PART I

TECHNO-CULTURE

Information Technology in Global Supply Chain Management

Neha Mittal is an Assistant Professor in the Department of Commerce at Salesian College, Siliguri Campus.

Abstract

One of the most significant paradigm shifts of modern business management is that individual businesses no longer compete as solely autonomous entities but rather as supply chains. Business management has entered the era of inter-network competition. The management of multiple relationships across the supply chain is being referred as Supply Chain Management (SCM). Information Technology (IT) and its use in organizations and across supply chains have become a determinant of competitive advantage for many corporations. Reflection on the evolving and emerging IT trends further highlights the importance of IT in the context of increasing global competition. This paper conducts an extensive literature review to identify the latest trends and the impact of Information Technology in the Global Supply Chain Management with the objective of collecting, organizing and synthesizing existing knowledge relating to SCM and IT.

Keywords: e-SCM, e-SCM Processes and IT, Information Technology Tools, e-Supply Chain Risks.

Introduction

Globalization has an important impact on business environment and on all business organizations. Enhanced competitiveness requires that companies ceaselessly integrate within a network of organizations. This integration of companies within a network has led to put more emphasis on Supply Chain Management (SCM). "SCM is the management of upstream and downstream relationships in order to deliver superior customer value at less cost to the supply chain as a whole".[1] Recent technological developments in information systems and information technologies have the potential
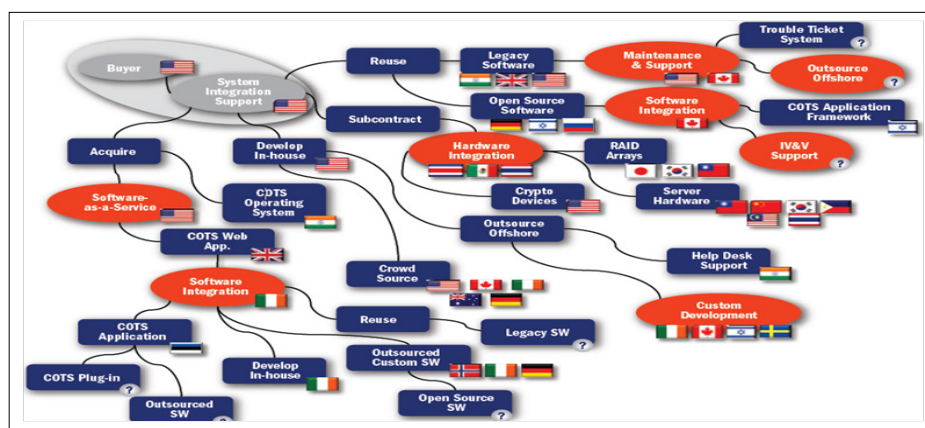
1 M. Christopher, *Logistics and Supply Chain Management: Strategies for reducing cost and improving service*, London, Financial Times Pitman Publishing, 1998.

to facilitate this coordination, and this, in turn, allows the virtual integration of the entire supply chain. The focus of this integration in the context of Internet-enabled activities is generally referred to as e-SCM.

Latest developments in Information Technology have propelled the e-Supply Chain Management (e-SCM) concept to newer dimensions. The main objective of this paper is to consolidate existing research efforts concerning the impact of Information Technology on Supply Chain Management. The work is organized as follows: the second section of this paper introduces the concept of e-SCM and the impact of IT on Supply Chain Management processes along with some ideas on further research, the third section deals with the existing and new tools of IT relating to SCM, the fourth section highlights the risks in Global IT Supply Chains and finally, the fifth section concludes stating how IT has become an indispensible part of the business world in managing their Supply Chains across the globe.

Defining e-SCM

SCM can be defined taking into account the eight supply chain processes identified by the International Centre for Competitive Excellence (now named Global Supply Chain Forum)[2]: customer relationship management, customer service management, demand management, fulfillment, procurement, manufacturing flow management, product development and commercialization, and reverse logistics. They explained SCM as "the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". SCM ideally embraces all business processes cutting across all organizations within the supply chain, from initial point of supply to the ultimate point of consumption.
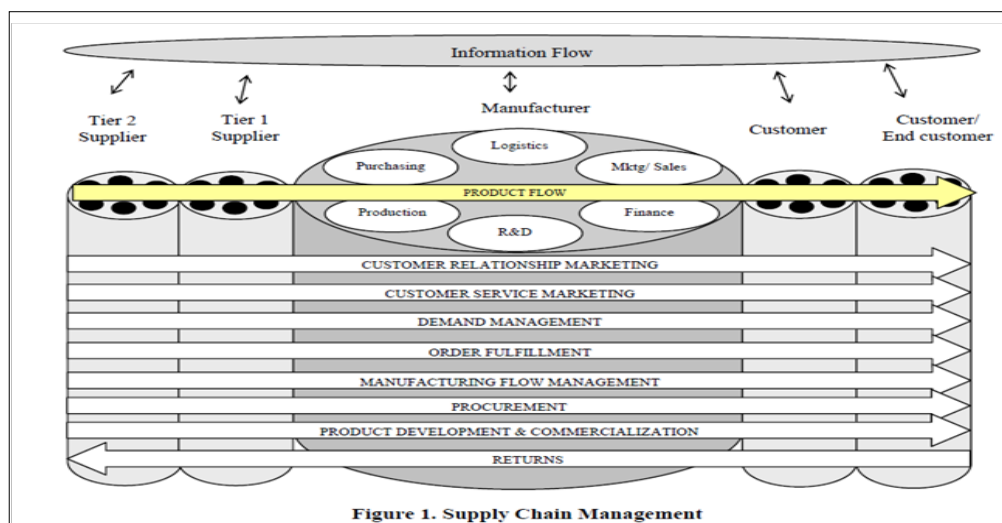

Figure 1. Supply Chain Management

Figure 1. Supply Chain Management

2 M.C. Cooper, D. M. Lambert, et al, "Supply Chain Management: More than a new name for Logistics", The *International Journal of Logistics Management* 8(1997)1, 1-13.

Accordingly, we define e-SCM as the impact that the Internet has on the integration of key business processes from end user through original suppliers. Due to the low implementation costs, the introduction of the Internet has brought about opportunities that allow firms to transact with other enterprises electronically. Amazon is one such example. The Internet can have three main impacts on the supply chain. One of the most covered topics in the literature is the impact of e-commerce, which refers mainly to how companies can respond to the challenges posed by the Internet on the fulfillment of goods sold through the net.

Another impact refers to information sharing, how the Internet can be used as a medium to access and transmit information among supply chain partners. However, the Internet not only enables supply chain partners to access and share information, but also to access data analysis and modeling to jointly make a better planning and decision making. This jointly planning and decision making is the third type of impact of the Internet on SCM and we refer to it as knowledge sharing.[3]

Impact of IT on SCM Processes

In this section we will study the impact of IT on each of the processes identified by the Global Supply Chain Forum.

The Customer Relationship Management Process

This process includes identifying key customers, segmenting them and tailoring products and services to their needs. The process also includes all activities related to working with customers in order to (1) improve processes, (2) eliminate demand variability and non-value added activities, and (3) develop agreements of metrics.

The Internet has two types of impact on this process: Internal and downstream. Internal effects refer to the impact of the Internet on the focal company. For example, through the Internet, all business units can have access to the same information about each customer. This means that all business units will be able to negotiate and relate with customers taking into account the same information. The downstream effects refer to the impact of the Internet on the relationships with customers. One of the most important aspects of the downstream effects is that web sites allow companies to collect data as users navigate around them. This means that the Internet can generate a large amount of data, which can be very useful to CRM if it is analyzed properly with Operations Research (OR) models.[4] Another downstream effect of the Internet is that it allows companies to provide new services to customers, increasing the companies' products and services offerings.

---

3 Cristina Giménez, Helena R. Lourenço, *E-Supply Chain Management: Review, implications and directions for future research*, URL: www.econ.upf.edu/docs/4apers/downloads/769.pdf (accessed on 31/Jan/2013).

4 A. M. Geoffrion, and R. Krishnan, "Prospect for Operations Research in the EBusiness Era", Interfaces 31(2001)2, 6-36. Also, see M. S. Sodhi, "Applications and opportunities for Operations Research in Internet-enabled Supply Chains and Electronic Marketplaces", *Interfaces* 31(2001)2, 56-69.

Further research regarding this process should try to analyse how different business units can use the same customer data. Future research should also try to determine what specific type of integration alternatives are available for organisations working with rapidly changing CRM and SCM support technologies. Future studies should also develop decision and OR tools to analyse the large amount of data gathered through the Internet. And, finally, researchers should also provide more empirical studies showing how the Internet is used to provide different product and service offerings.

The Customer Service Management Process

This process includes strategic aspects, such as the development of the response procedures and the establishment of the infrastructure needed to respond. The process also includes tactical aspects, such as the recognition of the events that require a response, the implementation of the responses and the control of the process.[5]

The most important impacts of the Internet on this process are in the internal and downstream parts of the supply chain. In the downstream part of the supply chain, the Internet can be used (1) to recognize events and listen to the customer, and (2) to communicate the response procedure to the customer. In the internal part of the process, the Internet can be used to enable information sharing on real time among different business units and among different functional areas of a firm. This internal information sharing will improve the response of the company to any event.

The future research should try to analyse intra-organisational and inter-organisational effects simultaneously showing how different business units share information on real time to provide a better customer service.

The Demand Management Process

The demand management process needs to balance the customers' requirements with the firm's supply capabilities.[6] This includes forecasting demand and synchronizing it with distribution, production and procurement. The Internet impacts this process along all the supply chain. Information sharing about actual sales enables companies to improve their forecasts. This affects the internal part of the supply chain (the focal company), but it also affects its upstream and downstream links. For example, in the grocery industry a manufacturer can receive information about the actual sales of its products at the stores. Internally, this information sharing can improve its forecasts, leading to an improvement in production planning and a reduction in stock levels. Downstream, this information sharing enables the customer (the grocery company) to eliminate the replenishment orders, because replenishment decisions can be made by the manufacturer. This means that the grocery customer reduces its order process costs and the stock levels (because its supplier's forecasts are better and stock-outs have

5 K. L. Croxton, S. J. García-Dastugue, and *et al*. "The Supply Chain Management Processes", *The International Journal of Logistics Management* 12(2001)2, 13-36.

6 *Ibid.*

decreased). Upstream, the information obtained about actual sales can be also shared with the focal company's suppliers. This improves the suppliers' forecasts, leading to an improvement in their production planning and a reduction in stocks.

The Internet affects this process along the supply chain, not only on the information sharing aspect, but also on the knowledge sharing aspect. The Internet not only enables the supply chain partners to access and share information, but also to access data analysis and modeling to jointly make a better planning and decision making.[7] One example of this knowledge sharing is Collaborative Planning Forecasting and Replenishment (CPFR). In these programs, customer, focal company and supplier do not only share information, they also plan together. In a CPFR program a forecasting support system is hold on an Internet server.

Further research should consider empirical analysis to determine the level of implementation of collaborative planning (such as CPFR) and collaborative replenishment (such as CRP) systems in different industries and the effects of this knowledge sharing on the performance of the supply chain.

The E-fulfillment Process

Order fulfillment is related with the effective management of all the activities needed to deliver the order to the customer. In a way, this process is about the integration of the manufacturing, logistics and marketing functions to ensure customer satisfaction and reduce total cost before, during and after the order fulfilment.

The impact of the Internet on the order fulfilment process has two main aspects. The first one is related to e-commerce and consists on fulfilling the customer orders placed through the Internet. While for customers the Internet has made the placement of orders more efficient, for the selling companies (of physical goods) the order fulfilment has become a critical operation (it is very costly and it is a key operation to obtain customer satisfaction).[8] The second aspect is related to the use of the Internet to improve the efficiency of the order fulfilment process for both online and offline businesses. The order fulfilment process requires the access and manipulation of a large amount of data, from customer orders to inventory levels. Therefore, the advantage of accessing and sharing data along the supply chain using Internet technologies can make this process more efficient and less costly. The possibility of all partners in a supply chain to see customer orders on real-time, or near real-time, can lead to a significant reduction of variability and costs and, at the same time, improve the responsiveness of the firm.

The directions for further research can enter into one of the following categories: (1) better use of information and the creation of knowledge by using actual and new

7 J. M. Swaminathan, S. R. Tayur, "Models for Supply Chains in E-Business", *Management Science* 49(2003)10, 1387-1406.

8 H. L. Lee, S. Whang, "Winning the last Mile of E-Commerce", *MIT Sloan Management Review* 42(2001)4 , 54-62.

analytical and decision tools; (2) new strategies applied to the e-fulfilment activities; and (3) more empirical research work, including case studies and business models about the implementation of e-fulfilment.

The Manufacturing flow Management Process

The manufacturing flow management process deals with making the products and establishing the manufacturing flexibility needed to serve the target markets. The process includes all activities necessary for: (1) managing the product flow through the manufacturing facilities, and (2) obtaining, implementing and managing flexibility.[9]

The Internet can have a positive impact on both aspects of the manufacturing flow management process. On one hand, the Internet provides the opportunity for demand and supply capacity data to be visible to all companies within a manufacturing supply chain, and therefore, the product flow through the manufacturing facilities can be improved. This visibility allows companies to be in a position to anticipate demand fluctuations and respond accordingly. The main effect of that is to reduce stocks and compress lead times. On the other hand, the Internet allows companies to be more flexible to respond to changes in demand. The Internet reduces the production cycles due to an increase in the speed of communication.

Further research should also be more empirically based. Finally, researchers should develop more decision models that take into account the global aspects of the supply chain to help improving the manufacturing planning.

The e-Procurement Process

The procurement process relates a firm with its suppliers and it is a fundamental process in SCM. The e-procurement process supports the procurement and sourcing activities via Internet technologies and enables an efficient negotiation between buyers and suppliers. We distinguish two types of e-procurement: marketplaces and B2B. Marketplaces bring multiple buyers and sellers together in a virtual market, meanwhile B2B e-procurement is a one to one relationship.

Since the procurement or supplier relationship process consists on a relationship between businesses and needs a large amount of information sharing and transfer, the use of the Internet has had a big impact on this process. The major impact of the Internet on the procurement process is certainly on information sharing, since this process involves retrieving, sharing and storing a large amount of data and information. However, knowledge sharing is becoming also a key issue in this process.

More studies regarding the benefits and implementation barriers of using B2B procurement should be conducted. Further research should also compare the benefits of B2B with respect to the EDI technology. Also, more studies should analyse how

9 *Ibid.*

to strategically segment e-procurement strategies (for example, for which products/ relationships are more suitable B2B applications and for which products/relationships are more appropriate marketplaces).[10]

The Product Development and Commercialization Process

The product development and commercialization process is critical to the success of the firm. It is the set of activities that companies should undertake to successfully develop and launch products. The process includes integrating customers and suppliers into the product development in order to launch the right product and to reduce the time to market.

The impact of the Internet on this process: One of the most important impacts is to enable collaboration among different functional areas and companies. Internet-based product development can make product design a truly collaborative process among designers, manufacturers, suppliers and customers without the limitations of geographical location and time zone.[11] Taking the perspective of a focal company, we can distinguish three types of effects: internal, downstream and upstream effects. Internal effects refer to the impact of the Internet on the focal company. The Internet enables the collaboration of different functional units in the new product development process. Downstream effects refer to the impact of the Internet on the relationships with customers: the Internet facilitates the involvement of customers in the design of new products, increasing the response of the company to the customer wants and needs. The company can also use the Internet to study the market in a faster and cheaper way. And, the upstream effects refer to the impact of the Internet on the relationships with suppliers: Suppliers can be involved in the process as early as possible in order to reduce costs and compress the time to market.

Further research should put more emphasis on conducting empirical studies in order to determine the real use and advantages of using the Internet in the product development and commercialisation process.

The Reverse Logistics and the Return Process

Effective returns management is a key process in today's business. The returns policy is one of the most attractive tools to stay competitive.[12]

How can the Internet help this process? Managing returns involves managing different types of data: reasons for return (defective, in warranty, old, etc.), conditions

10 B. Roberts & M. Mackay, "IT Supporting Supplier Relationship: The Role of Electronic Commerce", *European Journal of Purchasing & Supply Management*, 4(1998)2/3, 175-184.

11 K. Cheng, P. Y. Pan, et al, "The Internet as a Tool with Application to Agile Manufacturing: A Web-based Engineering Approach and its Implementation Issues" *International Journal of Production Research* 38(2000)12, 2743-2759.

12 D. S. Rogers and R. S. Tibben-Lemke, *Going Backwards: Reverse Logistics Trends and Practices*, Pittsburgh, PA, Reverse Logistics Executive Council Press, 1999.

of the product, point of return, instructions to customers, etc. The major impact of the Internet on this process consists on providing better information and knowledge to all members of the supply chain involved in this process. Another impact of the Internet on the returns process is related with e-commerce. Ecommerce generates more returns than the traditional commerce.[13] Handling these returns efficiently is, without any question, an important issue for companies selling through the Internet. Not only because the volume of returns is higher in the e-commerce than in the traditional channel, but also because the logistics involved is different Designing efficient close-loop supply chains is a key element to improve the reverse logistics and returns process, and the Internet can play an important role on this aspect.

Future research should focus on development of decision models to solve the problems related to the huge amount of returns associated with e-commerce.

Existing IT Tools and Applications in SCM[14]

Bar Coding and Scanner

Bar Codes are the representation of a number or code in a form suitable for reading by machines.[15] Bar codes are widely used throughout the supply chain to identify and track goods at all stages in the process. Bar codes are a series of different width lines that may be presented in a horizontal order, called ladder orientation, or a vertical order, called picket fence orientation. For example, goods received in a warehouse may be identified by the warehouse management system and added to stock held in the warehouse. When put away, the bar code is used to associate the storage location with the bar-coded stock, and on dispatch the stock record is amended. The use of bar codes can speed up operations significantly.

Warehouse Management Systems

Warehouse management systems are systems that control all the traditional activities of warehouse operations. Areas covered usually include receipt of goods, allocation or recording of storage locations, replenishment of picking locations, production of picking instructions or lists, order picking, order assembly and stock rotation. Some systems are used in conjunction with radio frequency (RF) communication equipment. The warehouse management system communicates with the RF system and directs the activities of the warehouse staff.[16] For example, when picking that it will provide the tasks for the operative to carry out. Once the task is complete the operative updates the

13 C. R. Gentry, "Reducing the cost of returns", *Chain Store Age* 75(1999)10, 124- 126. See also H. Meyer, "Many happy returns", *The Journal of Business Strategy* 20(1999)4, 27-31.

14 Prashant R.Nair, Venkitaswamy Raju and Anbudayashankar S. P, "Overview of Information Technology tools for Supply Chain Management", URL:www.csiindia. org/c/document_library/get_file?uuid...436f...

15 A. Rushton, J. Oxley and P. Croucher, "IT in the supply chain", The Handbook of Logistics and Distribution Management, Great Britain, Bell & Bain Ltd, Glasgow, 2000.

16 Thongchattu, Chakthong, Panu Buranajarukorn, "The Utilisation of e-Tools of Information Technology Towards Thorough Supply ChainManagement", Thailand, *Naresuan University Research Conference*, 2007.

system and is directed to the next task. This has the advantage of updating the stock holding in real time.

Transportation Management Systems

Transportation Management Systems provide more visibility into shipments and orders. Scheduling issues are also addressed on time. Multiple transportation options can be explored as a result of earlier visibility into the supply chain. Timely communication and status reports can also be obtained. By having control on its supply chain, businesses can make efficient routing decisions.

Inventory Management Systems

Advances in computer and software technology made the implementation of Inventory Management Systems possible. The systems work in a circular process, from purchase tracking to inventory monitoring to re-ordering and back around again. The systems ensure customers always have enough of what they want and balance that goal against a retailer's financial need to maintain as little stock as possible. Mismanaged inventory means disappointed customers, too much cash tied up in warehouses and slower sales. Factors such as quicker production cycles, a proliferation of products, multi-national production contracts and the nature of the big-box store make them a necessity. For e.g. Wal-Mart alone stocks items made in more than 70 countries, according to its corporate Web site. With those kinds of numbers, having an effective, efficient inventory control system, or inventory management system, is imperative.

Emerging and New IT Solutions for SCM

Radio Frequency Identification (RFID)

The bar code was intended to improve efficiencies in the retail space, but the bar code cannot uniquely identify the specific object such as when items are produced, the lot of the items was made and when will the items expire. RFID was able to take care of these issues. RFID is a type of automatic identification system. The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is
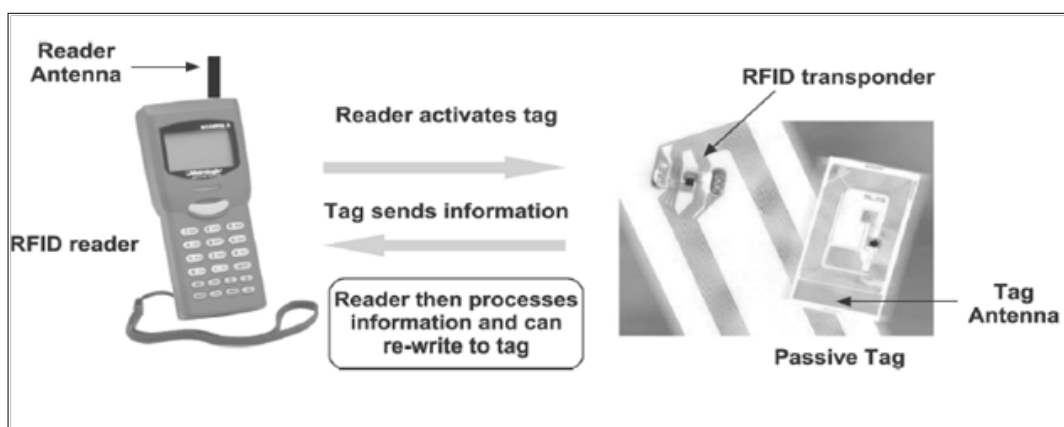
read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, colour, date of purchase, etc.[17]

Software Agents

A software agent is a software system, which has attributes of intelligence, autonomy, perception or acting on behalf of a user. One classification of agents given by Haag[18] suggests that there are only four essential types of intelligent software agents:

Buyer agents or shopping bots - Buyer agents travel around network (i.e. the internet) retrieving information about goods and services. These agents, also known as 'shopping bots', work very efficiently for commodity products such as CDs, books, electronic components etc. Amazon.com is a good example of a shopping bot.

Monitoring and Surveillance Agents - are used to observe and report on equipment, usually computer systems. The agents may keep track of company inventory levels, observe competitors' prices and relay them back to the company, watch stock manipulation by insider trading and rumors, etc.

User agents (personal agents) - are intelligent agents that take action on your behalf. In this category belong those intelligent agents that perform tasks like checking your e-mail and sorting it according to the user's order of preference, and alert you when important emails arrive etc.

Data mining agents - This agent uses information technology to find trends and patterns in an abundance of information from many different sources. The user can sort through this information in order to find whatever information they are seeking.

Monitoring and Surveillance agents and Data mining agents are being considered for applications in SCM.

Decision Support Systems

Decision Support Systems (DSS) are a specific class of computerized information systems that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions. In SCM, there is always a likelihood of having disagreements among parties for a certain decision making process. This phenomenon gets worse, when the business environment becomes more competitive and turbulent. Accordingly Decision

17 EPIC, 2002. URL: www.epic.org/privacy/rfid/

18 Stephen Haag, Maeve Cummings, Amy Philips, *Management Information Systems for the Information Age*, McGraw Hill College, 2006, pp. 224-228.

Support Systems (DSS) have been integrating in various areas like logistics, inventory management, facility design, sales analysis etc.

Electronic Commerce

Electronic commerce refers to the wide range of tools and techniques utilized to conduct business in a paperless environment. Some of the E-Commerce applications which are the changing the dynamics of Supply chain Management include:

e-Tailing: using the Internet for selling goods over the internet. The archetypal e-tailing application is that of a bookseller such as Amazon. This company is renowned for the fact that it only sells books over the internet and doesn't even take telephone orders.

e-Procurement: An e-procurement system which would automatically take the form produced by the person making the procurement, check that it satisfies all the company rules for procuring the item that is required, carry out authorization if it is below a certain limit or send the form to someone who can carry out authorization and then log the purchaser into the site of the supplier. He or she is then able to use this site to make the purchase, quoting an automatically generated procurement requisition number.

e-Auctions: These are sites on the web which run conventional auctions. There are two types of auction: those that are carried out in real time, where participants log in to an auction site using a browser at a specified time and bid for an article until the highest price is reached and no other bids are forthcoming. The other type of site - and the most common - is where an item is offered for sale and a date advertised after which no more bids are accepted. This is just an online analogue of a conventional business.

Risks in Global IT Supply Chains[19]

IT is created, supported, and integrated into complex, globally distributed networks of IT Supply Chains. These supply chains are not visible to, or well understood by, those who acquire and use the technology. This lack of visibility and understanding creates ample opportunities for intentional compromise of the IT components while they are being created, assembled and delivered throughout the supply chain. In addition, poor manufacturing, software development, and delivery practices can also open doors for compromising these components after they are installed and operational. As a result, many organizations face significant risk due to the high probability that the global IT infrastructure, including their own networks and systems, relies on tampered or tainted IT components that could either stop working unexpectedly or compromise the data that is delivered, processed, and stored by the IT infrastructure.

---

19 Ruud Bosman, *The New Supply Chain Challenge: Risk Management in a Global Economy*, URL: http://www. fmglobal.com/pdfs/ChainSupply.pdf

Examples of IT Supply Chain Risks

Cost-driven Risks: Cost considerations often drive decisions to obtain inexpensive parts, motivating less trustworthy suppliers to provide lower quality parts that have faster degradation rates. Some suppliers knowingly flood the market with counterfeit items that do not conform to required standards.

Obsolescence: Vendors discontinue hardware and software production as technology advances or business priorities change. This often results in the lifetime of a system significantly outlasting the lifetime of its components. System owners need to find alternative sources, some of which, unknowingly, are unauthorized suppliers. The only alternative is to perform costly upgrades or replace the systems.

Insertion of Malicious Content: The insertion of "logic bombs", "backdoors", and "spyware" in microchips and circuit logic, firmware, and software can sabotage or subvert the components they supply.

Unintentional Supplier Activities: Unintentional actions, such as errors in software coding, or overlooking faults due to inadequate hardware testing, can result in significant risks to system operation and integrity when the erroneous components are installed.

Addressing risks in IT Supply Chains

Incorporating IT SCRM in Acquisition Decisions

Organizations should address the risks associated with geographically dispersed global IT supply chains by integrating IT Supply Chain Risk Management (SCRM) considerations into the entire system lifecycle. Acquirers can mitigate risk by establishing explicit expectations with suppliers regarding specific supplier practices, and monitoring and validating these practices. For example: due diligence in the source selection process should include not just how and where the supplier does business, but the implications concerning how its business culture and practices may affect its readiness or ability to deliver trustworthy products or services. Analyzing the global risks identified through better IT supply chain visibility will allow organizations to take preventive measures to reduce risk exposure from malicious threats and intentional and unintentional non-malicious threats at all levels of the supply chain.

Working with IT Suppliers to Manage Supply Chain Risks

Today as acquirers demand increased visibility into how IT is put together, including proof of authenticity and integrity, suppliers are challenged with incorporating appropriate practices into the manufacturing or development lifecycle. Regardless of the development practices in use or the standards being required, suppliers must consider how they and their own suppliers are addressing basic acquirer expectations. According to the Software Assurance Forum for Excellence in Code (SAFECode),

security and integrity controls are critical to supplier's ability to demonstrate that they have addressed acquirer concerns, including protection of intellectual property and the potential of counterfeit components in the supply chain.

Managing IT Supply Chain Risk during Operations and Maintenance

Planning for continuous operations and maintenance of the system should be initiated early in the acquisition cycle and include requirements determination, production, and fielding.

One of the challenges of sustaining system operation over the course of a system's lifetime is replacing parts that break. In some cases, suppliers stop making them or go out of business, making it difficult to find genuine replacement parts to maintain intended system functionality. As a result, organizations are left with unattractive options, such as acquiring replacement parts from unverified third party suppliers, which can carry multiple risks.

Risk mitigation should consider how critical the system is to the organizations success, versus the costs and benefits associated with managing the supply chains that support sustainment of operational systems. Managers must consider the combination of all of the threats and vulnerabilities when defining and implementing their strategy for mitigating supply chain related risks to the health of operational systems.

Conclusion

Innovations enabled by Information Technology are creating new ways for firms to manage supply chain relationships.[20] Industry trends like globalization, outsourcing, customization, time to market and pricing pressure have compelled enterprises to adopt efficient and effective supply chain management technologies, practices, and policies. Adoption of Information Technology tools is vital for such efforts. Internet technology will change the way a company is required to do business. The companies must realize that they must harness the power of technology to collaborate with their business partners. Indeed, the Internet has emerged as a most cost-effective means of driving supply chain integration.

20 V. Sambamurthy, A. Bharadwaj and V. Grover. "Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms", MIS Quarterly 27(2003)2, 237-263.