, through a survey that will be distributed to members of the *ComVantage* project, as well as to their suppliers, customers and other supply chain partners, asking them to give their input from a specific system use case perspective. These evaluation processes and outcomes will be summarized in deliverables 9.4.1 and 9.4.2.
- Empirical assessment of secondary data collected by *ComVantage* industrial partners- The data generated by the enhanced functional prototypes (at M24) will be collected and analysed using statistical procedures and data mining, generating further understanding of the impact of the project on each system use case, as well as the relevance of various components of the evaluation framework and metric set. The methodology and results of this activity will be presented in deliverable 9.5.

The products of the research efforts describe above, aiming at evaluating the organizational and inter-organizational effects of *ComVantage*, will be the input for the final activity (Phase 3) of this Work Package – the development of implementation guidelines that can serve as a plan for companies implementing *ComVantage*. These guidelines will be detailed in deliverable 9.6.

3. EVALUATION FRAMEWORK

In this chapter, we present the constructed evaluation framework for *ComVantage*, which consists of three general construct types (see Figure 2): ICT capabilities (described in Section 3.1), SCM operational effects, and SCM strategic effects, as well as the relationships among them (detailed in Section 3.2).

3.1 ICT CAPABILITI`ES

A comprehensive literature review was conducted in order to identify Web-based ICT capabilities relevant to the *ComVantage* project. Those capabilities were analysed and categorized in light of the *ComVantage* use cases. As a result, three dominant Web-based ICT capabilities were identified.

- Linked Data – a method of publishing and connecting structured data which enables people and machines to find data on the Web (Berners-Lee 2009). The method allows users to move from one data source to another, connect between different data sources on the Web, even with information that has not been connected before (Bizer, Heath & Idehen 2008). For instance, it may link different databases between organizations in different locations or connect data within the organization (Bizer, Heath & Berners 2009). This capability is highly relevant to the mobile maintenance and the plant engineering and commissioning use cases where the use of relevant scattered information such as machine status, performance and history is required and may be collected, analysed and tested easily and effectively using Linked Data.

- Mobile applications – software that provides the ability to perform specific tasks with low-power hand-set devices. The software can be installed on the device or can be downloaded by the user. The application may be able to read, collect, and store information from machines in the production environment (Turcu, Cristina. & Graur 2008). From the literature review and the analysis of *ComVantage* use cases we identified that the use of mobile applications may be extremely relevant for customer-oriented production as well as in the mobile maintenance and plant engineering and commissioning use cases.
- Web-based Software and Services– Servers and applications that provide collaboration space available anytime and anywhere for sharing, communicating and interacting with partners (Koskinen 2006). With respect to organizations, web-based software as a service (SaaS, see glossary) is a special case of Web-based software and services, where the hardware and software are installed at the supplier (third party) and are provided as Web-based services for data storage and applications (Candan et al. 2009; Bajenaru 2010). This ICT capability is most relevant for the customer oriented production were most, if not all, of the interaction with the customer can be performed online. Web based software and services may be also dominant in the mobile maintenance use case, where the interaction among the customer, technician, and expert may be faster, easier and more efficient by harnessing web technologies into the process.

3.2 SCM Effects

Numerous operational effects of ICT capabilities can be found in the literature. In order to create a comprehensive and yet a clear and effective framework, we categorized them into six main categories: (1) reduce production cost and improve efficiency, (2) reduce supply chain cost and improve efficiency, (3) reduce coordination costs, (4) reduce total costs of ICT ownership, (5) improve customer service, and (6) increase customizability. Each of these operational effects may lead to strategic(s) effect(s), which were also categorized into eight main categories: (1) productivity, (2) profit margin, (3) quality of product and service, (4) market share, (5) customer loyalty and satisfaction, (6) differentiation, (7) social responsibility and sustainability and (8) agility. These effects and the relationship among them and with the ICT capabilities will be discussed in detail next.

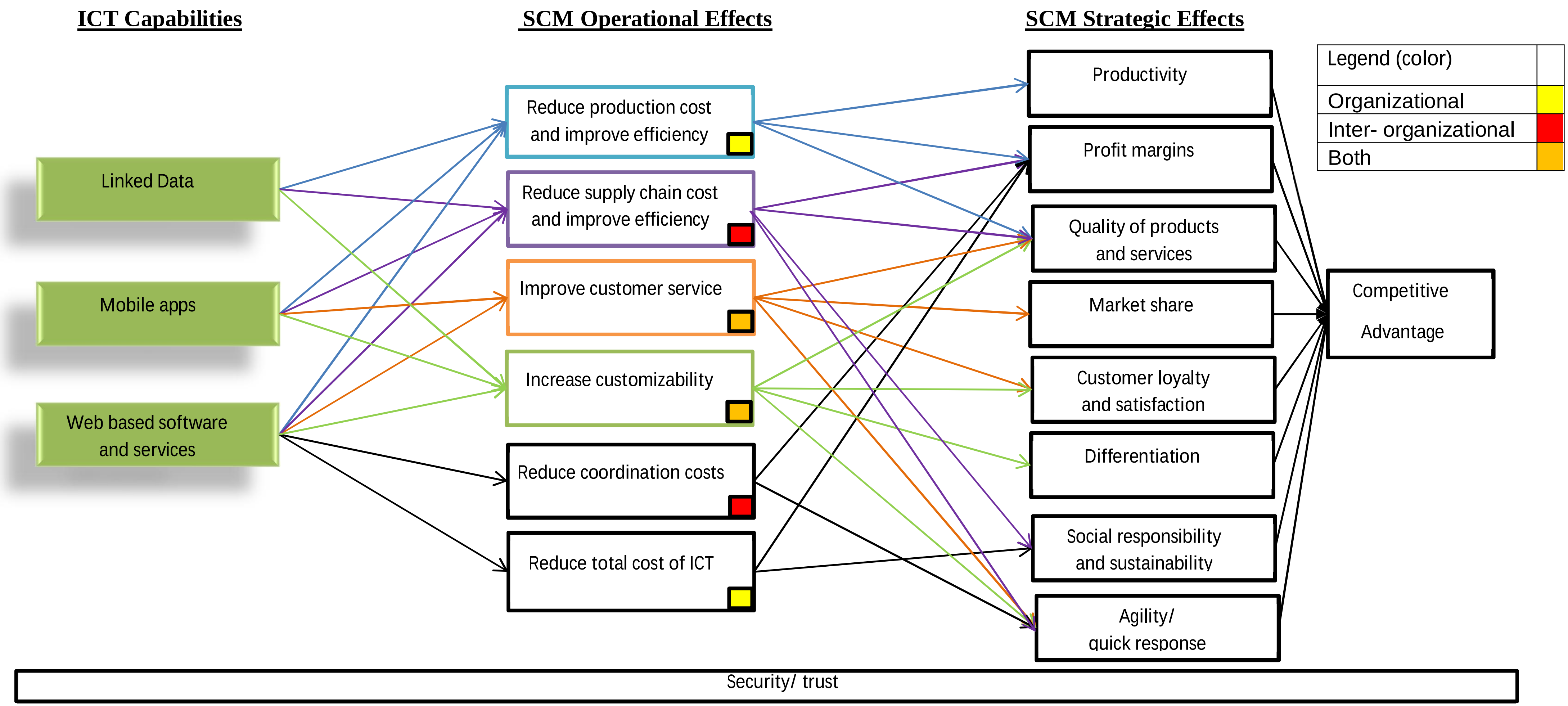

Figure 2: Evaluation Framework

3.2.1 Reduce production cost and improve efficiency

This section discusses how ICT capabilities (linked data, mobile applications, and Web-based software and services) may reduce production cost and improve efficiency. The section addresses four main metrics of the production environment: standardization, easier maintenance and troubleshooting, machine to machine (M2M) data exchange, and innovation and integration.

3.2.1.1 Standardize products, production working methods, procedures, and business processes

Standardization enables improved production and service methods. When working according to standardized procedures, the day to day activities are simple and clear and there is less room for mistakes. For instance, mobile devices help increase standardization for field workers by scheduling daily activities and by providing instructions and procedures for a specific production or business process. Photos exchanged by mobile devices may help in identifying problems within the supply chain. Location devices such as GPS and GIS may provide maps regarding the position of customer, products, and spare parts, and they may support delivery of the correct item at the first time. These technological capabilities may also facilitate the completion of tasks without the need for specific knowledge or specific worker (thus when a worker leaves, her knowledge is not lost, and the training of new employees takes less time (Juntumaa et al. 2009; Levitt 1972; Stevenson & Spring 2009).

3.2.1.2 Easier maintenance and troubleshooting

The use of mobile applications, Web based systems, and smart tags were found to facilitate maintenance and troubleshooting, as detailed next.

- Shorten response time to malfunction using on-line information available 24/7:
  Mobile technology used in maintenance activities enables field-staff to connect to machines with the use of smart tags that send and receive messages regarding the machine's status and configurations anywhere and anytime (Rossi, Tuunainen & Pesonen 2007). The employee can easily access the machine through the uniform resource identifier (URI) to identify and analyse the problem (Barnes, Scornavacca & Innes 2006; Juntumaa et al. 2009). Cameras can be used to capture video streams of current machine status in real-time and broadcast it to mobile devices or organizational information systems for faster analysis and maintenance (Harring 2011). Moreover, a technician who works in a remote site can use Web based systems and see the customer's machine status, conduct very detailed maintenance tests to diagnose the problem, and even solve it from afar or send the correct spare parts on the first occasion, saving travel costs for maintenance and repair.
- Identify relevant expertise:

  Organizations often learn and share information by collaborating with other partners in the supply chain, through individuals who get to know each other. As a result, employees know who to turn to when they have a problem (Dyer & Singh 1998). This acquired ability takes time and resources of unskilled technicians. Moreover, when an expert is needed for identifying and solving complicated problems regarding machines in the production environment (in the customer site or in the organization), the use of ICT capabilities reduces the time and resources needed to detect the right expert, communicate with her, and identify and fix the problem, because the technicians can use mobile or Web-based systems. The expert can solve the problem in a relatively short time, from a remote location, using the machine's Linked Data information.

- Manage items and inventory via smart tags:

Smart tags technology, such as Radio Frequency Identification (RFID), is efficient in collecting, managing, distributing, tracking, and storing information related to inventory, business processes, and machine information (Nambiar 2009; Angeles 2005). The technology enables broadcasting the data to ICT systems that interact with the smart tag (Angeles 2005), facilitate the identification of problems. For example, smart tags can facilitate identification of items that will soon be out of stock, direct new material into the warehouse, and locate components that are missing for assembly.

3.2.1.3 Identify, collect, and integrate data without explicit user involvement (M2M)

Smart tags and Linked Data technology may be used to identify objects and give machines the ability to capture information, communicate, and schedule tasks and activities among themselves (M2M) by integrating data from different sources without human keystroke operations (Crescenzi, Frongia & Eric 2010; Bojars et al. 2008; Turcu, Cristina. & Graur 2008). These capabilities improve the availability and efficiency of machines in production environments. For example, machines can utilize their production activities by automatically identifying occupied machines and transferring the raw material to available ones.

3.2.1.4 Enhance innovation by integrating the supplier into the production process

Organizations that use hybrid governance forms (such as alliance franchising, consortium, and joint venture) have close relationships with their suppliers. These close relationships may assist in the reduction of production cost and time-to-market by collaborating with the suppliers in production, planning, and design activities. Research shows that early and broad supplier involvement results in a faster development process (Dyer & Singh 1998), thereby making the process more efficient. In addition, organizations may integrate their resources with those of their supplier to enhance innovation, which may result in new products or services (Buvik 2002; Dyer & Singh 1998; Lusch, Vargo & Mohan 2010; Ranganathana, Teo & Dhaliwalc 2011).

Another type of integration occurs when organizations integrate their information systems. The integration of the systems enables transparency of data within the supply chain, which improves decision making and increases the ability to adapt quickly to market changes by reducing the uncertainty in the supply chain with respect to the demand (Fisher 1997; Lusch, Vargo & Mohan 2010; Ranganathana, Teo & Dhaliwalc 2011; Stevenson & Spring 2009; Juntumaa et al. 2009). For example, when an integrated system enables the supplier to view the organization's inventory, the supplier can renew and deliver materials on time (Verstrepen & Cools 2009; Ngai, Chau & Chan 2011). Similarly, information sharing may minimize inventory of raw materials and work-in-process (WIP) and finished goods, improve inventory turnover, create trust, and avoid over-production (Stevenson & Spring 2009; Sharif, Irani & Lloyd 2007; Gyeung-Min 2008), thereby facilitating organizational agility (Ngai, Chau & Chan 2011) and time-to-market (Sharif, Irani & Lloyd 2007; Radhakrishnan, Zu & Grover 2008; Clemons, Reddi & Row 1993; Turcu, Cristina. & Graur 2008). For example, information sharing of inventory levels contributes to field sale workers, who see updated inventory levels on demand. In that way, they are able to serve customers better and provide on line demand data to the organization (Rossi, Tuunainen & Pesonen 2007; Diewart & Smith 1994; Kauremaa 2010; Turcu, Cristina. & Graur 2008).

As detailed above, ICT capabilities enable to reduce production cost and to improve efficiency due to standardization in business and production process, shorter response time, identification of relevant expertise, and addressing problems quickly and efficiently. The strategic benefits potentially resulting from these capabilities are improved productivity, increased profit margin, and improved customer satisfaction.

3.2.2 Reduce supply chain cost and improve efficiency

This section addresses the potential contribution of ICT capabilities to supply chain cost reduction and efficiency improvement. The section focuses on three metrics associated with supply chain cost: supplier utilization, transportation costs, and knowledge sharing.

3.2.2.1 Improve supplier utilization

Suppliers have significant impacts on efficiency, information flow, and information-sharing in the supply chain. Thus, choosing and qualifying suppliers is important, and there are various variables to consider when choosing suppliers. For instance, supplier flexibility to changes can support the organization in coping with deviations in demand, and enable faster development of new products and services, consequently facilitating response to market changes and improving the quality of products and services. Suppliers who are reliable and have short lead times allow the organization to reduce inventory levels and, consequently, the cost of products and services (Wang, Huang & Dismukes 2004; Inemek & O. 2009). Linked Data can be used to identify inter-organizational information regarding the supplier. This data can then be analysed by organizational systems in support of decision making (Ekström et al. 2003).

After selecting the suppliers, technological and organizational adjustments are needed in order to work efficiently with them. The use of ICT capabilities may help to qualify new suppliers in a fast manner. Suppliers who were approved may learn about the organization and its working methods through video or Web classes without visiting the organization or the production site. This enables quick learning and adaptation to the new organization.

3.2.2.2 Reduce transportation costs

The use of geographic applications such as GPS and GIS facilitates and simplifies supply chain processes, e.g. field workers can get accurate directions regarding customer location and identify the location of inventory. These capabilities can reduce the total time from order to delivery and increase the accuracy of the delivered products. The use of mobile applications enables to remotely finalize orders and deliveries, perform sales and marketing activities, and check the sequence and status of open tasks. These transactions can be completed without the need for paper signing or returning to the office. Mobile applications also improve location-based services of field workers by tracking them (Bartel 2009; Juntumaa et al. 2009; Barnes, Scornavacca & Innes 2006). All this may result in decreased fuel consumption and vehicle maintenance, as well as increased customer satisfaction and product/service quality (Juntumaa et al. 2009). The use of mobile technology also enables to reduce the uncertainty of production and field workers by gathering real time information on production and the supply chain and by sharing it on demand (Juntumaa et al. 2009). The information can be related to operational decision making, such as machines' capacity and status, utilization, availability, and inventory or it can be related to supply chain decision making, such as customer demand, supplier availability, inventory visibility, logistics, marketing, sales, and planning (Stevenson & Spring 2009).

3.2.2.3 Knowledge sharing, learning, and “know how” capabilities

In order to achieve competitive advantage, firms form inter-organizational alliances for combining, sharing, and exchanging valuable resources that cannot be obtained efficiently through other governance forms (Das 2000). Organizational resources may be reputation, physical resources or capabilities, and knowledge. Alliances enable the enhancement of knowledge or the acquisition and maintenance of organizational "know-how" (Kogut 1988). According to Madhok (1997), the collaboration among alliance members may take place when enhancing knowledge is important but the timeframe to achieve the knowledge is short. Another aspect of alliance collaboration is the improvement of common learning capabilities by knowledge sharing and joint-learning when working together with the suppliers in the supply chain (Levinson & Asahi 1996). Common learning and knowledge sharing may lead to new ideas on how to improve technology and performance that ultimately may become a source of competitive advantage (Dyer & Singh 1998). In order to form strong knowledge sharing in alliances, trust and awareness must exist between the partners (Kathleen & Claudia 1996).

With respect to organizational and inter-organizational supply chains, knowledge sharing can improve production, reduce inter-organizational uncertainty (regarding delivery, demand, and design), and decrease the risk level in the supply chain by improving coordination and planning abilities (Stevenson & Spring 2009).

As detailed above, ICT capabilities integrated into the supply chain may lead to higher profit margins and higher social responsibility as they are associated with a reduction in transportation and CO_2 footprint. Enhanced agility and better response to market changes may be another strategic effect, as a consequence of better analysis of the performance of suppliers and better selection of supply chain partners. A third potential strategic effect is improvement in quality of products and services as a result of reducing the time from order to delivery and combining resources and knowledge to make the supply chain more efficient.

3.2.3 Reduce coordination costs

This section addresses the potential impacts of ICT capabilities on organizational governance and structure as a consequence of reducing organizational coordination costs. The section addresses three metrics: improve intermediate processes, shift from hierarchy to hybrid forms of governance, and increase virtual integration.

3.2.3.1 Improve intermediate processes within the organizational value chain

Intermediate processes can be divided into two groups: operational and managerial. Operational intermediate processes refer to the primary activities of the organization such as inbound logistic processes (warehouse, inventory, returns, and suppliers), customer service, market and sales, distribution, pricing, and maintenance (Porter 1985). Managerial activities deal with coordination, optimization, planning, entering new markets, and identifying new projects (Melville, Kraemer & Gurbaxani 2004). Integration of ICT systems can increase automation, improve communication, and increase the flow of operational and managerial activities in the value chain (Ngai, Chau & Chan 2011; Malone, Yates & Benjamin 1987; Clemons, Reddi & Row 1993; Porterfield, Bailey & Evers 2010). Utilizing the coordination among activities in intermediate processes may reduce transaction costs by changing the way organizations interact and connect in the value chain (Radhakrishnan, Zu & Grover 2008; Porter 1985; Young & Johnston 2003).

3.2.3.2 Shift from hierarchy to hybrid forms of governance

Transaction cost theory (Williamson 1979; Williamson & Masten 1999) asserts that organizations determine their preferred form of governance according to the complexity of their products and services and according to the level of uncertainty in their environment (Buvik 2002; Makador & Coff 2009; Ménard 2004; Williamson 1979; Williamson & Masten 1999; Powell 1990; Masters et al. 2004). According to this theory, there are three prototypical forms of governance: market (standardized products, the price is determined according to supply and demand, there is no production – e.g. the organization assembles parts), hybrid (complex products, the organization outsources the non-core and standardized products or services and focuses on the core business, there are production costs and coordination costs), and hierarchy (idiosyncratic products, the organization performs both non-core and core activities, production costs are high and coordination costs are very low compared to hybrid governance).

The use of ICT reduces the complexity of products and services and decreases coordination costs because it improves communication and information sharing regarding products and services, integrates supply chain systems, and allows visibility of information (Clemons, Reddi & Row 1993). Moreover, ICT enables more accessibility to product description and instructions and enables to follow up on the progress of production and supply chain through Web systems and mobile applications. It enables to change product and service characteristics to a generic and standardized form (Malone, Yates & Benjamin 1987; Gurbaxani & Whang 1991). Therefore, ICT enables organizations to change their form of governance, to reduce coordination costs, to outsource non-core activities, and to focus on their core businesses (Robert & Shin-Kap 2003; Wang & Wei 2007; Briscoe & Marinos 2009). The consequence is a transition toward more reliance on hybrid and market forms of governance.

3.2.3.3 Increase virtual integration among organizations

Virtual integration is the level to which organizations enable common business processes among supply chain partners. Virtual integration can be seen in procurement, logistics, and production.

ICT capabilities enable integration among partners within the supply chain that can reduce coordination costs (Wang & Wei 2007). Virtual integration contributes to interoperability among partners because it improves coordination activities among the partners in the supply chain (Zhao, Tanniru & Zhang 2007; Wang & Wei 2007; Grover, Teng & Fiedler 2002). It also reduces communication costs by enabling better planning, managing, and scheduling of product supply and inventory. For example, when a customer places an order, there is integration with all the levels of the supply chain downstream and upstream, thereby enabling better planning of production.

Virtual integration also facilitates product changes, maintenance, and problem troubleshooting since information from all parts of the supply chain is accessible (Wang & Wei 2007; Juntumaa et al. 2009; Glassberg & Merhout 2007). Virtual integration was also found to be positively associated with agility because it improves the adjustment to market changes, which helps sustain competitive advantage (Ngai, Chau & Chan 2011; Buvik 2002).

ICT capabilities reduce coordination costs as a consequence of increasing virtual integration and knowledge sharing among supply chain partners. ICT capabilities are also associated with changes in governance forms, in particular shifting from the hierarchy form toward the hybrid and market forms, as a consequence of reducing transaction costs. The potential strategic benefits are higher profit margins, increased supply chain agility, and better response to market changes.

3.2.4 Reduce total cost of ICT ownership

This section addresses the potential impacts of ICT capabilities on the total cost of ICT ownership. The section focuses on four main impacts: shifting from capital expenditure to variable costs, decreasing ICT resources, transferring information processing and data storage to remote servers, and reducing energy consumption and carbon footprint.

3.2.4.1 Shift from capital expenditure to variable costs (pay per use)

With the use of Web-based software as a service, organizations pay per use of ICT resources and, therefore, the threshold for using ICT resources is lower (the massive investment in implementation and upgrades of software and hardware is not required). This shift in the financial model of ICT acquisition also enables prediction and planning of the total cost of ICT, as costs are linearly associated with usage. The shift from capital expenditure to variable costs results in increased financial liquidity and reduces the capital outlay involved in organizational extension (Karabek, Kleinert & Pohl 2011; Lasica 2009; Kaur 2011).

3.2.4.2 Decrease ICT resources

The primary motivations for using Web based software as a service are cost savings, flexibility and scalability of resources (Lindner et al. 2010), availability (Kaur 2011; Candan et al. 2011), and accessibility anytime anywhere (Karabek, Kleinert & Pohl 2011). In the context of SCM systems, the primary objectives of managing Web-based SCM were found to be cost efficiency and improvement in customer service (Venkatraman 2009; Kaur 2011). Through the implementation of Web-based software as a services, it is possible to provide SCM systems in a short time, no massive setups are required, and the maintenance costs are minor compared to the implementation of ERP systems (Lasica 2009). Web based systems also reduce the need for large ICT departments and skilled employees (Karabek, Kleinert & Pohl 2011; Siegele 2008), resulting in ICT cost reduction.

3.2.4.3 Transfer information processing and data storage to remote servers

With the development of Web-based platforms, organizations can shift most of their data storage and applications from their local servers and PCs to external platforms (Lasica 2009). Organizations can use third-party service providers to rent storage space per use (Candan et al. 2009) and access it via mobile devices, desktops, and laptops anytime anywhere. In this configuration, information processing is being done by a third party. The use of Web-based software and services enables higher information processing for lower costs. According to Ranganathana, Teo & Dhaliwalc (2011), "information intensive environments are likely to foster higher levels of Web enabled SCM".

3.2.4.4 Reduce energy consumption and carbon footprint

Web-based software and services relieve organizations from the need to generate their own computing power by using remote servers and data centres. The remote servers enable 24/7 access to computing resources through Web-based services. They facilitate cost reduction and improve reliability (Beneto 2010). Carbon footprint is another driver of moving to third-party providers: moving to large-scale remote servers reduces energy consumption and leads to higher social responsibility and sustainability (Koomey et al. 2009; Fischer & Turner 2009; Baliga et al. 2011)

In conclusion, Web–based software and services enable the reduction of total cost of ICT ownership by enabling organizations to generate more control over their expenses. Because organizations pay per use of ICT resources, they do not have to invest in implementing hardware and software and do not require large ICT departments. Furthermore, they can perform information processing for lower costs. Therefore, the primary strategic benefits are higher profit margins and higher social responsibility and sustainability

3.2.5 Improve customer service

This section addresses the potential impacts of ICT capabilities on customer service. With the use of ICT capabilities, customers can place orders, perform transactions, follow up on the status of orders, make changes regarding the configuration of their products and services, or check delivery time. All this and more can be done with a click of a finger using mobile applications or Web sites, providing customers with better, customized, accessible service.

3.2.5.1 Provide customer service on demand

When the supply chain is integrated (i.e., the partners trust each other, are more collaborative, and data is visible to the different parties), the suppliers can enhance the readiness for changes within the supply chain and respond faster to customers' demands for changes (Stevenson & Spring 2009). The construction of modular production processes and the involvement of the suppliers in product design may increase the flexibility of the supply chain as well. An integrated supply chain may also provide the option of letting the customer make changes regarding product configuration in late stages of the manufacturing process, because it gives the supplier more influence on requirements and changes (Stevenson & Spring 2009). For example, BMW enables customers to change their vehicle configuration within six days before assembly (Gunasekaran & Ngai 2005). ICT enables customers to make changes, place orders, choose third-party products (Sharif, Irani & Lloyd 2007), and follow-up on the production process. The customers can perform those activities with the use of their mobile applications or through Web sites. ICT that is aimed at involving the customer in the supply chain should be visible, lean, agile, integrated, and should provide information along the supply chain (Sharif, Irani & Lloyd 2007) in order to meet various customer demands.

3.2.5.2 Increase accessibility and communication

ICT capabilities facilitate accessibility to services and remote support for customers and projects. Integration between the systems of customers and suppliers facilitate information exchange and lead to service level improvements because the supplier can collect data and perform analyses related to customer services (arrival of products, status of machines, etc.). The accessibility of information can also reduce commissioning time and travelling expenses. There are various ways to perform the above, for example:

- Transferring status information via mobile or Web-based systems, allowing customers to access information regarding the progress of products or services, such as bottlenecks, current shop loads (Stevenson & Spring 2009), and estimated time of arrival.
- Sending and receiving SMS – sending information to singles or groups without the need to connect to a system (Rossi, Tuunainen & Pesonen 2007), or receiving information from automatic stations regarding the design and status of products and services. This technology can improve services by, for instance, alerting the supplier in real time about machine status and alerting when there is a rapid increase in demand, so that the supplier and customer can be ready for delivering and receiving new products.

In conclusion, the increased information flow and the provision of services on demand may lead to improved customer service by facilitating the collection and distribution of real time information and by generating more information about customers' needs. These capabilities may improve customer satisfaction and ultimately result in increased market share.

3.2.6 Increase customizability

Customizability (or mass customization) means delivering what the customers want and when they need it according to individual requests (Piller 2010), practically segmenting the market into segments of individual customers. The challenge of mass customization is to utilize resources with minimal costs. The organization should analyse customers' preferences, transactions, and feedbacks about products and services. ICT can provide effective tools for sensing the customers' needs, for analysing their preferences, and for providing better customer management. On the one hand, ICT may identify products that are rarely explored and eliminate them. On the other hand, it can identify products that are popular and enable more customizability for them. The collection of information about customer needs and trends may be performed with the use of Linked Data, and it may be analysed by organizational information systems. ICT such as mobile applications and Web software and services enable more direct interaction between the customer and the organization and may facilitate the organizational ability to adapt to changes in customer needs. The customer can determine the product's configurations with the use of a design toolkit system, which provides customization options that are consistent with the capabilities of the processes, the product architecture, and the degree of variety (Piller 2010). After the customer completes the order, the configurations are entered automatically into the organizational information system for manufacturing.

Examples of mass customization include Pandora Radio (personalized music), BMW (customers can design the roof of the Mini Cooper), Selve (personalized shoes), and Sears (personalized furniture) (Piller 2010).

An increase in the variety and complexity of products should be associated with an increase in operational costs. According to Caglar (2008), three methods should be used in order to minimize costs and have an efficient supply chain while offering increased customizability: postponement, modularization, and customer order decoupling point. Next, the first two methods are described.

- Postponement – the relationship between postponement and mass customization is expressed by the delay of differentiated products until the last possible point. In order to make that possible, the entire supply chain should be integrated (Feitzinger & Lee 1997). ICT capabilities enable the efficient integration of the supply chain and, therefore, they may support efficient mass customization.
- Modularization- breaking down the product into standardized components for build-to-order processes; when the customer orders the customized product, it can be produced in minimal lead time (Sharif, Irani & Lloyd 2007). The organization must have modularity in production in order to work in an efficient way (Kumar 2004). ICT capabilities enable the organization to meet customer demand by enabling the customer to delay with product specifications.

Organizations may perceive mass customization as an opportunity to increase market share and agility. ICT capabilities enable the collection and analysis of customer preferences and needs, as well as the construction of efficient supply chains, thereby enabling differentiation and improved quality of products and services.

4. DISCUSSION AND FUTURE WORK

This work is the first step in the construction of an evaluation framework that will be further developed during the first year of the *ComVantage* project, followed by the main objective of this Work Package – the evaluation of the organizational and inter-organizational impacts of *ComVantage*. This deliverable aims at integrating the body of knowledge in the field of business value of ICT in order to construct a theoretical evaluation framework, while focusing on intermediate SCM operational effects as a mediating layer between the ICT capabilities and their strategic effects.

Six operational effects have been identified. Out of the six effects, four are related to cost reduction in production, supply chain, coordination, and ICT ownership, and the other two are related to customer service and customizability. In addition, eight strategic effects have been recognized: productivity, profit margins, market share, customer loyalty and satisfaction, quality of products and services, differentiation, social responsibility and sustainability, and agility and quick response.

Further research is required in order to validate and quantify the relationships described in the evaluation framework. The next phase in the construction of the evaluation framework will be to identify specific, observable metrics for each operational effect and to quantify them. In the following stage, in order to assess the validity of the framework, interviews with key personnel who use these ICT capabilities or are familiar with their potential within the supply chain will be conducted. The evaluation framework will be further analysed via the three *ComVantage* use cases, which represent various supply chain processes and settings (plant engineering and commissioning, customer-oriented production, and mobile maintenance).

5. GLOSSARY

- Smart tags – components that enable to receive and transmit information from machines or items to the organizational information system. Smart tags are efficient in collecting, managing, distributing, tracking, and storing information related to inventory, business processes, and machine information regarding products (Angeles 2005; Nambiar 2009). An example for a smart tag may be radio frequency identification (RFID) (Angeles 2005).
- Web-based Software as a Service (SaaS) – a delivery model where hardware and software of the organization are installed at the supplier (third party), and are provided as Web-based services anytime anywhere. The organization is not required to implement or install hardware and software and can use it from a remote location. The organization is not required to pay for upgrades or maintenance, or maintain a large ICT department, and it instead pays according to the use of services (Candan et al. 2009; Bajenaru 2010).
- Uniform Resource Identifier (URI) - a string of characters used to identify a name or a resource on the Internet

6. REFERENCES

Angeles, R 2005, 'RFID technologies: supply chain applications and implementation issues', *Information Systems Management*, pp. 51-65.

Angeles, R 2009, 'Anticipated IT infrastructure and supply chain integration capabilities for RFID and their associated deployment outcomes', *International Journal of Information Management*, vol. 29, pp. 219–231.

Bajenaru, A 2010, 'Software as a service and cloud computong, a solution for small and medium sized compamies', *Economic Sciences*, vol. 3, pp. 173-185.

Baliga, J, Ayre, RWA, Hinton, K & Tucker, RS 2011, 'Green cloud computing: balancing energy in processing, storage, and transport', *Institute of Electrical and Electronics Engineers*, vol. 99, pp. 149-167.

Barnes, SJ, Scornavacca, E & Innes, D 2006, 'Understanding wireless field force automation in trade services', *Industrial Management + Data Systems*, vol. 106, pp. 172-181.

Barney, CC, Tan, SLP & Hackney, R 2010, 'The strategic implications of web technologies: a process model of how web technologies enhance organizational performance', *Institute of Electrical and Electronics Engineers Transactions on Engineering Management*, vol. 57, pp. 181-197.

Bartel, SAH 2009, 'Smart computing drives the new era of IT growth', *Forrester Research, Inc*, pp. 1-44.

Beneto, AM 2010, 'Cloud computing: IT change or management revolution', *Oxford Business & Economics Conference Program*.

Berners-Lee, T, *Linked Data* Available from: <http://www.w3.org/DesignIssues/LinkedData.html>.

Bizer, C, Heath, T & Berners, LT 2009, 'Linked Data - the story so far', *International Journal on Semantic Web and Information Systems*, vol. 5, pp. 1-3.

Bizer, C, Heath, T & Idehen, K 2008, 'Linked Data on the web (LDOW2008)', *Workshop Summary*.

Bojars, U, Breslin, JG, Finn, A & Decker, S 2008, 'Using the semantic web for linking and reusing data across web 2.0 communities', *Jornal of Web Semantics*, pp. 21-28.

Briscoe, G & Marinos, A 2009, 'Digital ecosystems in the clouds: towards community cloud computing', *Digital Ecosystems and Technologies Conference*.

Buvik, A 2002, 'Hybrid governance and governance performance in industrial purchasing relationships', *Scandinavian Journal of Management*, vol. 18, pp. 567–587.

Caglar, CK 2008, 'Postponement, mass customization, modularization and customer order decoupling point: building the model of relationships', *Linkoping University Institute of Technology*, pp. 2-81.

Candan, KS, Li, W-S, Phan, T & Zhou, M 2011, 'At the frontiers of information and software as services new frontiers in information and software as services', in, vol. 74, eds D Agrawal, KS Candan & W-S Li, Springer Berlin Heidelberg, pp. 283-300.

Candan, KS, Li, WS, Phan, T & Zhou, M 2009, 'Frontiers in information and software as services', *Proceeding of the Institute of Electrical and Electronics Engineers 25th International Conference on Data Engineering*.

Clemons, E, Reddi, S & Row, M 1993, 'The impact of information technology on the organization of economic activity: the 'Move to the Middle' hypothesis', *Journal of Management Information Systems*, vol. 10, pp. 9–35.

Crescenzi, F, Frongia, D & Eric, S 2010, 'Statistics and web:who needs who?', pp. 1-6.

Das, TK 2000, 'A Resource-Based theory of strategic alliances', *Journal of Management*, vol. 26, pp. 31-61.

Diewart, W & Smith, A 1994, 'Productivity measurement for a distribution firm', *National Bureau of Economic Research*, pp. 1-21.

Dyer, JH & Singh, H 1998, 'The relational view: cooperative strategy and sources of interorganizational competitive advantage', *The Academy of Management Review*, vol. 23, pp. 660-679.

Ekström, MA, Björnsson, HC, Kunz, JC, Levitt, RE & Nass, CI 2003, 'The impact of rating systems on subcontracting decisions. A transaction cost analysis', *Center for Integrated Facility Engineering Technical Report # 135*, pp. 1-35.

Feitzinger, E & Lee, HL 1997, 'Mass customization at Hewlett-Packard: the power of postponement', *Harvard Business Review*, vol. 75, pp. 116 – 121.

Fischer, F & Turner, F 2009, 'Cloud computing as a supply chain', *Business Operations-Systems Perspectives in Global Organizations*, pp. 1-18.

Fisher, ML 1997, 'What is the right supply chain for your product?', *Harvard Business Review*, vol. 75, pp. 105–116.

Glassberg, BC & Merhout, JW 2007, 'Electronic markets hypothesis redux: where are we now?', *Communication of the Association for Computing Machinery*, vol. 50, pp. 51-55.

Grover, V, Teng, JTC & Fiedler, KD 2002, 'Investigating the role of information technology in building buyer-supplier relationships', *Journal of the Association for Information Systems*, vol. 3, pp. 217–245.

Gunasekaran, A & Ngai, ETW 2005, 'Build-to-Order supply chain management: a literature review and framework for development', *Journal of Operations Management*, vol. 23, pp. 423–451.

Gurbaxani, V & Whang, S 1991, 'The impact of information systems on organizations and markets', *Communication of the Association for Computing Machinery*, vol. 34, pp. 59-73.

Gyeung-Min, K 2008, 'E-business strategy in Western Europe: offshore BPO model perspective', *Business Process Management* vol. 14, pp. 813-828.

Harring, M 2011, 'Special report: personal technology ', *The Economist* pp. 1-25.

Inemek, A & O., T 2009, 'Global supplier selection strategies and implications for supplier performance: Turkish suppliers' perception', *International Journal of Logistics: Research and Applications*, vol. 12, pp. 381–406.

Irani, Z & Love, PED 2001, 'The propagation of technology management taxonomies for evaluating investments in information systems', *Journal of Management Information Systems*, vol. 17, pp. 161–178.

Juntumaa, M, Lauraeus, NT, Tuunainen, VK & Öörni, A 2009, 'Managing uncertainty in service production with mobile systems-case waste management company', *International Federation for Information Processing Technical Committees: 8*.

Karabek, MR, Kleinert, J & Pohl, A 2011, 'Cloud services for SMEs –evolution or revolution?', *Business + Innovation*, pp. 26-33.

Kathleen, ME & Claudia, BS 1996, 'Resource-Based-View of strategic alliance formation: strategic and social effects in entrepreneurial firms', *Organization Science*, vol. 2, pp. 136-150.

Kaur, R 2011, 'Cloud computing', *International Journal of Computer Science and Technology*, vol. 2, pp. 373-381.

Kauremaa, J 2010, 'Studies on the utilization of electronic trading systems in supply chain management', *Aalto University School of Science and Technology* pp. 1-88.

Kogut, B 1988, 'Joint ventures: theoretical and empirical perspectives', *Strategic Management Journal*, vol. 9, pp. 319–332.

Koomey, JG, Belady, C, Patterson, M, Santos, A & Lange, K-D 2009, 'Assessing trends over time in performance, costs, and energy use for servers ', *Institute of Electrical and Electronics Engineers*, pp. 1-57.

Koskinen, T 2006, 'Social software for Industrial Interaction', *Proceedings of the 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments OZCHI'06, November 20-24*.

Kumar, A 2004, 'Mass customization: metrics and modularity', *The International Journal of Flexible Manufacturing Systems*, vol. 16, pp. 287 – 311.

Lasica, JD 2009, 'Identity in the age of cloud computing: the next-generation Internet's impact on business, governance and social interaction', *The Aspen Institute*, pp. 1-110.

Levinson, NS & Asahi, M 1996, 'Cross-national alliances and interorganizational learning', *Organizational Dynamics*, vol. 24, pp. 51-63.

Levitt, T 1972, 'Production-line approach to service', *Harvard Business Review*, vol. 50, pp. 41-52.

Lindner, M, Galan, F, Chapman, C, Clayman, S, Henriksson, D & Elmroth, E 2010, 'Cloud supply chain: a framework for information, monitoring, accounting and billing', *CloudComp 2010*.

Lusch, FR, Vargo, LS & Mohan, T 2010, 'Service, value networks and learning', *Academy of Marketing Science*, vol. 38, pp. 19–31.

Madhok, A 1997, 'Cost, value and foreign market entry mode: the transaction and the firm', *Strategic Management Journal*, vol. 18, pp. 39–61.

Makador, R & Coff, R 2009, 'Both market and hierarchy: an incentive-systems theory of hybrid governance forms', *Academy of Management Review*, vol. 34, pp. 297–319.

Malone, TW, Yates, J & Benjamin, RI 1987, 'Electronic markets and electronic hierarchies', *Communication of the Association for Computing Machinery*, vol. 30, pp. 484–497.

Masters, JK, Miles, G, D'Souza, D & Orr, JP 2004, 'Risk propensity, trust, and transaction costs in relational contracting', *Journal of Business Strategies* vol. 21, no. 1, pp. 47-68.

Melville, N, Kraemer, K & Gurbaxani, V 2004, 'Review: information technology and organizational performance: an Integrative model of IT business value', *Management Information Systems Research Quarterly*, vol. 28, pp. 283-322.

Ménard, C 2004, 'The economics of hybrid organizations', *Journal of Institutional and Theoretical Economics*, vol. 3, pp. 345-376.

Nambiar, AN 2009, 'RFID technology: a review of its applications', *Proceedings of the World Congress on Engineering and Computer Science*, vol. 2, pp. 1-7.

Ngai, EWT, Chau, DCK & Chan, TLA 2011, 'Information technology, operational, and management competencies for supply chain agility: findings from case studies', *Journal of Strategic Information Systems*, vol. 20, pp. 232–249.

Piller, FT 2010, 'Mass customization: a strategy for customer-centric enterprises - a review of the strategic capabilities to make mass customization work', *Social Science Research Network*.

Porter, ME 1985, *Competitive advantage creating and sustaining superior performance*, 1 edn, The Free Press, New York.

Porterfield, TE, Bailey , JP & Evers, PT 2010, 'B2B eCommerce: an empirical investigation of information exchange and firm performance', *International Journal of Physical Distribution & Logistics Management*, vol. 40, pp. 435-455.

Powell, WW 1990, 'Neither market nor hierarchy: network forms of organization', *Research in Organizational Behavior*, vol. 12, pp. 295-335.

Radhakrishnan, A, Zu, X & Grover, V 2008, 'A process-oriented perspective on differential business value creation by information technology: an empirical investigation', *Omega The International Journal of Management Scince*, vol. 36, pp. 1105-1125.

Rai, A, Patnayakuni, R & Patnayakuni, N 2006, 'Firm performance impacts of digitally-enabled supply chain integration capabilities', *Management Information Systems Research Quarterly*, vol. 30, pp. 225–246.

Ranganathana, C, Teo, TSH & Dhaliwalc, J 2011, 'Web-enabled supply chain management: key antecedents and performance impacts', *International Journal of Information Management*, vol. 31, pp. 533–545.

Robert, JD & Shin-Kap, H 2003, 'A systematic assessment of the empirical support for transaction cost economics', *Strategic Management Journal*, vol. 25, pp. 39-58.

Rossi, M, Tuunainen, VK & Pesonen, M 2007, 'Mobile technology in field customer service big improvements with small changes', *Business Process Management Journal*, vol. 13, pp. 853-865.

Sa´nchez, AMn & Pe´rez, MPr 2005, 'Supply chain flexibility and firmperformance A conceptual model and empirical study in the automotive industry', *International Journal of Operations & Production Management*, vol. 25, pp. 681-700.

Shang, S & Seddon, P 2002, 'Assessing and managing the benefits of enterprise systems: the business manager's perspective', *Information Systems Journal*, vol. 12, pp. 271–299.

Sharif, AM, Irani, Z & Lloyd, D 2007, 'Information technology and performance management for Build-to-Order supply chains', *International Journal of Operations & Production Management*, vol. 27, pp. 1235-1253.

Siegele, L 2008, 'Let it Rise: a special report on corporate IT', *The Economist*, pp. 1-26.

Stevenson , M & Spring, M 2009, 'Supply chain flexibility: an inter-firm empirical study', *International Journal of Operations & Production Management*, vol. 29, pp. 946-971.

Turcu, C, Cristina., T & Graur, A 2008, 'Improvement of supply chain performances using RFID technology', in *The Way to Flat Organisation*, eds Y Huo & F Jia, Vienna, Austria, pp. 404-422.

Venkatraman, A 2009, 'Capture the cloud', *Information World Review*, pp. 16-17.

Verstrepen, S & Cools, M 2009, 'A dynamic framework for managing horizontal cooperation in logistics', *International Journal of Logistics Systems and Management*, vol. 4, pp. 228 - 248

Wang, ETG & Wei, HL 2007, 'Interorganizational governance value creation: coordinating for information visibility and flexibility in supply chains', *Decision Sciences*, vol. 38, pp. 647–674.

Wang, G, Huang, SH & Dismukes, JP 2004, 'Product-driven supply chain selection using integrated multi-criteria decisionmaking methodology', *International Journal of Production Economics*, vol. 91, pp. 1-15.

Williamson, OE 1979, 'Transaction-Cost Economics: the governance of contractual relations', *Jornal of Law and Economics*, vol. 22, pp. 233-261.

Williamson, OE & Masten, SE 1999, *Economics of Transaction Costs*, Edward Elgar, Cheltenham, Uk.

Young, LW & Johnston, RB 2003, 'The role of the Internet in business-to-business network transformations: a novel case and theoretical analysis', *Information Systems and E-Business Management*, vol. 1, pp. 73-91.

Zhao, JL, Tanniru, M & Zhang, LJ 2007, 'Services computing as the foundation of enterprise agility: overview of recent advances and introduction to the special issue', *Information Systems Frontiers*, vol. 9, pp. 1-8.

Zhao, X, Kraemer, K, Huo, B, Flynn, BB & Yeung, JHY 2008, 'The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain', *Journal of Operations Management*, vol. 23, pp. 368–388.

Zhu, K & Kraemer, KL 2005, 'Post-adoption variation in usage and value of e-business by organizations: cross-country evidence from the retail industry', *Information Systems Research*, vol. 16, pp. 61–84.

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