

Exploring e-Business Trends with Supply Chain Management Perspective

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Abstract—The emergence of Internet and related technology changed the manner of conducting business globally. Several web and related technologies evolved that supported e-business and were adapted by major organizations to support their supply chain activities. Supply Chains are managed efficiently and responsively through web technologies and trends in e-business. Our study shows how e-business trends align with the supply chain management perspective. Through this exploratory alignment of web technology to enterprise solutions, our study aims to demonstrate and reinforce the continued recurrence of the phenomenon of technology leading to enterprise solutions. The article concludes by linking the emerging supply chain solutions with the continued developments in recent web generations.

Index Terms—E-business, technology, emerging trends, supply chain management.

I. INTRODUCTION

E-business has been evolving from infancy to toddler-hood [1] and getting mature day by day. The recent inventions in internet technology (IT) have boosted the growth of e-business. Researchers believe that there is still lot of scope in making the e-business activities more intelligent with the help of semantic web and its supporting technologies. While information systems have been the heart of E-Business there have concerns about its overall reliability as the business grows globally. The entrance of Cloud Computing has on the other hand revolutionized the e-business performance, it still cannot be risk free and researchers are evaluating its reliability with regards to functions like, request stage failures and execution stage failures [2], while some have focused on issues like server failures and non server based activity failures [3]. It's a known fact that online purchases are increasing rapidly which shows that consumers have began to trust online purchasing, although the fraud cases have also shown considerable increase. If focus is laid on the trust of the consumers, it is the opportunity for any organization to cement it and take initiatives to have multichannel offering to the customers. While CEOs are now focusing on providing online services, the major challenge faced by them is to select right infrastructure, software and service provider. This decision seeks lower costs, higher productivity and maximum customer satisfaction while maintaining efficient transactions in the whole supply chain. The emergence of technology has made things more

complicated to make decisions, as they involve huge investments.

The focus of organizations around 2002-2003 was on attracting and to keep customers by providing purchase decision support [4] and integrating their systems for supply-chain improvements. Later, the focus shifted to core POS, payment systems, mobile devices, and kiosks to replace aging infrastructure and enable lower operating and maintenance costs [5]. The organizations started then to simultaneously enhance their front end and back end process. While they wanted quality customer service in the front end, they created higher labor productivity and removed data entry redundancies by using a centralized repository to share information and business intelligence to help the decision process [6].

Given the dynamism in supply chain management and emerging business trends and technology it would be interesting to explore how IT has made an impact on supply chain management. The exponential growth in information technologies is creating solutions for every function of SCM and has made real time decision making possible. Researchers also link the growth in information technologies to web generations and their offerings. Mapping the evolving technologies to web generations can give a new direction in understanding the evolution of technologies and how the business world is adapting and demanding new technologies to cater their needs.

The objective of this paper is to discuss the emerging trends in e-Business, enabling technologies and map recent trends in supply chain management with web generations. The success of supply chains is directly related to the success of e-business. However, it has to be acknowledged that several technologies evolved because of the characteristics of supply chain functions. A brief discussion about the supply chain management in e-business perspective will be given in section 2. A general discussion about the technological advances in general and with respect to SCM will be presented in section 3. Section 4 discusses the emerging trends within supply chain management and effort to map the technologies to web generations will be provided in section 5 which will be followed by conclusions.

II. E-SCM

SCM has been defined in several ways in literature and Nurmilaakso [7] had put it as "A supply chain is a bidirectional flow of information, products and money between the initial suppliers and final customers through different organizations". Although three main components were mentioned it can be noted that in the context of

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e-business the first one, which is the bidirectional information flow is crucial, as it stands between the success and failure of any supply chain. Information integration between supply chain partners is very challenging as various organizations use different infrastructure, level of technology, software, etc. Nurmilaasko [7] identified three levels of Supply Chain Integration depending on the integration combinations between human and systems.

The concept of e-SCM is defined and discussed by several researchers [8], and some have provided a number of common definitions for E-SCM from literature (see [9]). It is obvious that SCM is inter twinned with e-Business activities and can be considered as the backbone of supply chain management. Lancaster *et al.* [9] provided an overview of E-supply chain management (E-SCM) initiatives, focusing on the evolution and technological drivers of moving to the web. Shavazi *et al.* [10] discussed the relationship between different components and aspects of ICT and how affect the different parts of SCM. Major components like internet (web), ebusiness, e-internet marketplaces, e-procurement, intranet and extranet were discussed in detail and further provided the benefits the organizations avail through ICT are also listed.

Initially, organizations could avail only automated calculations and efficient data storage and the increased use of computers later brought along applications like MRP systems which started aiding significantly in efficient operations planning. Large firms started including suppliers and customers in operations decisions where concepts like the quality of the materials in use, the on-time delivery of those materials, and customer follow up were adopted. The inclusion of suppliers as partners brought reliable, cost-efficient, high quality and longer-term relationships [9]. Internet had become a tool for organizations to readily access information related to, inventory, delivery schedules, etc [11]. As the interaction between firms increased, the necessity of integrated management evolved [12] leading to the growth of ERP systems that had the potential to include several units like inventory control, customer relationships, finance book keeping, etc. Common information between partners like price quotes, product specifications, and job bids online were offered through supply chain exchanges [13]. One of the major advantages of such collaboration resulted in minimizing the bull whip effect in the supply chain. The increasing trust among partners enhanced the pull based demand inventory system and aided in minimizing costs and increase productivity.

III. TECHNOLOGICAL ADVANCES

In the following a brief discussion as per the timeline of IT technologies will be discussed. The most prominent technologies that had an impact on e-Business in general are discussed briefly and then those technologies that are directly related to SCM will be presented.

A. Information Technologies (IT) in General

1) Internet and computer technology

The information and communication technology (ICT)

starts with abacus which was originated almost 3000 years B.C. Around 500 BC this early version of calculator has been developed. In 1833 first general purpose computer was designed by Charles Babbage, the first super computer were introduced in early seventies and in 1981 IBM created the first PC. In 1991 Tim Lee developed the concept of World Wide Web and 1st web server created by CERN. In 1995 the first world internet was connected. The internet and World Wide Web turned the trend to e-commerce. Although ICT is yet not fully embedded in commerce but it is a valuable asset for industries and companies to improve and speed up their business.

2) EDI: 1970s and 1980s

Electronic data interchange (EDI) was amongst the first technologies used through Value added network (VAN). EDI is an early Inter organizational system (IOS) that allowed exchange of information between supply chain partners without human intervention and it required that the documents be in agreed standard format [14]. The main advantage of EDI was to secure data transfer between point to point networks. However, EDI was not adopted widely in small and medium organization due to its high cost, implementation and batch processing instead of real time data processing.

3) XML and internet: 1990s

XML (Extensible Markup Language) brought simplicity in terms of dealing with formats of the files shared and allowed encoding documents in a format that is both human-readable and machine-readable. The developments in XML programming aided in the transformation of the supply chain into a supply chain network. The drawbacks of EDI were now taken over by XML and VPN that provided secured information sharing over public internet in real time [15]. With the use of XML the companies no longer have the connection issues. B2B became one of the standard business to business model applied by SCM [14].

4) E-Commerce and c-commerce: 2000

In 2000 Gartner group brought the idea of c-Commerce which can be defined as a collaborative interaction between all participant of SCM and to leverage on the internet tools to make the interaction among customers, suppliers, business partners and employees. c-commerce allows all the supply chain participants to collaborate in designing, development and management of products through its entire life cycle and makes the automatic flow of information across networks (See [16] for more details).

5) Web services

Web Services gained a lot of attention since 2003. Web Services provide components for use which was different from ASP, where the whole systems or applications are provided as a service. These components supported by system or application programming interface (API). These services offered can range from basic services like submitting invoices, scheduling appointments, browsing product catalogues, validating credit cards, etc. and can handle complex functions carried out by an entire supply chain, a customer relations management system, or ERP (enterprise resource planning) applications. More details about web services can be found in [6].

6) *Dynamic service composition (DCS)*

DSC is a process of creating new services at run time from a given set of service components. The advantage is that a new set of services can be created which were not envisioned during the design stage. Tosic *et al.* [17] discussed DSC's applicability to e-business software systems. They discussed about how DSC supports business agility, flexibility, and availability particularly in modern e-commerce and m-commerce software systems. Their work also mentioned issues and challenges of dynamic services compositions. For a detailed classification of the state-of-the-art dynamic web services composition techniques see [18].

7) *Web as a platform*

Compatibility of platforms and different applications had been one of the main challenges in terms of collaboration in SCM. Web 2.0 resolved this compatibility issue by allowing users to use the web as platform and eliminated the requirement to download any application [16]. B2B and e-commerce may also allow application to use web as a platform but web2.0 uses AJAX (Asynchronous JavaScript) and XML (Extended Markup Language) due to which only little information will pass between the server once the page is loaded and the web site will be loaded in real time dynamically [19].

8) *Grid computing*

Grid computing is a collection of resources that can perform tasks. Its functioning can be compared to an electric power grid that delivers energy on demand, grid computing dynamically manages network, computing and storage resources to automatically support business processes across the IT infrastructure [6]. Since grid computing allows to unite pools of servers, storage systems, and networks into a single large system so you can deliver the power of multiple-systems resources to a single user point for a specific purpose. Details of grid computing products offered by leading providers like IBM, Oracle and Sun, and elaborated in the vision of MicroSoft can be found in [6] who also highlighted the major obstacles of Grid Computing.

9) *SaaS and cloud computing*

SaaS (Software as a Service) is a business delivery model for many business applications such as MIS, CRM, DBMS, ERP, HRM and CAD etc. The SaaS is especially suitable for SME to reduce SCM cost as it can be deployed on the internet according to the demand and requirements of a customer and the customer only pay for what is needed [16]. Cloud computing is similar to distributed computing which means to run a program on all the connected computers in a network at the same time. This cloud computing also helps the SME to reduce the cost of powerful applications. Unlike other business technologies like B2B, EDI etc, separate server is not required and the SME can use it for SCM without paying a lot.

10) *Crowd sourcing*

Crowd sourcing refers to the concept where the user of the web contributes to the contents of the web like YouTube, Digg etc. This contribution is very important to lead the website to high relevance. The crowd computing is important in SCM where the suppliers, customers and other

stakeholders can contribute to improve the website to better customer relationship. Like Digg the suppliers and customer can also vote for important ideas and products to satisfy the end customer [20].

11) *Service oriented architecture (SOA)*

SOA is an application development and integration methodology that automates, integrates, and maintains business processes in a dynamic and cost-effective manner. It is based on XML and Web Services technologies and has been incorporated into Business Process Management and Enterprise Application Integration (BPM/EAI) platforms [6]. One of the advantages for organizations is that it can extend the SOA outside the boundary of the organization to link to partners, and offer collaboration with outside systems via the same architecture.

12) *Grid service*

The major issues faced by organizations were the integration of diverse standards used by various components between organizations. Using the benefits of Web Services technologies the Grid community designed the Open Grid Services Architecture (OGSA), which offered an extensible set of services that virtual organizations can aggregate in various ways [21]. The services can be therefore now be deployed on the grid in case of system failure the organization can immediately move to new server.

B. Technology Solutions Related to SCM.

1) *Material requirements planning (MRP) systems manufacturing resource planning (MRP II)*

MRP (Manufactured Resource Planning) originated in late 1960s and initially applied to airplane and mobile industries. The main purpose of MRP was to deliver right product to the right place at the right time. Later, it was adopted by small and large organization to reduce the production cost and increase productivity [22]. Before MRP, independent software used for business functions such as Excel spreadsheet was used in manufacturing/production planning etc, which was limited to track only an order at manufacturing stages rather than warehouse/shipping, sale etc. These fragment software could not updated data in various departments and led to errors. The MRP replaced such legacy software used in business organization to enable data sharing, report generation and product tracking from manufacturing to delivery [23]. *Enterprise resource planning (ERP)* is an extension of MRP. Akkermans *et al.* [24] describe ERP as a "comprehensive transaction management system that integrates many kinds of information processing abilities and places data into a single database".

2) *E-Procurement*

A common definition of e-procurement is the business-to-business purchase and sale of supplies and services over the Internet. The main components of e-procurement include e-tendering, e-auctioning, vendor management, catalogue management, Purchase Order Integration, Order Status, Ship Notice, e-invoicing, e-payment, and contract management. Based on the number of components involved it is clear that a very efficient information system should be in place for this level of

integration. Based on Economic Value Added model [25] provided a conceptual framework for organizations to use in strategic decisions regarding the deployment of Internet technologies within their supply chain.

E-Design emerged to facilitate supplier involvement in the specification development process of a product. It facilitates reduced time-to-market cycles by overcoming the silo-effect of the traditionally sequential design activities [25].

E-Sourcing is the process of finding new potential suppliers using ICT with the aim of decreasing search costs. Identifying new sources of supply increases competition during the tendering process [26].

E-Tendering is the process of sending RFx (request for information, request for proposal, and request for quotation all put together) to suppliers and receiving responses electronically [26].

Electronic Purchasing Consortia (EPC) helps to electronically perform tasks that are crucial for the management of demand aggregation between any legal entities. EPC can exploit the potential of economies of scale and scope without the diseconomies of increased transaction and communication costs [27].

Reverse auctions is a buyer-initiated quotation process, where purchasers post an RFQ for a product, while suppliers electronically bid against each other in a progressive way and compete in an online bidding event to achieve a sale for the requested product. Reverse auctions are based on game theory, with dynamic price applications used to streamline the RFx process [26].

Laseter *et al.* [28] define an *e-marketplace* as a “forum that leverages the Internet to facilitate commerce among businesses including a wide range of entities — from independent or pure-play dotcoms financed by venture capital, to industry consortia backed by pooled funds, to private networks created by individual companies.”

A *B2B e-marketplace* is a platform where numerous buyers and suppliers meet to seek information and to buy and sell goods and services at a fixed or dynamic price. The price is determined in accordance with the rules of the exchange and a commission is charged for the products sold through it.

Baldi and Borgman [29] also identify ‘*meta*’ *e-marketplaces* that are formed by a group of independent market providers who collaborate and exchange requests and offers by interconnecting their *e-marketplaces* to increase liquidity.

Buy-side solutions are governed by one organization (private *e-business* solution) or several firms (consortia-led solution) and are set up to support the purchasing processes.

A *sell-side solution* typically comprises a supplier and multiple buyers and is initiated by suppliers and distributors to support their sales processes. Sell-side solutions can be direct ordering on supplier websites or seller-led *e-marketplaces* [30].

RFID based Inventory Control and Management System (*RICMS*) was proposed for manufacturing enterprises [31] to enhance product life cycle. It is a type of product management where accurate real time data of a transaction of a product is collected. The transactions associated with a specific product is encoded as a set of decision rules to improve the timeliness, visibility and integrity of transactions and location records of a product. The *RICMS*

can also help to improve warehouse management by speeding up operations, reducing operation costs and eliminating errors.

IV. TRENDS IN SCM

In this section we will discuss the latest trend in SCM. However, the trends associated with *e-business/e-commerce* are also directly linked with the development of SCM and therefore trends in *e-business* will be discussed first.

Early 2000s the businesses started to look into elements like customer relationship management, enable customers to personalize and customize products, develop and serve online communities with niche interests, etc. It was then hoped to have efficient *e-business* virtual supply chains that will intimately link manufacturers and producers directly to customers in future [32]. The growth and development of IT has made that expectation possible and several business models have been built to enhance real time business. Later, with the aid of developing technology, the need of application development also grew. Ma [6] discussed the emerging trends in *e-commerce* and listed some of the trends that included application services, Web Services, grid computing and their combinations. A recent list of the top 10 trends [33] shaping the future of *e-commerce* included concepts like Collective intelligence, Social network integration, Mobile sites, Location-based tie-ins, Contextual visualization, etc. The realization of Software as a Service (SaaS) has put the small and medium scale enterprises into action. Once deprived of software due to high cost, SMEs now can afford to rent the software as needed and in proportion to their needs. The major players who provide such services include huge organizations like Microsoft, Google, IBM and salesforce.com. Balaraman and Kosalram [34] assessed the trends in E business and its impact on Business processes while discussing the metrics and criteria of evaluating E commerce platforms.

In the context of SCM the trends also fall in line with the technological developments in IT industry. Kumar [35] stated that “*enterprise-focused systems such as enterprise resource planning (ERP) systems, executive information systems, and decision support systems, become key to achieving cost efficiencies and organizational effectiveness through intraorganizational process integration*”. He further emphasized the use of Advanced Planning Systems (APS) which was later integrated as part of the ERP systems.

The supply-chain managers then had already started looking forward to transfer information and raw data into information and knowledge that can be used for operations. Singh [36] discussed the concept of Automatic Data Capture (ADC) which was capable of handling bar code scanning, voice recognition, and radio frequency data capture (RFDC). He further added that Artificial Intelligence (AI) can be used to solve complex supply-chain problems that involved intelligent decision-making data and online analytical processing.

It was already predicted by 2005 that RFID can fill some of the information gaps in the supply chain, especially in retailing and logistics and as a mobile technology, RFID can enable “process freedoms” and real-time visibility into supply chains [37]. RFID started gaining popularity

researchers predicted RFID and EPC (Electronic Product Code) as an enabler to provide intelligent B2B e-Commerce supply chain management [38]. In the year 2007, RFID was among the most promising technologies in SCM and the others in the list were multi-enterprise visibility systems, people enabling software, execution-driven planning solutions, and human supply chain technology [39]. A collaborative research project [40] based on oil industry was conducted from Auckland University to examine the emerging technologies for supply-chain. In this research, which was based on the oil industry found four very rapid up-and-coming technologies that again included RFID along with GPS (Global Positioning Systems), AIDC (Automatic Identification and Data Capture), and OCR (Optical Character Recognition). A study on retailers and the emerging technologies within listed RFID, EDI, POS (Point of Sales), and DM (Data Mining) [41]. To end all the government needed documentation and approvals in easier manner which reduces cost and enhance responsiveness time, the use of Supply Chain Networks was proposed with e-government ideology [42].

V. MAPPING E-SCM WITH WEB GENERATIONS

Before mapping e-SCM with web generations, it is imperative at this stage to introduce web generations. The first concept of Web was introduced by Tim Burners-Lee in 1989 and in the due period of time researchers talked about Web 2.0 which is believed as the current era. Researcher also talked about Web 3.0 and even Web 4.0 which do not exist but are currently speculations based on the trends of web technologies and the business needs of large global organizations who need efficiency in their supply chains.

Fig. 1 summarizes the web generations and their characteristics as given by Getting [43]. However, it has been a long time since then and therefore it would be interesting to see how things have developed in terms of solutions and technologies. Ooi *et al.* [16] presented good overview of overview of application of Web 2.0 in Supply Chain Management. The discussed about the current era of Web 2.0 which brought technologies like user centered design, crowd sourcing, using web as platform, collaboration, power decentralization, dynamic content, Software as Service (SaaS) and rich user experience.

Aghaei *et al.* [44] presented an overview of the evolution of four web generations and compared their characteristics. They predict that artificial intelligent techniques will be embedded in all aspect of web applications and allow intelligent interactions.

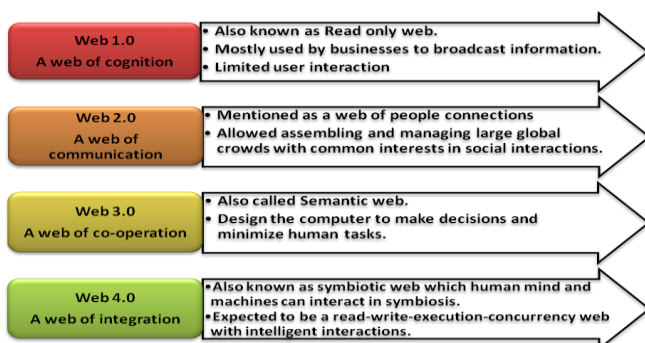


Fig. 1. Web generations and their characteristics.

Technology solutions to SCM evolve with the evolution of the technology itself. With each web generation development came newer technology solutions to SCM challenges. Fig. 2 shows the adoption of evolutionary web technologies to move SCM from an enterprise platform to a mobile platform with location based secure solutions and anticipated selected examples. Some of the selected examples of SCM solutions are listed in Table I and mapped in Fig. 2.

TABLE I: SELECTED EXAMPLES OF SCM SOLUTIONS

Web 1.0	Web 2.0	Web 3.0	Web 4.0
① EDI	① User Centered Design	① Web of Data	★ WebOS
② E-Commerce	② Crowd Sourcing	② Global Database	★ Mind Contolled Interface
	③ C-Commerce	③ User Engagement	★ Intelligent Web
	④ SaaS & Cloud Computing	④ Unicode	
	⑤ Web Platform	⑤ Uniform Resource Identifier(URI)	
	⑥ Dynamic Content	⑥ EDI	

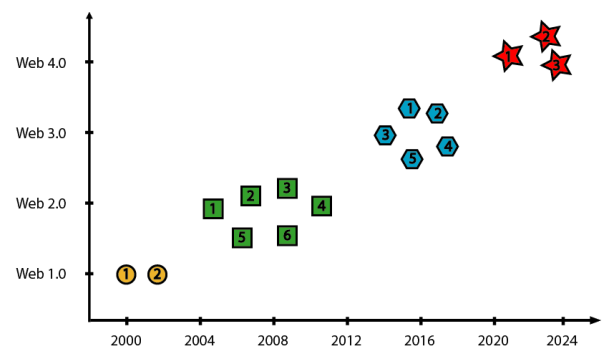


Fig. 2. Mapping web generations to SCM Technologies.

VI. CONCLUSION

The development of internet technologies with regard to e-business was presented and technological advances were discussed. The paper discussed how e-business activities and solutions shaped the SCM into e-SCM and related advances and trends were provided. The developments were also discussed from the perspective of web generations and selected technology solutions were mapped to assess the progress and direction of web's future.

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