Supply Chain Management Information System

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***Abstract* – It is no surprise that IT played a big role in enabling many processes and ideas in supply chain management (SCM) that seemed impossible in earlier years. Information system (IS) is no longer simply a support for supply chain (SC) operations; it is at the heart of its operations. In order to achieve better results in the SC, supply chain management information system (SCM IS) need to be developed.**

SCM IS is information system used to coordinate information flow between internal and external customers, suppliers, distributors, and other participants in a SC.

The performance of the SCM IS greatly relies on its infrastructure. The proposed SCM IS embraces the concept of distributed object technology to enable efficient data exchange among various SC participants which may reside in distributed platforms.

***Keywords* – Information technology, Information system, Supply chain management.**

I. INTRODUCTION

The adoption of information technology (IT) along a supply chain has become a necessity for enhancing supply chain (SC) performance [1].

IT played a big role in enabling many processes and ideas in supply chain management (SCM) that seemed impossible in earlier years. It is a critical enabler of effective SCM. Indeed, much of the current interest in SCM is motivated by the opportunities that appeared due to the abundance of data and the savings that can be achieved by sophisticated analysis of these data [2].

IT-based SCM systems, such as supply chain management information system (SCM IS) coordinate and integrate the flow of products, information, and finances between supplier, manufacturer, wholesaler, retailer and end consumer. They serve to create a multiplicity of digital options to be applied for operational, tactical and strategic purposes.

The task of SCM IS is to collect, exchange, synthesize and analyze the life cycle information necessary to support decision making process and help in identifying and implementing features that will maximize economical effect and minimize environmental degradation.

Successful implementation of the SCM IS requires a distributed computing and controlling infrastructure to connect with the computer systems of all SC participants. To meet this objective, the distributed object-oriented technology can play an important role in terms of easy access and sharing of information across a distributed IS. In this paper, we preferred distributed component object model (DCOM)-based infrastructure of the SCM IS.

The remainder of the paper is structured as follows: Section II gives some comments about SCM topic. Section III introduces basic concepts and framework of supply chain management information system. Finally, concluded remarks are given in Section IV.

II. SUPPLY CHAIN MANAGEMENT BASICS

Interest in SCM has grown rapidly over the past several years, and continues to grow. At the same time, information and communication systems have been widely implemented, providing access to comprehensive data from all components of the SC [2].

SCM has many definitions, all with a similar underlying theme of integrating the firm's internal processes with suppliers, distributors, and customers. Perhaps the most often cited definition comes from the Council of supply chain management professionals (CSCMP) [3]: "SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. SCM integrates supply and demand management within and across companies."

SCM is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance, and information technology [4].

The existing literature on SCM is extensive (comprehensive review is given, for example, in [5]) and mainly proposes that integrated control of these "multi-company networks" can provide significant benefits.

The ability of customers to access information is becoming an essential requirement in SCM, because visibility of information is what an increasing number of customers expect. The Internet enables these capabilities, and companies will need to invest in SCM IS that supports it.

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III. SUPPLY CHAIN MANAGEMENT INFORMATION SYSTEM

An IS can be defined as a set of interrelated components that collect (or retrieve), process, interpret, store, filter and distribute information to support decisions within and across partners [6].

Efficient information handling in a SCM is of the most significant importance; i.e., information system (IS) is no longer simply a support for SC operations; it is at the heart of its operations [7].

The information environment is the backbone of SCM. Information flows connect SC participants, SC functions both vertically and horizontally and management decision levels [8].

IS and new technologies could be used to improve a SCM operations. It has been identified that the use of appropriate IS could lead to the creation of differential business value [9].

In SCM area, there are widespread adoption of IS like: material requirements planning (MRP), manufacturing resource planning (MRPII), enterprise resource planning (ERP), supplier relationships management (SRM), customer relationships management (CRM) [10]. However, due to their incapability to deal with uncertainty, other systems and/or technologies are needed to improve product traceability in a SCM. As a result, advanced technologies such as RFID, global positioning system (GPS), and mobile technology have recently been applied in the SCM. They all together could to ensure improved efficiency in information processing, improved security, fast ordering, improved customer relationships, better control of supplies, etc.

SCM IS is information system used to coordinate information between internal and external customers, suppliers, distributors, and other participants in a SC [11]. It plays an increasingly critical role in the ability of firms to reduce costs and increase the responsiveness of their SC.

In the remainder of this Section, basic concepts and infrastructural framework of SCM IS are introduced.

A. Supply chain management information system: basic concepts

It must be said that the IT provide a new level of coordination capabilities in SCM and enable a breakthrough in SCM responsiveness and flexibility. IT, on one hand, serves as an environment to support SCM; while on the other hand, it is the enabler of much advancement in SCM. Modern IT can potentially enable almost any coordination concept.

In addition, there is a wealth of literature on IT in SCM; i.e., [1], [6], [7], [9], [10], [12], [13], [14], [15], [16], [17]. The comprehensive literature review from above identifies that IT is expected to have a pivotal role in SCM, now and in the future. In fact, it seems that the use of IT is crucial, particularly for managing contemporary SCs [17].

IT-based SCM systems differ from the traditional supply chain function due to computational speed and large data stores [14]. Although increased computational capacity and access to large data stores are valuable, the primary advantage of IT-based SCM systems comes from the ability to share information across all supply chain functions and, increasingly, across all SC's participants.

IT-based SCM systems deliver information to decision makers when they need it and in the format, they need it. Decision makers can create, customize, and deploy reports easily and efficiently as required. IT-based SCM systems allow monitoring of the extended supply chain, providing entire supply chain visibility.

According to [18] the *objectives of IT in SCM* are:

- Providing information availability and visibility;
- Enabling a single point of contact for data;
- Allowing decisions based on total SC information; and
- Enabling collaboration with SC partners.

IT-based SCM systems, such as SCM IS, coordinate and integrate the flow of products, information, and finances between supplier, manufacturer, wholesaler, retailer and end consumer. They serve to create a multiplicity of digital options to be applied for operational, tactical and strategic purposes. The task of such SCM IS is to collect, exchange, synthesize and analyze the life cycle information necessary to support decision making process and help in identifying and implementing features that will maximize economical effect and minimize environmental degradation. In addition, development of the SCM IS is needed in order to: Support operational decisions made in day-to-day processing; and to provide an IT infrastructure.

It is important that SCM IS has the ability to integrate not only several actor groups, but all of them across the SC. In fact, the lack of integration is a great obstacle to building an effective IS [19].

New Auto-ID technologies (like RFID, for example) enables *intra-* and *inter-organizational* communication. It is adopted for intra-organizational processes, such as inventory management, point-of-sales management, and asset management; for inter-organizational processes, such as tracking and tracing the status of item in SC [1]. For example, classical example of internal (i.e., intra- organizational) IS is ERP system. On the other hand, inter-organizational IS are used for information sharing and/or processing across organizational boundaries. There are three categories for the use of inter-organizational IS in SCM [20]:

1). Transaction processing;
2). Supply chain planning and collaboration; and
3). Order tracking and delivery coordination.

B. Supply chain management information system framework

In general, a SC logistic network comprises the *physical element* (physical SC) and the *information element* (information SC). Information part supplements the physical one, in order to achieve the efficient performance of the whole SCM. The SCM IS extends the scope and efficiency of the

SCM by providing an infrastructure to facilitate the efficient exchange of data among all SC participants (see Fig. 1).

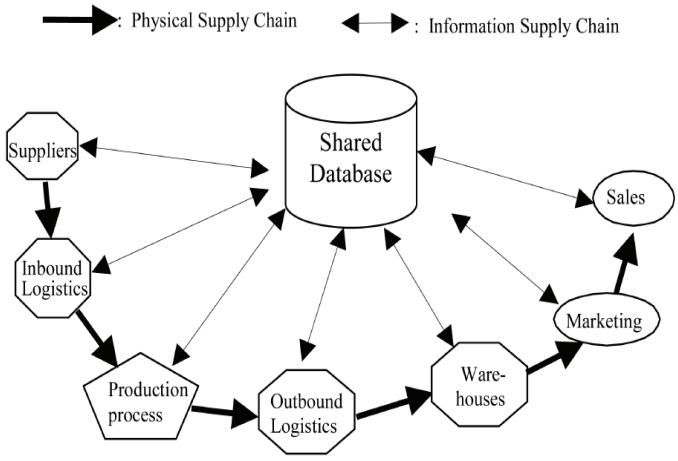

Fig. 1. Internet-based SCM [21]

All SC participants need better information flow together with easier and quicker access to required information. As SC participants begin to demand more out of the computer system to manage their everyday operations, they begin to suffer from restrictive connectivity and integration constraints. Even if a small portion of a large customer base chooses to get information over the Internet (which can include millions of inquiries per month) that would stretch the capability of the server to the limit.

The performance of the SCM IS greatly relies on its infrastructure. Studies concerned with the detailed infrastructure of a SCM IS, have not received the attention they deserve. However, there are some bright examples like [21], who elaborated on an infrastructure of integrated component-based SCM IS. The proposed SCM IS embraces the *concept of distributed object technology* to enable efficient data exchange among various data objects, which may reside in distributed platforms. In addition, the significance of this paper represents the provision of a cross-platform data exchange.

C. Supply Chain Management Information System: Infrastructural framework

Successful implementation of the SCM IS requires a distributed computing and controlling infrastructure to connect with the computer systems of all SC participants. To meet this objective, the *distributed object-oriented technology* can play an important role in terms of easy access and sharing of information across a distributed IS.

Any Internet server have to use some of distributed technologies, such as for example, the *common object request broker architecture* (CORBA) standard [22] or the *distributed component object model* (DCOM) [23]. CORBA and DCOM technologies make it possible to distribute information across virtually any number of physical servers located on a local area network (LAN) and/or wide area network (WAN), which form the infrastructure of the SCM. In addition, CORBA and DCOM-based systems avoid the single server bottlenecks that are frequent in traditional client-server systems [21]. In addition, important feature of using distributed object technology, as CORBA and DCOM are, is to ensure interoperability between applications on different machines in a heterogeneous distributed environment.

CORBA supports different computing languages and runs on different machines in heterogeneous distributed environments, and it is a well-accepted standard. There are a number of specifications and standards associated with CORBA. The core ones are as following:

- ORB is a middleware with which is able to access data storage on remote systems;
- Internet inter-ORB protocol (IIOP) is the protocol that ORB use to communicate over TCP/IP networks;
- Interface description language (IDL) is used to specify the interface between the client ORB and the server ORB; and
- Business objects, defined as high-level representations of things that exist in a business domain [22].

On the other hand, Microsoft has released its *DCOM* architecture. In brief, DCOM is an architecture that enables components (processes) to communicate across a network in a distributed way. DCOM provides distributed messaging services, distributed transaction services, data connectivity services, etc.

We preferred DCOM-based infrastructure of the SCM IS (see Fig. 2), because of two reasons: its acceptance is growing due to the wide Windows customer base; and DCOM is comparatively cheaper than other similar products (it arrives totally ”free” with Windows NT program package).

The SC participants exchange information with the ”main actor” (for example, before point-of-sale paramount participant (or main actor) is producer) based on two approaches. The first is through the DCOM directly; and the second is through Internet browser with HTTP protocol.

Business object is regarded as the organized data about certain SCM activity, which is encapsulated in the form of an entity called business object [21]. With the help of object technology, all kinds of SCM activities can be represented as business objects and incorporated into the SCM IS.

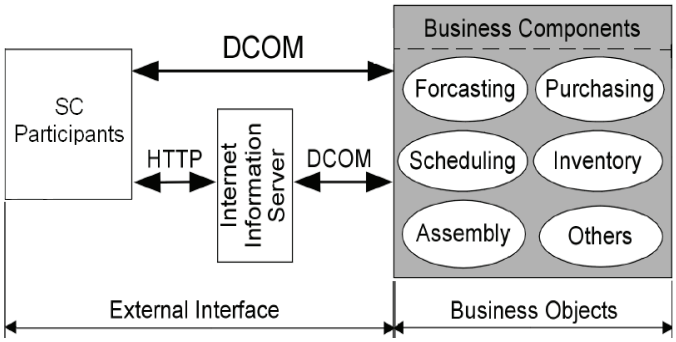

Fig. 2. DCOM-based infrastructure of the SCM IS

IV. CONCLUSION

IT-based SCM systems, like SCM IS, deliver information to decision makers when they need it and in the format, they need it. SCM IS should be regarded as an essential ingredient to provide SC participants with the ability to see, know, anticipate, model, link, and trade off available resources.

The SCM IS is aimed at making use of an efficient information flow mechanism for coordinating and monitoring the data interchange among various SC participants. SCM IS is characterized by its ability to provide accurate and relevant information to enhance the performance of the SCM processes. In addition, it can be regarded as a fully integrated and distribution-based IS.

The performance of the SCM IS greatly relies on its infrastructure. The proposed SCM IS embraces the concept of distributed object technology to enable efficient data exchange among various SC participants, which may reside in distributed platforms.

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REFERENCES

[1] K. Lai, C.W.Y. Wong and T.C.E. Cheng, "Institutional isomorphism and the adoption of information technology for supply chain management", Computers in Industry, vol. 57, no. 1, pp. 93–98, 2006.

[2] D. Simchi-Levi, P. Kaminsky and E. Simchi-Levi, Managing the Supply Chain: The Definitive Guide for the Business Professional, McGraw-Hill, USA, pp. 1-16, 2004.

[3] CSCMP and Supply Chain Visions. Supply Chain Management Process Standards: Enable Processes, Council of Supply Chain Management Professionals: Oak Brook, IL, 2004.

[4] J.L. Sutherland, "Logistics from a Historical Perspective", in Logistics Engineering Handbook, (Editor: M.G. Gaukler), pp. 4, Taylor & Francis Group, Boca Raton, Florida, 2008.

[5] K.C. Tan, "A framework of supply chain management literature", European Journal of Purchasing & Supply Management, vol. 7, no. 1, pp. 39-48, 2001.

[6] N.R. Sanders, R. Premus, "IT applications in supply chain organizations: A link between competitive priorities and organizational benefits", Journal of Business Logistics, vol. 23, no. 1, pp. 65-83, 2002.

[7] J.V. Pereira, "The new supply chain's frontier: Information management", International Journal of Information Management, vol. 29, pp. 372–379, 2009.

[8] D. Ivanov, B. Sokolov, Adaptive Supply Chain Management, Springer-Verlag, London, pp. 45-57, 2010.

[9] A. Radhakrishnan, X. Zu and V. Grover, "A process-oriented perspective on differential business value creation by information technology: an empirical investigation", Omega, vol. 36, pp. 1105–1125, 2008.

[10] P.H. Ketikidis, S.C.L. Kohc, N. Dimitriadisa, A. Gunasekarand and M. Kehajova, "The use of information systems for logistics and supply chain management in South East Europe: Current status and future direction", Omega, vol. 36, pp. 592–599, 2008.

[11] T.S. McLaren, M.M. Head and Y. Yuan, "Supply chain management information systems capabilities. An exploratory study of electronics manufacturers", Information Systems and e-Business Management, vol. 2, pp. 207–222, 2004.

[12] A. Gunasekaran, E.W.T. Ngai, "Information systems in supply chain integration and management", European Journal of Operational Research, vol. 159, pp. 269-295, 2004.

[13] C. Chandra, J. Grabis, "Information technology support for integrated supply chain modeling", Human Systems Management, vol. 27, no. 1, pp. 3-13, 2008.

[14] B. Dehning, V.J. Richardson and R.W. Zmud, "The financial performance effects of IT-based supply chain management systems in manufacturing firms". Journal of Operations Management, vol. 25, pp. 806–824, 2007.

[15] E.A. Williamson, D.K. Harrison and M. Jordan, "Information systems development within supply chain management", International Journal of Information Management, vol. 24, pp. 375-385, 2004.

[16] P.K. Humphreys, M.K. Lai and D. Sculli, "An inter-organizational information system for supply chain management", International Journal of Production Economics, vol. 70, pp. 245-255, 2001.

[17] J. Auramo, J. Kauremaa and K. Tanskanen, "Benefits of IT in supply chain management: an explorative study of progressive companies", International Journal of Physical Distribution & Logistics Management, vol. 35, no. 2, pp. 82-100, 2005.

[18] D. Simchi-Levi, P. Kaminsky, and E. Simchi-Levi, Designing and Managing the Supply Chain: concepts, strategies, and case studies, McGraw-Hill, New York, NY, pp. 247, 2003.

[19] S.R. Croom, "The impact of e-business on supply chain management: An empirical study of key developments", International Journal of Operations & Production Management, vol. 25, no. 1, pp. 55–73, 2005.

[20] M. Kärkkäinen, S. Laukkanen and S. Sarpola, "Roles of interfirm information systems in supply chain management", International Journal of Physical Distribution & Logistics Management, vol. 37, no. 4, pp. 264-286, 2007.

[21] H.C.W. Lau, W.B. Lee, "On a responsive supply chain information system". International Journal of Physical Distribution and Logistics Management, vol. 30, no. 7/8, pp. 598-610, 2000.

[22] Object Management Group, "The Common Object Request Broker: Architecture and Specification". Available from: http://www.omg.org/ [accessed 12.04.2010].

[23] N. Brown, C. Kindel, "Distributed Component Object Model Protocol ± DCOM/1.0", Microsoft Corporation, Network Working Group, 1996. Available from: http://tools.ietf.org/pdf/draft-brown-dcom-v1-spec-00.pdf [accessed 12.04.2010].