Supply Chain Integration, a Chain of Efficient Utilization of Information Technology: Its Benefits & Challenges

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ABSTRACT

Business renovation, effective utilization of information technology and the role of business process modeling are dealt in supply chain integration projects. The main idea is to show how the performance of supply chain can be improved with the integration of various tiers in the chain. Integration is preconditioned for efficient sharing and utilization of information between diverse companies in the chain.

Keywords: Supply Chain Management; Supply Chain Integration; Benefits & Challenges; Business Process Renovation; Simulations; Information Transfer System

1. Introduction

One of the major transformations in the rapidly evolving digital economy occurs in the SCs of both traditional and e-commerce companies. Information technology has enabled channel partners to trade goods, share information, and integrate their processes, thereby reshaping the inter-organizational dynamics and resulting in more efficient channels. The power of inter-organizational information systems (IOIS) is well known. It has proven to be effective for reducing transaction costs. Three progressive degrees of IOIS are transactional, operational, and strategic (Seidmann and Sundararajan, 1998) [1]. This paper will reveal how business process modeling (explicitly process maps) can be used in order to develop such business models that will lead to improve sharing of information. Appropriate business processes are a prerequisite for the strategic utilization of information. The mere implementation of new technology without changes in a company's operation will realize only some of all the possible benefits. The rest therefore mainly deals with business renovation and changes in business processes that thus might improve the flow of information, as well as their challenges. All the theoretical findings are illustrated in a company that deals with transport of their product to their suppliers' base.

2. Literature Review: SC Management as a Whole

SCM is the management of interconnected businesses network involved in the ultimate provision of product and service packages required by end customers (Harland, 1996).

2.1. A Linked Set of Resources and Processes

This begins with the sourcing of raw materials and widens to delivery of end items, to the customer (Bridgefeld Grp ERP/SCGlossary, 2004).

2.2. The Integration of Key Business Process

SCM is "that key business processes from end user through original suppliers that provide products, services, and information…" (Chan & Qi, 2003).

2.3. SC Propagate & Enlarge Companies

Even though SC is often measured with the bullwhip effect. Some companies have incomplete information about the needs of others, however (Forrester, 1958-1961; Holweg & Bicheno, 2002) have shown that production peak can notably reduce by transmitting the information directly to the manufacturer.

3. Current Situation: Overall Model of Information Transfer in SC

Recent studies have emphasized the importance of information sharing within SC (e.g. Barrat, 2004; Lambert and Cooper, 2000; Lau and Lee, 2000) [2], which shows different changes as a result of using e-business.

3.1. Information Transfer in an SC

ICT has an important influence on dexterity between

companies, (Hengst and Sol, 2001). Internet by itself demonstrates no benefits and has not decrease inventory in any enterprise (e.g. Slovenia's) Paul Trkman, [3] 2000. Gavirneri (2002) summarized findings that show reductions of costs between 0% and 35%.

3.2. E-Business Transfer as a Business Renovator

Process renovation is a re-engineering strategy that critically examines current business policies, practices and procedures, rethinks them, then redesigns the mission-critical products, processes, and services (Prasad, 1999). The Internet enables companies of all sizes pursue intensive and interactive relationships with their suppliers, collaborating in new product range issues. E-business represents a shift in changing traditional organizational models, business, relationships and operational models that have been dominant for the past 20 years. (Phipps, 2000). However, IT alone is not a panacea for all SC problems. It was shown that electronic data interchange (EDI) could reduce swings in inventory and safety stock levels.

3.3. Business Renovator Goals

They remain a buzzword that brings back memories of headcount reductions, budget cuts, facility closures, costly consulting engagements and endless reorganizations that destroy and confuse partners/customers (Davenport, 1993; Miller, 1994). For more, see Leavitt's diamond in Burke and Peppard, 1995. IT serves as a facilitator through time saving and efficient application e.g. business modeling and computer aided design tools (Chang, 2000); also, analysis and simulation, including, Computer-Aided System Engineering (CASE) tools. At first, Customer satisfaction would grow if one managed to reduce costs, shorten execution times and increase service, excluding therefore 3 goals.

3.4. Business Process Modeling

Venkatraman and Henderson (1998-2000) [4] defined this as a co-ordinate plan to design strategy along three vectors: customer interaction, asset configuration and knowledge. There are several reasons producing this (Eriksson and Penker, 2000): *A business process model helps us understand the business*: it's to increase understanding and facilitate communication. *A business process model is a basis for creating suitable information systems*: used in identifying information systems needed. *A business process model is a basis for improving the current business structure and operation*: used to identify changes required to improve business. *A business process model provides a polygon for experiments*: used to study the implications of business structure. *A business process model acts as a basis for identifying outsourcing opportunities*.

4. SC Integration: The Benefits That Emanate

Integrated SCs can benefit its major participants *i.e.* suppliers, manufacturers, distributors and customers. Benefits include increasing loyalty among partners, reduce inventory, improved on-time delivery and increased flexibility.

4.1. Initial Benefit

Here, integration grows deeper over time. The 1st benefit is forming partnerships, thus trust among SC partners solidifies, leading to consistent predictable sourcing.

4.2. Forecasting

In addition to real-time tracking, companies begin to exchange planning data, thus Inventory management, shipping and production schedules with goal of increasing efficiency.

4.3. On time Delivery and Inventory

The SC center for advanced purchasing studies, said companies that moved to an integrated SC reported 50% increase in sales with 35% lower inventory.

4.4. Resilience

In chaotic times, true partnership, companies can quickly adapt to changes without prolonged production or delivery gaps.

5. SC Integration: The Challenges That Emerge

The developed business model helps to understand the current problems and also makes them more visible to all decision-makers in both companies. Problems on tactical level are: 1) the stock level cannot be measured accurately since the tank always contains some water; 2) communication between various departments and companies is costly; and 3) the transport company's trucks are not fully utilized. However, strategic level has bigger problems: 1) The flow of information in the process is slow and costly; 2) Human limitations prevent the decision-maker from using all available information (e.g. stock levels); 3) Each member in the chain is trying to attain its local optimum instead of the global chain's optimization; 4) Companies in the SC may not be primed to share their production data, lead times; (Terzi and Cavalieri, 2004) [5] indeed, lack of trust between partners is

one of the main barriers to collaboration (Barrat, 2004; [6,7] Ireland and Bruce, 2000); 5) Asymmetric distribution of costs and benefits: since substantial investments are needed from both sides, but the transporter realizes less benefits, while taking on new responsibilities, risks and a more strategic role in the process. Thus, the financial compensation plan for its services also has to be changed from previous system that was based on number and punctuality of deliveries to the final customer and average inventory costs; 6) Different organizational cultures and leadership styles; and 7) A new way of thinking: since employees will have to seek solutions on the SC global instead of local optima and learn to cooperate closer with its supplier/buyer. Business modeling plays the role of a facilitator of changes (Bay, Tang and Bennet, 2004; [8] Burgess, 1998; Kidd, Richter and Li, 2003).

6. Case Study & Results of a Specific Field

Based on the mentioned problems, several improvements were proposed. The main change is that the processes at both companies are now integrated and the supplier takes responsibility for the whole procurement process. Therefore, a renewed business model is perceived.

6.1. Case Study

This case study can be found with explicit details in (Aleš Groznik and Mujkic, 2005) [9]. This case deals with the fulfillment/procurement process in SC that contains a Petrol Company (with multiple fuel stations at different locations) and the supplier that transports the fuel to the stations from a few larger warehouses. The main goals are similar to the usual SC goals: to offer good service to the final customer, while keeping costs and lead-times low. The main cost of drivers is thus: number of stock-outs, stock level at the fuel station and process execution costs. The description of the current process is as follows: the stock level is measured manually once a day. Results are faxed to the purchasing department that collects information from all fuel stations. It predicts future demand, while taking seasonal and cyclical actions into account. Additional consultation with the fuel station manager is possible, if needed. The needs of several fuel stations are merged into one order. Tacit employee knowledge is used to make and optimize orders and transport routes. The analytical department controls possible changes in demand and supply patterns and transport routes. If required, it can adjust or cancel orders. After that, the order is sent to the transport company. The order has to be fulfilled with the available fleet, but cannot be modified. Financial compensation is paid to the transporter on the number of miles driven, fuel delivered and punctuality of deliveries. While the description focuses on one typical fuel station, the inputs from other stations are also taken into account at various points in the model. Most importantly, the capacity of each truck is considerably higher than the needs of one station so orders from different stations are usually merged into one. Obviously this is a specific case study with a standardized product and only one supplier so the results cannot be generalized to other industries without caution. The main findings are however relevant to most SCs regardless of the industry. Based on the process described in this study, an AS-IS model was developed. Process maps (standard method for modeling and analyzing in business renovation) were used for visualization of the model. Here, employees can be quickly taught how to develop/validate these models (Chen, 1999). They enable analyses of the costs and time needed for the process (Indihar Stemberger, Jaklic and Popovic, 2004). The Igrafx Process 2003 with a graphical user interface was used—such interface enables an easy understanding of everything involved in the project (Bosilj-Vuksic, Indihar Stemberger, Jaklic and Kovacic, 2002) [10].

6.2. Results of the Business Process Modeling

Although all phases are supported by IT, deep structural changes were needed to fully realize the potential benefits. Some of the proposed changes can be described with the popular buzz-word "vendor-managed inventory" (VMI), others with material requirements planning, data mining, operations research and generally SCM. However, it's the interconnection of those changes that bring the desired benefits. The chief idea is that the transport company takes a strategic role in providing a sufficient inventory to fulfill the demand of the end customer. It takes all important decisions regarding orders in order to realize this goal. The main proposed changes are: 1) The measurement of the product is now fully automatic; 2) The stock levels from all fuel stations are instantly available to the transport company; 3) Future demand is predicted using the model based on neural networks; 4) The system at the transport company automatically identifies the current levels of stock, predicted future needs and suggests possible orders and delivery among different petrol stations; 5) The final decision is made and approved daily by an employee in the transport company; 6) Operation research methods (e.g. the vehicle routing problem) are used to optimize transportation paths and times (see Gayialis and Tatsiopoulos 2004); and 7) In a long-term, the locations of the warehouses can also be optimized to bring further reduction in costs and transportation times. Further advantages not directly visible include: 1) Due to the use of optimization methods with full information available the transport is more efficient; 2) the predictions of future demand are considerably improved tacitly. The role of IT in all these suggestions is

crucial. An automatic system for the measurement and communication of current levels of stocks at all stations, neural networks, computer-assisted operation research methods etc. enable the changes. While it becomes possible to develop an information system to support the AS-IS model, it would be much more beneficial to do so for a renewed model.

7. Recommendation & Conclusion

After all the adequate benefits & challenges, integrated SCs are not ubiquitous at this time, thus cases of failures and breakdowns. During this research, some main keys were established for a brighter network process in SC integration.

7.1. Recommendation

The 1st is to set up how financial & non-financial results will improve SC integration. The 2nd is developing people, culture & an organization that support the SC vision. The 3rd is establishing the correct positioning of work on a global basis. The 4th is to incorporate SC consideration into product & service design decisions. The 5th is maintaining sourcing as a first-level priority. The 6th is to stay focused & consistent in relationships with customers & suppliers. The 7th is to create an effective Sales & Operation process. The 8th is to develop valid & reliable databases & information. The 9th is to develop the capabilities & analytic tools to make effective decisions in an increasingly complex & risky environment. The 10th is to build trust within & across organizations in the supply chain. The 11th is to find ways to share risk equitably among SC partners. The 12th is to truly share rewards equitably among SC partners.

7.2. Conclusion

In this paper, one analyzed the main aspects needed for the successful renovation, integration and operation of SC (This research does not grant all of the answers to overcome these challenges to integrating SCs or even a comprehensive approach for doing so. Nevertheless, one can find strategies & good practices developed by spotlight companies to meet these challenges & to push ahead in integrating SC). The core idea is that the successful implementation of SC integration projects is not as much a technological problem and that a thorough study of the current and desired states of business pro-

cesses in all companies involved is required. The case study showed a two-phased approach to estimate the different challenges & benefits of business process renovation with the use of simulations. The transfer of information transports important advantages in process costs and lead-times, while the resulting possibility of smaller and more frequent orders means reduced inventory costs.

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List of Acronyms

SC: Supply Chain
SCs: Supply Chains
IOIS: Inter-Organizational Information Systems