

Modeling Supply Chain Management Information System Using ARIS Framework

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Abstract

Information systems and technologies are a major enabling tool for firms to respond to customers and suppliers in real time resulting in higher sales and higher profits. Information systems have become essential tools for helping enterprises operate in a global economy. The main objectives are reducing inventory levels, improving delivery services, improving the customer service, reducing the cost through the supply chain, and increasing sales. All these will improve the firm's profitability. Firms are using intranets to improve coordination among their internal supply chain processes, and they use extranets to coordinate supply chain processes shared with their business partners. Despite of the growing importance of information system (IS) for Supply Chain Management (SCM) activities, the lack of comprehensive framework for modeling and developing IS for SCM has a negative impact on the performance of small and medium size enterprises. In this paper, ARIS framework is implemented for modeling of Supply Chain Management Information Systems (SCMISs). In the first place, we considered the inventory driver.

Keywords: Modeling of supply chain, Supply chain management, Framework, Information systems, Modeling tools.

1. Introduction

Nowadays, the Information Systems have significant effects on the integration of the supply chain main elements, and are the major enabling tools to respond to the customers demand, according to their desired quality, in a shortest time and with the lowest price. Li Pheng Khoo et al. [1], investigated a customer-driven information system (CDIS) and employed to establish a closer link between product re-innovation and customer involvement in the context of product concept development. M. Ghiassi et al. [2], described a software system that satisfied the needed properties that can support business operations of a massively customized production system and its supporting supply chain partners. Elizabeth A. Williamson et al. [3], analyzed the development and role of inter organizational information systems within supply chain management. A. Gunasekaran et al. [4], classified the literature available on IT in SCM using suitable criteria and then critically reviewed to develop a framework for studying the applications of IT in SCM. Based on this review and analysis, recommendations have been made regarding the application of IT in SCM and some future research directions are indicated. Pierre-Alain Millet et al. [5] analyzed the contribution of the current SCOR model to the alignment of business processes and information systems. As the alignment is currently only based on the functional realization of best practices, they showed that this alignment risks neglecting important process dependencies. An extended reference model is then proposed, including the structuring of information exchanged between processes. Xinyu Liu et al. [6], analyzed the main feature of customer-driven manufacturing system and pointed out that there are four crucial subsystems, namely integrated manufacturing subsystem, data warehouse subsystem, quick responding subsystem and e-sales subsystem, catering to the requirements of various customers in time. P.H. Ketikidis et al [7], investigated the current status and future direction of the use of information systems for logistics and supply chain management (LSCM) in South East Europe. The objectives were threefold: (1) to identify major challenges and developments on the use of information systems for LSCM by enterprises, (2) to examine the actual level of satisfaction of current policy on LSCM, and (3) to reveal the actual need of enterprises in South East Europe on effective use of information systems for LSCM. M. Victoria de la Fuente et al. [8] proposed a new enterprise modeling methodology called ERE-GIO applicable to supply chain reengineering and integration. It is based on two major phases: reverse engineering of the supply chain and then forward engineering. It takes advantages of previous enterprise modeling methodologies, especially CIMOSA. Dean C. Chatfield et al. [9] developed an open information standard to assist supply chain modeling, analysis,

and decision support. Besides, a modeling language for supply chain, known as Supply Chain Modeling Language (SCML), which is a platform- and methodology-independent. Further, the Extensible Markup Language (XML)-based, may be used for storing supply chain structural and managerial information. SCML enables supply chain problem instance reuse and sharing, provides a common format for analytical software interoperability, and can improve the quality of the supply chain description. Yeong-Dong Hwang et al. [10] investigated the sourcing processes and their accompanied performance metrics in the SCOR model version 7.0. Wang et al [11], examined an agent-mediated approach to on-demand e-business supply chain integration. Each agent works as a service broker, exploring individual service decisions as well as interacting with each other for achieving compatibility and coherence among the decisions of all services.

2. SCM Information Systems

2.1 Supply Chain Management description

Supply chain management is simply the integration of the activities that respond to the customer orders, in a way of obtaining the necessary materials and/or components, and the required services to transform them to products, which fulfills the customer orders. Slack, N. et al [12], stated that supply chain management is the management of the interconnection of organizations which relate to each other through upstream and downstream linkages between the different processes that produce value in the form of products and services to the ultimate consumer.

The Supply Chain Operation Reference (SCOR) model was developed to achieve supply chain customer satisfaction, which is the aim of most businesses these days. It describes all phases of customer demand and is divided into five primary management processes: *Plan*, *Source*, *Make*, *Deliver* and *Return*. By describing supply chains using these process building blocks, the model can be used to describe supply chains that are very simple or very complex, using a common set of definitions [13-14]. The SCOR model is shown in Figure 1.

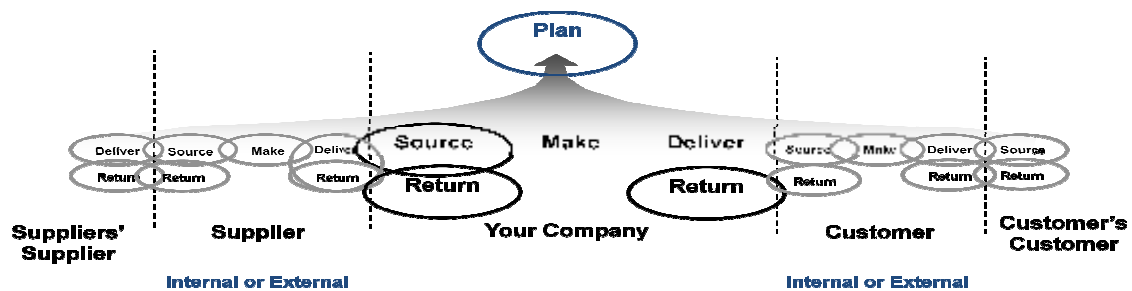


Figure 1: SCOR Model [13]

2.2 Supply Chain Management Information

The information consists of data, analysis tools, methods, techniques and algorithms. Which are concerning *Inventory*, *Facilities*, *Transportation*, *Costs*, *Prices*, and *Customers*. Figure 2 shows basic entities and interfaces of the supply chain management drivers.

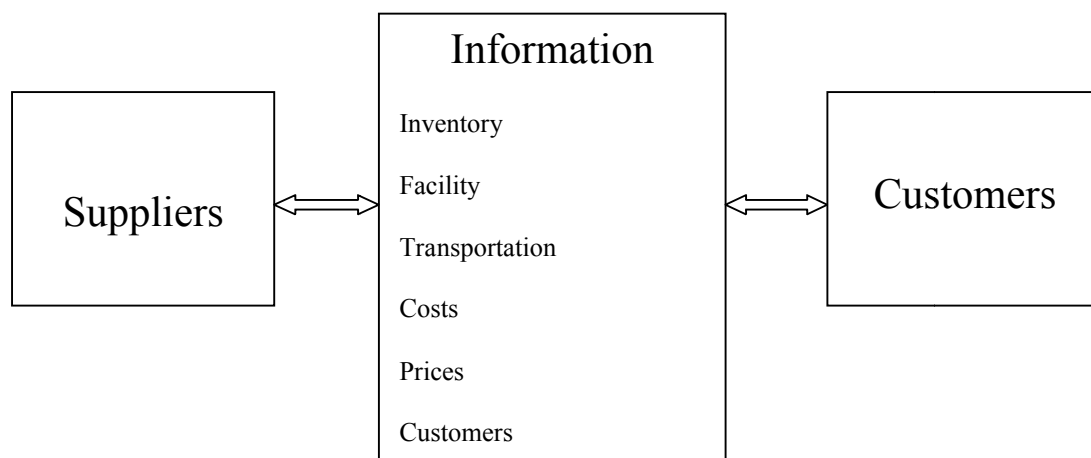


Figure 2: Basic entities and interfaces of the supply chain management drivers

There are three major macro processes in Supply Chain Management [15]:

- Supplier Relationship Management (SRM): Supplier & Design collaboration, Source planning, Negotiate, and Buy.
- Internal Supply Chain Management (ISCM): Strategic planning, Demand planning, Supply planning, Fulfillment, and Field service.
- Customer Relationship Management (CRM): Marketing, Sell, Order management, and Call/Service center.

SCM Information systems should consider all of them to have a succeeded SCMIS, and for using the decision making in Manufacturing Enterprises. In a comprehensive SCMIS, the mentioned drivers should be considered in all three macro processes. The following important factors are the success keys in SCMIS: Functional performance and user friendly, Integration of three macros (SRM, ISCM, and CRM).

As already mentioned, SCOR model can guide us to particle each of the above mentioned macro processes (SRM, ISCM, and CRM) in details within Plan, Source, Make, Deliver, and Return . Also, it is better to consider and operate on every driver (Inventory, Facility, Transportation, Costs, Prices, and Customers) of the SCMIS separately. More details will be explained in next sections.

3. Agile System Development and ARIS Framework

3.1 Agile System Development and its methodologies

The term '*Agile Development Method*' and '*Agile Manifesto*' were created in 2001 [16]. Agile System

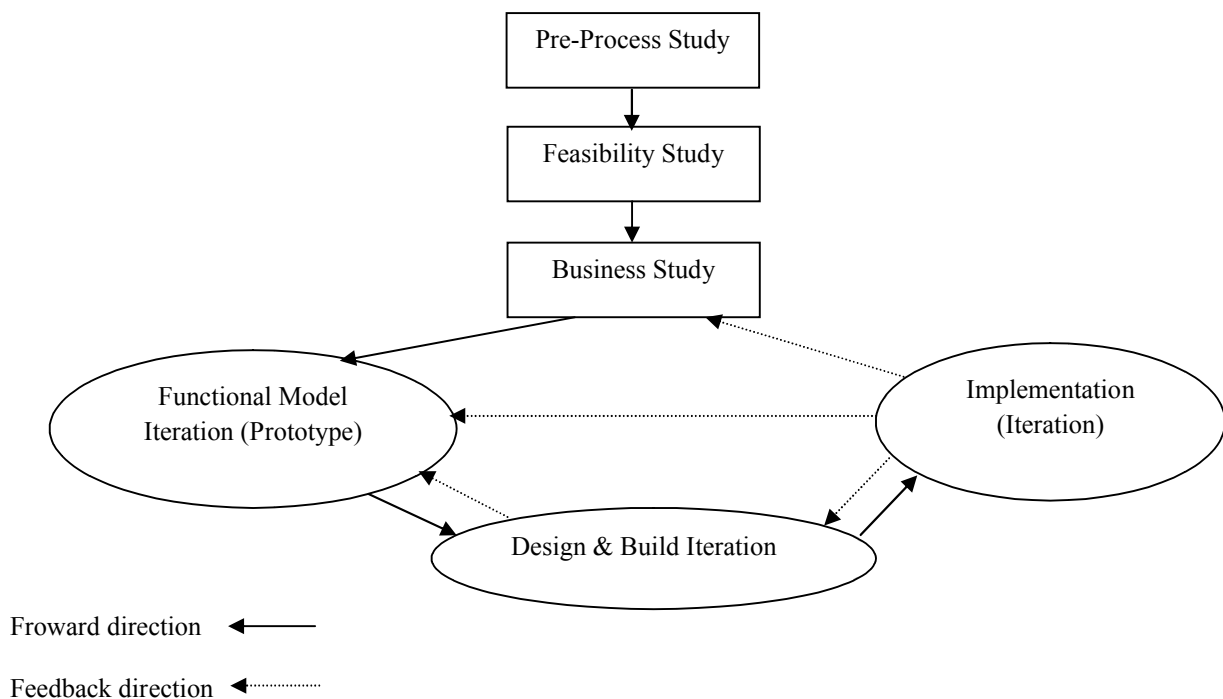


Figure 3: DSDM flowchart diagram

Development has six methods to implement in enterprises: *Adaptive software Development (ASD)*, *Dynamic System Development Method (DSDM)*, *Extreme Programming (XP)*, *Feature-Driven Development (FDD)*, *Lean Software Development (LD)* and *Scrum* [16-19].

Dynamic Systems Development Method (DSDM) may be utilized in a primary modeling in this case. The DSDM process has six main phases. Thus, three of them are iterative, includes steps for: *Pre-process Study*, *Feasibility study*, *studying the business needs*, *Functional modeling (iteration)*, *Design & Build (iteration)*, and *Implementation (iteration)*. Figure 3 shows the DSDM diagram.

DSDM is based on nine overriding principles. The first principle of DSDM is "*Active user involvement is imperative*". With the use of the word "*imperative*" as its principle, makes it clear that, the end user is a critical participant in a DSDM project. This is normal; because of the development methodology should focus on the fitness of the system for the purpose to which it will be put. DSDM is essentially a model for collaboration of stakeholders in system. This collaboration causes the product to fit the intended business purpose [17].

3.2 ARIS Framework

Architecture of Integrated Information Systems (ARIS) has five views to each Information System: *Organization*, *Data*, *Function*, *Control*, and *Output*. Figure 4, shows these views and the relation of them. A.W. Scheer [20] stated the views descriptions as followings:

Organization View: the hierarchical organization structure and the specifications of computer resources, network concepts, hardware components and other technical specifications related to the organization.

Data View: details of data models, access paths, and memory usage.

Function View: application programs which may be described in a more detail by module concepts, transactions or programming languages.

Output View: includes the various types of physical or non-physical input or output, such as material output and information services.

Control View / Process View: the respective classes with their view-internal relations are modeled. Relationships among the view as well as the entire business process are documented; also a framework for the systematic inspection of all bilateral relationships of the views and the complete process description are created in the control or process view.

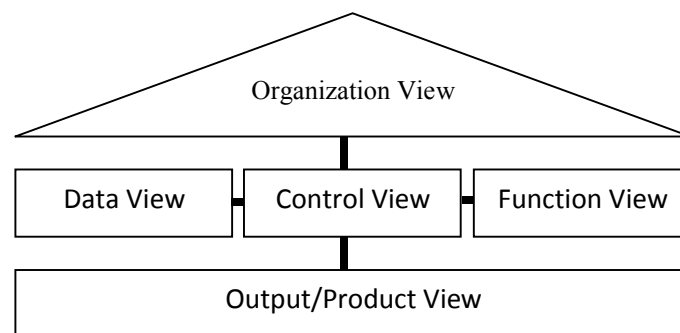


Figure 4: ARIS House [20]

Because of complexity of the IS in SCM, a comprehensive architecture should be used for this purpose. It seems that the ARIS Framework can cover these needs and covers all aspects of the ISs for SCM.

4. Modeling of SCMISs using ARIS Framework

In this model, we are focusing only on the *inventory driver*; the same approach can be applied on the other drivers. Figure 5 shows the implementing of ARIS for modeling a SCMIS considering only the inventory driver. In this model, there are some samples of entities for Inventory information and only top level of model is shown. Because of the limitation in the space of this paper, it's not possible to continue for more details of the different views. The following remarks have to be noted:

The **Functions** can be detailed and modeled with IDEF0. Also, the Functions can be described more details with function description.

The **Data** (Entities, Attributes, and Keys) can be defined and modeled with IDEF1X in necessary detailed level to ready for implement.

The **Organizational Chart** should be drawn with details of people, their roles, skills, and authority with details.

The **Output** can be detailed with necessary Input and Output that need from the SCMIS.

There are enormous technical obstacles in getting IS operational. The system designer has to consider all these technical and operational aspects, regarding *Organization View*, *Data View*, *Control View* and *Function View* of

the ARIS framework. Thus, the *Organization View* in the ARIS framework has to consider the problems associated with using the system by all types of the system users. Thus, the first principle of the DSDM is "*Active user involvement is imperative*", and is considered as a basic rule in designing of the organization view. Regarding the security aspect of the SCMS, the *Control View* of the ARIS framework considers the users' authority, virus attack, hacking the online systems and so forth. The required outcome from the system is specified by the *Output View* of the ARIS framework.

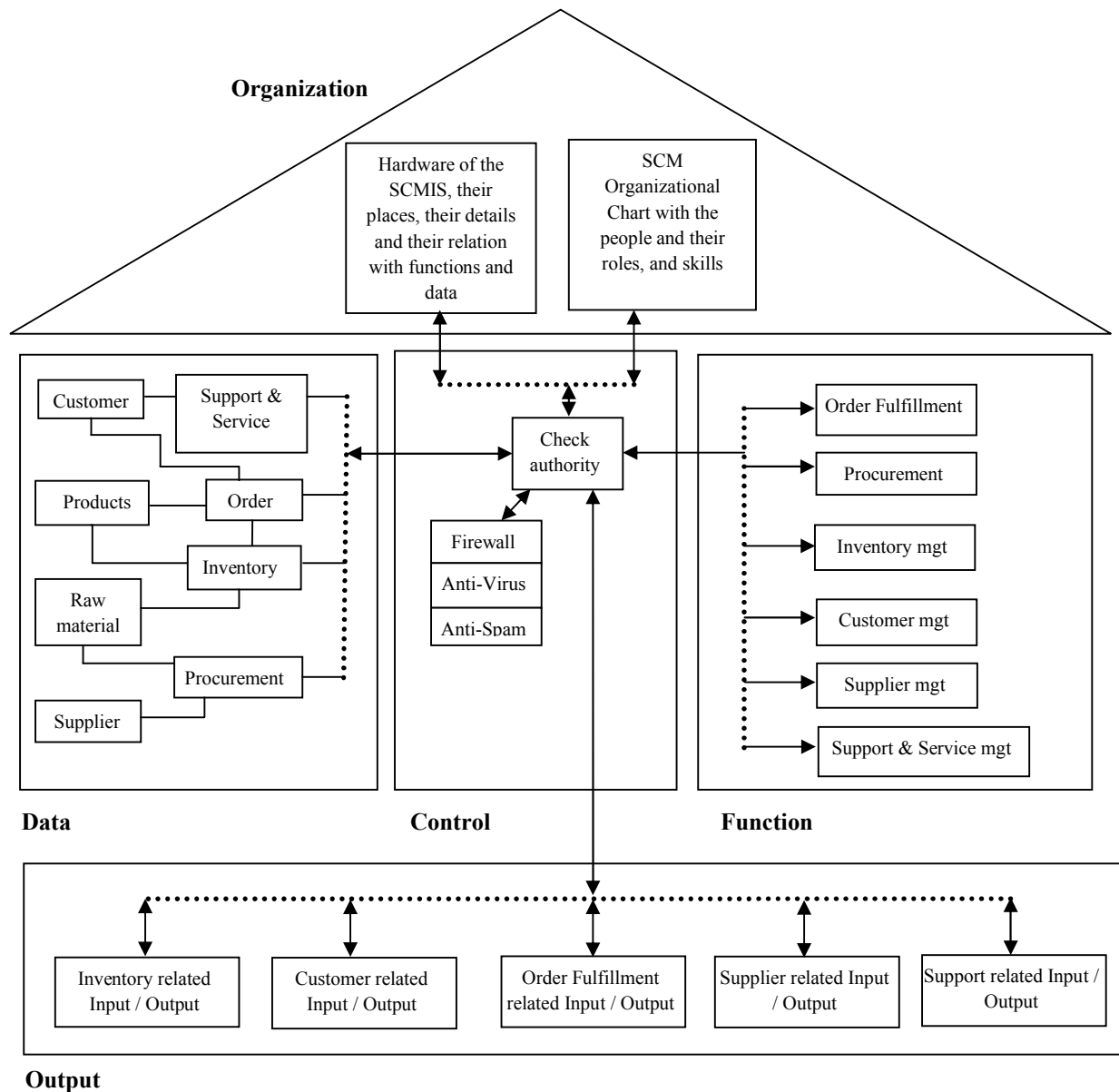


Figure 5: the implementing of ARIS for modeling a SCMS considering only the inventory driver

5. Conclusion

In this paper, the concept of Agile system development method (DSDM) has been enhancing the implementing of the ARIS framework to model SCMSs. Our focus was on analyzing the technical and operational aspects of the *inventory driver* with respect to the *Organization View*, *Data View*, *Control View*, *Function View* and *Output view* of the ARIS framework. The procedure could be applied for the other drivers; *facility*, *transportation*, *costs*, *prices*, and *customers*. The framework modeling has shown clearly the interaction and the flow of information between the various activities. Besides, the security issues have been highlighted and

identified. This framework model identifies the necessary modeling tools to specify each view in the system. Further, the framework model facilitates the next step for implementing of the related modeling tools, to build up the prototype software of the SCMIS.

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