

A PROCESS ORIENTED METHODOLOGY FOR THE SUPPLY CHAIN ANALYSIS OF IMPLEMENTING GLOBAL LOGISTICS INFORMATION SYSTEMS

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ABSTRACT

Developing information systems normally requires feasibility and demand analysis before the designing phase. Particularly when the information systems are to be adopted for the purpose of supply chain management, the preliminary analyses have to identify current operation processes and look into the constraints of enterprises capability to adapt ideal processes in a Business-to-Business (B2B) context. The Supply-Chain Operations Reference-model (SCOR) is a process reference model that has been endorsed by the Supply-Chain Council as a standard tool and is widely used for the industrial projects of supply chain integration. It can help to diagnose interfirm flows especially when the geographical map is developed based on SCOR elements and the format of target supply chain. Although SCOR has provided many 'best practices' in suggesting interorganisational behaviour, nevertheless, there is still some limitation in real world implementation for the nature of its referential feature. Therefore, this paper attempts to bridge current knowledge niche between the SCOR utilisation and information systems development in a case of global logistics management.

Keywords: supply chain analysis, SCOR, global logistics management, interorganisational systems

1. INTRODUCTION

A supply chain is established when there is the integration of operations across its constituent entities – the suppliers, partners, and business customers [9]. Supply chain management (SCM) aims to balance the demand requirements and material supplies so as to increase the rate of customer fulfilment and reduce high inventory risks. It involves the collaboration of planning and execution activities across the boundaries of firms. These activities are recently supported by interorganisational systems (IOS) based on a range of new features for information sharing, communication, and decision-makings [11]. To develop IOS, the initiator [7] has to preliminarily

investigate the business processes in multiple sites including the customers, delivers, manufacturers, and suppliers some of which can be legally owned by the same enterprises. Such investigation is not only for transferring the manual processes into automation but also for identifying the gaps to successful IOS adoptions. It provides the foundation of feasibility analysis and system demand analysis prior to the designing phase.

Despite the importance of utilising IOS for supply chain management, however, extant literature has not put emphasis on the combination of business processes and information system development. The literature of supply chain management encompasses the areas of operation management, performance measurement, strategic management, and information systems (IS), etc., which focus on the knowledge of pursuing operation excellence, strategic planning, and IOS adoption (e.g., [4]) respectively. Similar to building up an enterprise resource planning (ERP) system for an enterprise, it is not possible to implement IOS for a set of supply chain entities without identifying the elements of current business processes to customise the system designs.

This paper aims to propose a framework for the preliminary investigation of IOS adoption. Based on the Supply-Chain Operations Reference-model (SCOR) which has been recognised as one of the useful tools for the analysis of interfirm activities, this paper also discusses the limitations of SCOR that can be overcome with our proposed framework by a case of implementing Global Logistics Management (GLM) systems.

2. THE SUPPLY CHAIN OPERATIONS REFERENCE MODEL

Developed in 1996, SCOR is a standard model of supply chain processes and is used similar to International Organization for Standardization (ISO) documents for intra-enterprise processes. The SCOR model also builds on the concepts of business process reengineering (BPR), performance measurement, and logistics management by integrating these techniques into a configurable, cross-functional framework. It lays a tool to diagnose the business flow in between a firm's first & second tier customers and suppliers. This framework consists of four levels as the analytical stages leading to the implementation of an effective SCM strategy that level 1 & 2 are shown on Table 1 and all four levels are described as following:

- Level 1 broadly defines the key supply chain processes -- plan, source, make, and deliver -- thereby helping companies establish their SCM objectives.
- Level 2 defines the core process categories that can be found in an actual and idealised supply chain around an enterprise. For example, the 'source' category includes 'source stocked products', 'source make-to-order (MTO) products', and 'source engineer-to-order (ETO) products'.
- Level 3 contains information for the supply chain entities to plan and set goals for their SCM strategy, including process definitions, benchmarks, and system software capabilities.

- Level 4 focuses on implementation. Because SCM implementations are unique to each firm, the specific elements of Level 4 are not defined within the SCOR model.

Table 1. Supply Chain Activities based on SCOR level 1 & 2

Plan	Source		Make		Deliver	
P1 Plan Supply Chain	S1	Source Stocked Product	M1	Make-to-Stock	D1	Deliver Stocked Product
P2 Plan Source	S2	Source MTO Product	M2	Make-to-Order	D2	Deliver MTO Product
P3 Plan Make						
P4 Plan Deliver	S3	Source ETO Product	M3	Engineering-to-Order	D3	Deliver ETO Product
Source Return			Deliver Return			
SR1	SR2	SR3	DR1	DR2	DR3	
R1: Return Defective Product		R2: Return MRO Product		R3: Return Excess Product		

Source: Supply Chain Council SCOR version 6.1, MRO: Maintenance, Repair, Overhaul

The typical procedures to conduct SCOR follow the ‘top-down’ processes identification of the four levels above. It can be also computerised by software in order to proceed with the SCOR elements [5]. The first step is named ‘As-Is’ stage and it requires the project team to canvas the business environment of an enterprise which should normally include two ties from the core firm (the centre of a supply chain, see [1] & [12]), that is, ‘the customer’s customer’ and the supplier’s supplier’. Beginning with, it suggests the analysts to prepare the level 1 document regarding the geographical context so as to manifest the transportation costs and trading relationships between the legal entities. Then level 2 diagram can be developed to describe the information flows of forecasts/orders and the material flow associated with the types of goods produced and delivered. Once the two levels of interfirm processes are confirmed, hundreds of key performance indices (KPI) suggested by SCOR can be then applied to measure the current operation excellence along the specific supply chain such as ‘day of inventory’ (level 2) in the category of cash-to-cash cycle time (level 1) and ‘supplier on time and in full delivery’ (level 2) in the category of delivery performance (level 1).

The step in measuring KPI of the supply chain activities belong to the second stage of SCOR, namely ‘gaps analysis’ which underpins the design of ‘To-Be’ processes. In other words, the differences between current status and ideal performance are actually the opportunities for the improvement based on the expectation of target firms and on the comparison with competitors. Additionally, the enterprises can map the ‘best practices’ and ‘features’ in the level 3 of SCOR standard that are practical actions such as the use of electronic data interchange (EDI) for the just-in-time order adjustments in delivering elements.

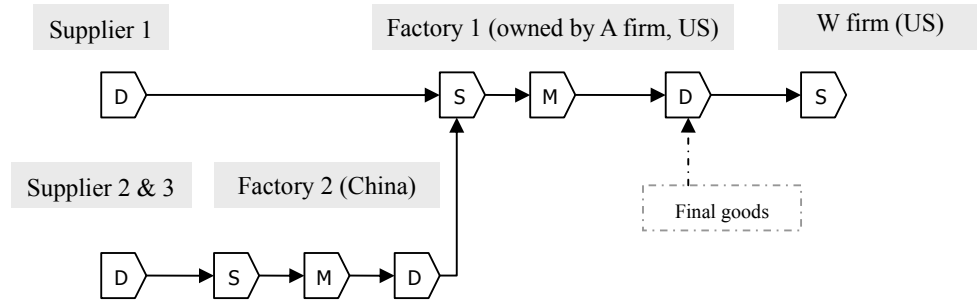
3. A CASE OF GLOBAL LOGISTICS MANAGEMENT AND THE LIMITATIONS OF SCOR

One goal of the SCOR model is to help firms break out of the box, the ERP box, and see where they fit into the supply chain [3]. The model indeed facilitates seeing how SCM involves balancing tactical approaches against satisfying the business goals of an enterprise in a B2B context. Therefore, it recently attracts much attention to the possibility of extending such analysis for the preparing of IOS adoption, for example, the ERP systems installation in multiple sites of Acer Group [14].

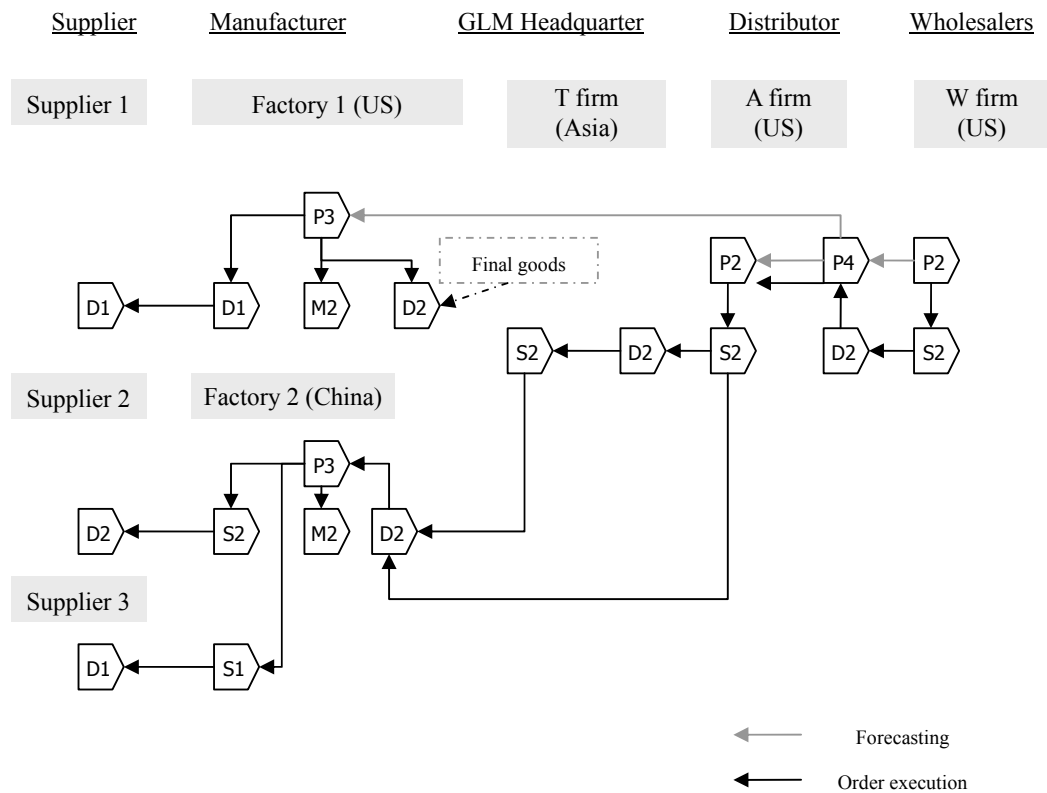
In our case study, T firm is originally a manufacturer in South-East Asia with a sales volume of USD one hundred million that its main business focuses on providing raw materials for the production of industrial products to other enterprises. Due to the decreasing of profit margin as being only a manufacturer, it has attempted to develop the capability of product sign and move closely to the consumers' market. It targets to make equal sales in the market for the categories of consuming products and industrial products in a five years period. Under the vision, T firm has merged an US-based brand owner, A firm, and utilised the reputation of A firm to approach wholesalers in the United States. In order to reduce the manufacturing costs, T firm decides to reallocate the manufacturing procedures from factory No.1 in the United States to factory No. 2 in China except the final step of product assembly in Beta supply chain (figure 1.1). The reason of leaving assembly procedures in the factory No1 is due to the consideration of shipping costs calculated by product volume. Although the strategy sounds marvellous, nonetheless, the subsequent longer lead-time of shipping and the potential higher risk of fail delivering on time may occur since the consuming products can only made by MTO mode. The only solution to overcome such difficulty is to have a GLM planning centre which is responsible to coordinate the communication of forecasting, decision-making, and order execution in order to balance demand and supply in time. Hence, T firm decides to adopt the GLM systems built in multiple sites with an enterprise portal as the communication platform.

Before the implementation of GLM systems, T firm has used SCOR to investigate the 'As-Is' processes in Beta supply chain. In figure 1.2, it already points out clearly that there are two major gaps for the control of supply chain. The decision of order dispatching and the demand forecasting have not been passed to T firm with the acquisition of A firm. However, it is not possible to take over the two functions all of a sudden since the concerns of generating tensions between the employees of the sites despite the fact that T firm owns all manufacturers and A firm in the Beta supply chain. A mission-oriented 'matrix' structure is therefore introduced for minimising the potential confliction. That is, both the procurement staff in A firm and T firm can play the role in sourcing but the planning and decision activities are to be done by a GLM team leader in a 'virtual enterprise'.

1.1 The materials flows (in level 1)



1.2 The information flows (in level 2)



Note: this diagram was modified from a real case that some of the flows have been changed and the names of supply chain entities were made-up because of the concern of confidentiality.

Figure 1: The ‘As-Is’ flows of SCOR level 1 & 2 in Beta supply chain

Another difficulty that T firm has encountered relates to the lacking of KPI information. It is necessary to address enough information regarding the enterprise performance for the purpose of mapping KPI calculation with the activities of SCOR level 1 to level 3. Normally there is a premise for getting accurate KPI analysis in large firms that is, to equip ERP systems with historical data for aggregating calculation. However, the ERP systems is still a new tool for the

employees of T firm and even some departments feel reluctant to use it so far since the incomplete customisation interfaces of ERP in T firm. Moreover, the ERP modules of T firm have not yet been extended to its affiliate subordinates such as factory No 2 and A firm. Additional to the difficulty of getting KPI information cross-sites, another concern appeals that T firm requires a plan instrument as the decision-base to deal with emergent orders or cancelling orders from the wholesalers. Otherwise, it may cause critical loses if the M2 process element in factory No2 (figure 1.2) is done before a solution made to the cancelling orders. On the other hand, finish goods will not be delivered on time without the decision-base to reallocate production resource. Again, there is no specific suggestion in SCOR documents for address these situations. In other words, it is not possible to follow the typical analysing sequence of SCOR as a basis to develop GLM systems and enterprise portal in the case of Beta supply Chain.

Based on the case above, we have found three types of limitations for applying SCOR in improving current interfirm processes. These limitations have not been indicated in the literature and are critical issues for the practical adoption of GLM systems. They are the limitations regarding graphical presentation, 'gaps' identifying, and none-defined business activities that summarised below:

The limitation of graphical presentation for interfirm flows

- SCOR can only present business flow in between legal or geographical entities but not any matrix organisation structure or the concept of 'virtual enterprise'.
- SCOR is limited to the presentation of one single supply chain while most of the enterprises may be associated with multiple channels of markets and products.

The limitation of gaps identifying

- The KPI of SCOR is not always available in the target firm, particular when it involves with cross-sites information.
- Problems sometimes can not be identified by KPI gaps such as information systems readiness ([6], [7], [8], and [13]).

Some essential activities are not defined in SCOR standard, for example,

- Demand up-size and down-size from order changes, e.g., emergent orders or order cancelling.
- The activities of collaborative design and customer relationships management are not defined in SCOR.

4. THE PROPOSED FRAMEWORK FOR SUPPLU CHAIN ANALYSIS

Mentioned previously, typical SCOR is a 'top-down' analytical method which fails to be applied

in the Beta supply chain. As participating in the GLM project of T firm, we have proposed and used a ‘bottom-up’ framework which combines the merits of quality control, performance measurement, and process engineering to build up the foundations for designing the architecture of IOS in a supply chain context.

As shown on figure 2, there are thirteen elements in the framework for supply chain analysis. The elements labelled 1 to 8 are analysis procedures while the rest are possible output documents. Each of the elements may have interrelations with the others in a way of being either antecedent analysis or the consequent reports.

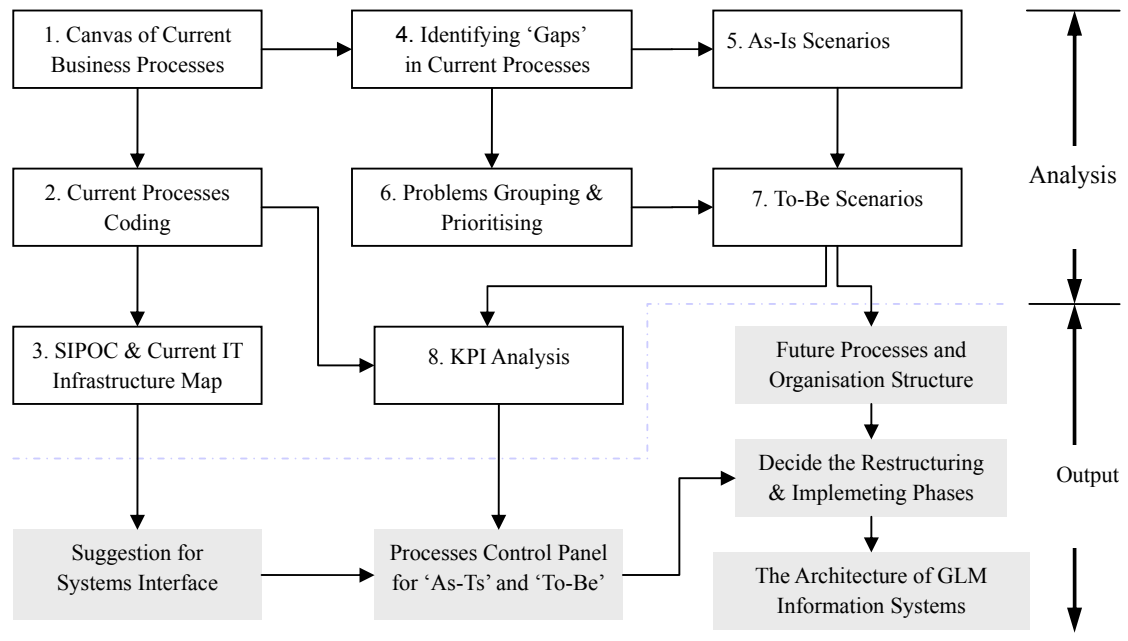


Figure 2: A Framework for Supply Chain Analysis and Related Output in Designing GLM Systems

Contrary to the traditional way of SCOR analysis, the framework in figure 2 adapts a ‘bottom-up’ logic flow. Similar to ‘As-Is’ step in SCOR, it is suggested to canvas the current business processes by interviewing the employees in several entities along the target supply chain. Nevertheless, the processes are recorded and labelled in the format of normal flowchart but not SCOR standard as shown on figure 3. Then, each of the codified processes should be analysed by a set of SIPOC diagrams [10] which are originally used as a tool for quality control and can detail the information deliver (supplier), data sent (input), data generated (output), and information receiver (customer) for the purpose of systems development. This instrument allows us to see the opportunities of improving current communication interfaces among departments and trading partners.

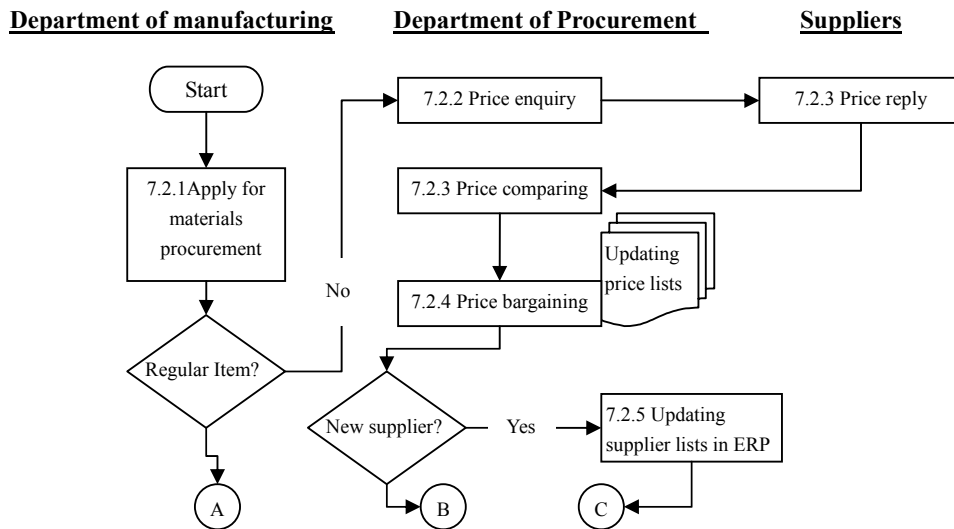


Figure 3: Example of current processes coding in the flowchart

Although we can not identify the processes ‘gaps’ when the KPI information of the supply chain entities are not available like T firm and its trading partners, it is possible to find out the existing problems and difficulties by interviewing the employees across the firm boundaries. Based on the picture of current processes and interviews, the ‘As-Is’ diagrams which follow SCOR standard are drawn. It is similar to figure 1 but divided into several scenarios in order to correspond to the situation that different products or markets normally occupy the same manufacturing capacities in the real business environment. The previously identified ‘gaps’ should be then codified, grouped, and prioritised since some of them may cause similar problems, affect related business processes and supply chain entities, or be overcome by integrated solutions. The grouped and prioritised ‘gaps’ thus become the basis for creating ‘To-Be’ scenarios which are associated with the adjusting of corporate policies, organisation structures, business flows, and information systems.

Such ‘bottom-up’ framework still needs the KPI items defined in SCOR since eventually KPI can be used to monitor the ‘To-Be’ processes. Luckily most of the KPI items are naturally related to existing business processes because of their formulas for calculation. For instance, the KPI ‘day sales receivable outstanding’ in the D element of SCOR level 2 related to the processes performance of sales department. As for the case of Beta supply chain, it is possible to map the KPI with the existing processes of current organisation structure and the future processes of ‘virtual enterprise’ encompassing team members from T firm, A firm, and the factories.

Formulated in another way, the business processes can be divided into two types which are the planning & decision-making activities owned by the ‘virtual enterprise’ and the operation activities

owned by actual entities along the supply chain. The commonality of the two categories falls on the staffs that are in charge of the activities. In other words, the staff in the department of procurement in A firm can play the role as the team member of GLM sourcing centre. They are evaluated both by the KPI of A firm and the KPI of GLM centre based on certain percentages in order to monitor the two types of business processes. A control panel is thus generated in the tables for bridging across the ‘gaps’ and monitoring future performance.

Table 2 The Control Panel of Planning and Decision-Making Activities

Virtual Enterprise		Actual Supply Chain Entities					Current Business Processes Code
GLM Functions	SCOR Code	‘To-Be’ SCOR KPI	T firm	A Firm	Factory 1	Factory 2	
Supply Chain	P1	Provided by SCOR	V				Recorded in step 1 & 2 in
Planing		documents (should be					the proposed framework
Plan Sourcing	P2	further selected based on the	V	V			and should be mapped to
Plan Making	P3	top managers’ opinion).	V		V	V	the planning processes.
Plan Delivering	P4		V	V			

Note: The level 3 SCOR code and the related departments of each supply chain entities should be shown on a real control panel. They are omitted in this table because of consideration of simplicity

Table 2 is an example of the control panel for planning and decision-making activities which maps the existing processes and ‘To-Be’ processes. It entails the information of how to control over the GLM functions across the boundaries of firms based on the selected KPI which are predefined by SCOR standard. More importantly, it implies the ‘gaps’ between the current and future infrastructures of information exchange since SIPOC analysis is recorded based on the current business processes code. Finally, it is able to decide the implementing phases of GLM systems since the ‘gaps’ has been prioritised according to the degree of importance and adaptability.

CONCLUSION

As stated in the foregoing sections, SCM plays a role in influencing the economic behaviour by the way business processes are managed. This in itself is certainly a very significant point, as it influences the costs of inventory holding, goods delivering, and manufacturing processes. Particularly, it affects the performance in customer fulfilment and cash-to-cash cycling which is a vital point to enterprise survival [2]. Achieving effectiveness of SCM does not only rely on processes tuning but also the just-in-time communication and decision-making through IOS.

Even SCOR has been the most widely adopted tool for supply chain analysis and modified several times since its first announcement by the Supply Chain Council in 1996. There is yet another point deserving the attention of academia and practitioners, that it is not a complete solution for

IOS development for supply chain entities. In the case of T firm, which plans to achieve operation excellence by developing GLM systems we have identified the limitations of SCOR. Based on that, a new framework is proposed for the preliminary analysis before the designing and implementing phases of the GLM systems. Notably, the sequences of the elements in our proposed framework are possible to be modified. For example, KPI analysis might be done prior to other steps when the targeted supply chain is not newly generated like Beta case. Therefore, we do not conclude that it is the only way to solve all kinds of challenges in SCM. Rather, the main contribution of this paper is considered to be a new attempt in extending the knowledge of supply chain analysis for practical IOS adoption.

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