2006-2611: AN EFFECTIVE FRAMEWORK FOR TEACHING SUPPLY CHAIN MANAGEMENT

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An Effective Framework for Teaching Supply Chain Management

Abstract

To survive in today's competitive business environment, companies strive to adopt the strategies of supply chain management. Thus, supply chain management has become an integral part of the engineering management curriculum. This paper discusses a framework that can be helpful for teaching and managing supply chains effectively. The framework that is named the "Supply Chain Management Process Map" establishes a relation between the end-to-end supply chain processes and the strategic, tactical and operational decision phases of a supply chain. An example from the soft goods supply chain is presented to illustrate the proposed framework.

1. Introduction

Supply chain management (SCM) education has become an important part of the management and engineering management curriculum. This is due to many companies realizing that eliminating supply chain inefficiencies such as excessive inventory levels, poor customer service, high operating costs, long order cycle times, and inefficient asset utilization can save millions of dollars. Based on the State of Logistics Report[5], over $1 trillion (10% of Gross National Product – GNP) is spent on supply-related activities in the US alone, which implies large potential savings. Although everyone agrees on the importance of SCM, many companies still find it difficult to achieve supply chain excellence. Based on a recent survey[2], in terms of cost versus revenue, average players in a supply chain are half as efficient as the star players. A good SCM curriculum can help students, thus their companies achieve supply chain excellence. Accordingly, the purpose of this paper is to provide a framework that can help not only teaching supply chain management more effectively but also making companies achieve supply chain excellence.

Accurate characterization of the supply chain and the SCM processes is especially important with the increasing trends in outsourcing and globalization, which require tight communication and collaboration between multiple enterprises. Effective frameworks do not only enable communication and collaboration, but also can help supply chain partners to identify and eliminate non-value adding supply chain activities as part of a lean strategy, to check if the supply chain strategy is aligned with the company's overall strategy, to benchmark against competition, and to select the right information technology infrastructure during the supply chain reengineering projects by focusing on the right processes. The proposed framework can enable the students, the future supply chain practitioners, to communicate and collaborate more effectively, which in turn should increase their company's and the overall supply chain's efficiency and the responsiveness to the end-customer needs.

One of the most referred SCM frameworks is the Supply Chain Operations Reference[4] (SCOR) model. It was developed by the Supply Chain Council, which was founded as a non-profit organization by AMR research (www.amrresearch.com), PRTM consulting (www.prtm.com) and 65 major companies. While SCOR provides standard terminology,

process definitions, metrics, and best practices, it does not cover end-to-end supply chain processes. More specifically, SCOR focuses on the planning and execution of the SCM processes and neglects the design processes. The proposed framework in this paper, includes design, planning and execution decision phases under SCM, and provides a clear linkage of these decision phases to the end-to-end supply chain processes as described next.

2. A Supply Chain Management Framework: Supply Chain Process Map

Supply chain management (SCM) is **designing, planning, and execution of** the materials, information and financial flows across **the supply chain processes** for different players to provide product and services to the end customers profitably.

In short, SCM is about "getting things right". For example, getting things right for a retailer means selling the right product at the right price at the right store in the right quantity to the right customer at the right time. This translates into higher profits.

Design, planning and execution are the three key phases of SCM (Figure 1). These phases differ in the scope of the decisions and the time horizon over which these decisions impact the supply chain. Design decisions relate to the supply chain's strategy and structure. These decisions have a long-term impact that last for at least several years. Planning decisions are tactical, covering weeks to months, up to a year. Execution decisions relate to the day-to-day operations, and span from hours to weeks. The SCM decision phases are hierarchical such that the strategic decisions drive the tactical decisions, and the tactical decisions drive the operational decisions.

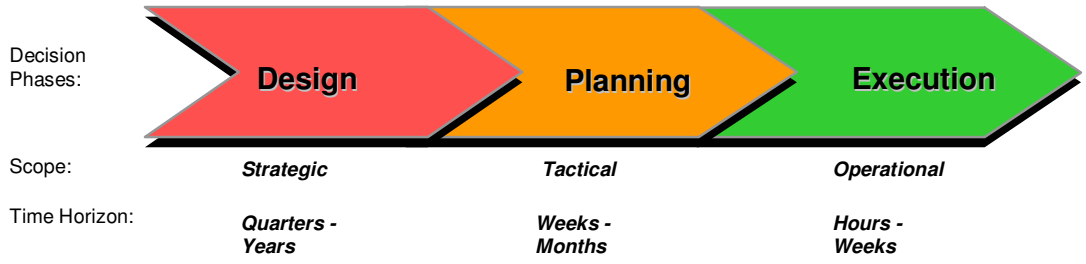

Figure 1. Decision phases in SCM.

Decisions have to be made in supply chains regarding a number of core processes to deliver a product to the end customer. These core processes as "create", "source", "make", "move", "store, "market", "sell", "return" and "service" as illustrated in Figure 2.

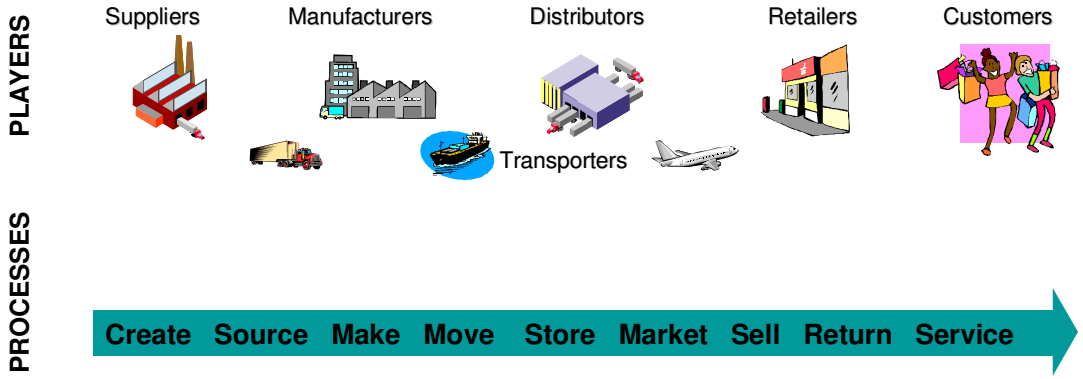

Figure 2. Supply chain process description and typical decisions

The key question is how the SCM decision phases are related to these core processes. Here, we are proposing a framework called the "Supply Chain Management Process Map" (SCM Process Map) to define this important relationship as illustrated in Figure 3. As shown in this figure, SCM decision phases exist for each of these core supply chain processes. For example, the create process includes product design at a strategic level, and portfolio planning at a tactical and product transition at an execution level. The SCM Process Map enables us to view SCM management either from a process or decision phases perspectives.

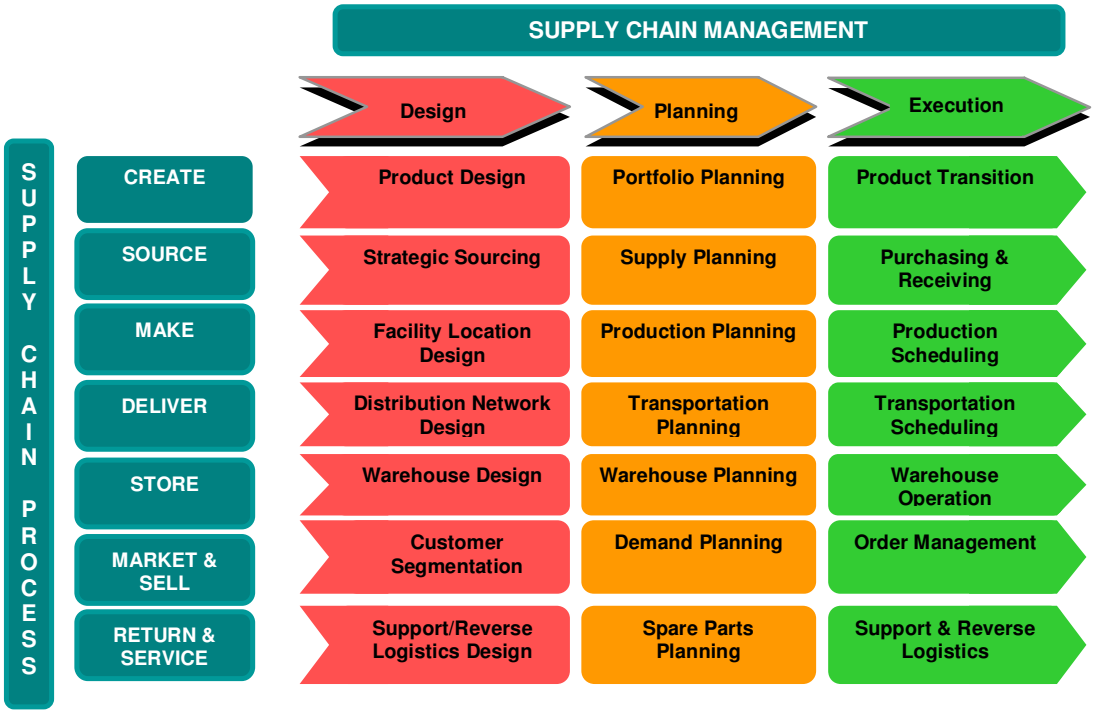

Figure 3. SCM Process Map.

3. An Example: Soft goods Supply Chain

Soft goods are textile, apparel, footwear and related merchandise. The main raw materials for soft goods products come from cotton, wool, polyester and leather, which are then processed into yarn, fabric and sole, and finally converted into the final products such as carpet, bed linen, apparel, and footwear. As shown in Figure 4, the manufacturing process involves multiple sub-processes with different manufacturing and transportation requirements. The major sub-processes are yarn spinning, greige knitting, fabric finishing, fabric cutting, and garment sewing. The upstream processes are capital intensive, whereas the downstream processes are labor intensive. Soft goods companies balance efficiencies and responsiveness of their supply chain by focusing on maximizing customer service levels, minimizing obsolescence and markdowns, maximize capacity utilization for capital intensive operations, minimize the cost of goods and maximizing inventory turns.

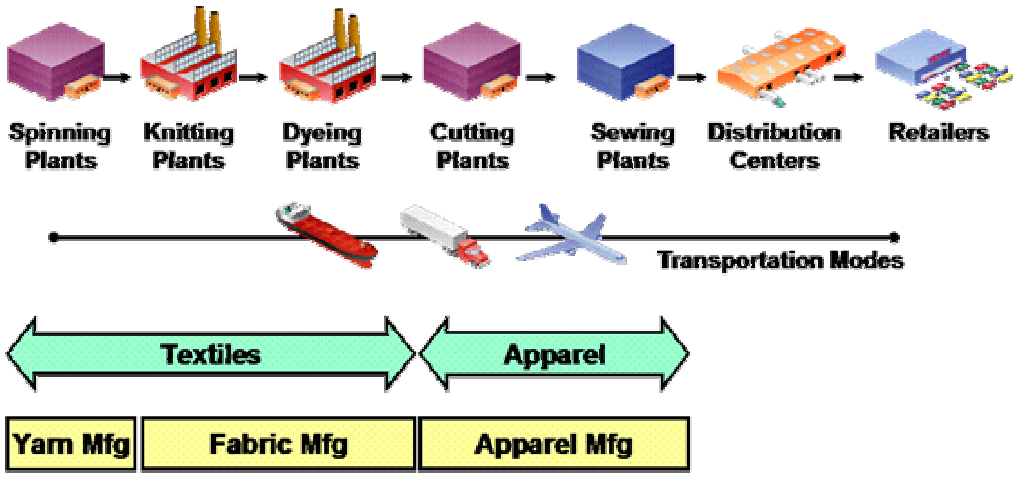

Figure 4. Textile-Apparel supply chain structure (Source: Item[3])

Each player in the soft goods supply chain can perform one or more of the supply chain processes. We highlight some of their core processes in Figure 5. Although some companies do own their own manufacturing facilities, some soft goods manufacturers such as Nike use contract manufacturing extensively, focusing on designing, marketing, selling and providing customer services. Also, it is not uncommon in soft goods industry for the brand manufacturers to own their own distribution centers and retail stores in addition to partnering with local distributors and retailers. For example, Nike operates distribution centers in Wilsonville, Oregon and Memphis, Tennessee and deals with local distributors all over the world (http://www.nike.com). In addition, Nike also has retail stores called Niketown stores (13 in US) and Nike factory stores (80 in US) around the world.

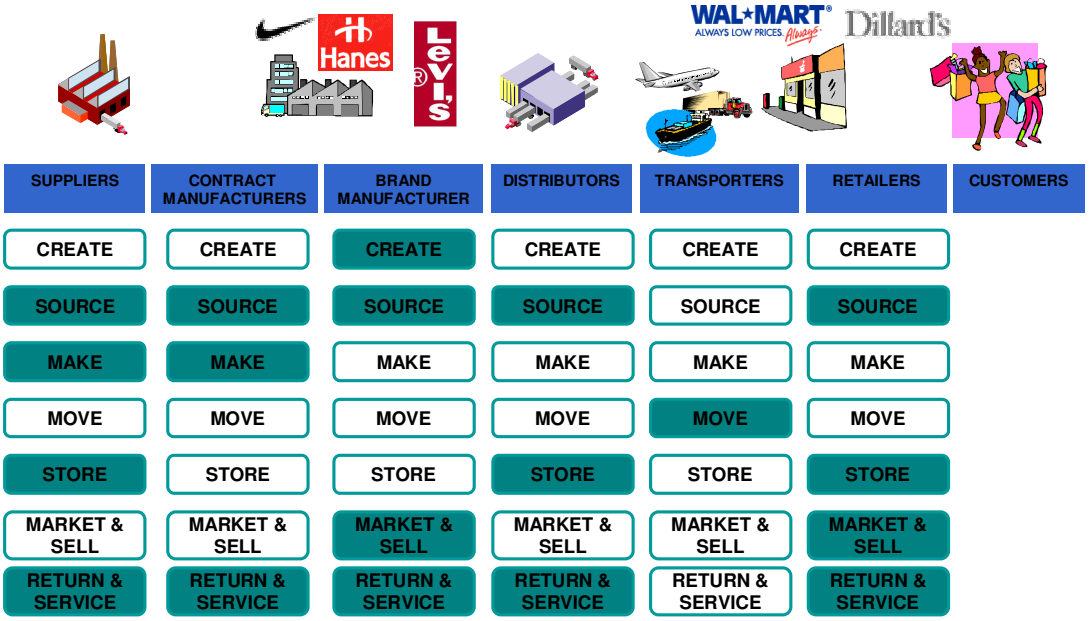

Figure 5. Example processes for each player in a soft goods supply chain.

SCM activities in the soft goods industry directly follow from the processes that each player focuses on in the chain. For each player, the SCM process map helps to identify which sub-processes they need to perform. For example, a soft goods brand manufacturer such as Nike focuses on the "create", "source", "market & sell" and "return & service" processes. During the "create" process, the products are designed to capture the customer's needs, while product life cycles are planned during portfolio planning, and finally the products are transitioned in and out of the market. Nike focuses on the "source" process to do strategic sourcing by selecting contract manufacturers and suppliers primarily in Asia, thus establishing not only long term contractual agreements but monitoring them as well. During the supply planning process, capacity and material plans are generated to meet the footwear and apparel demand. These plans are validated through collaborative processes with the contract manufacturers and suppliers. A soft goods brand manufacturer will design their distribution network, plan for the transportation of the materials, and validate these plans with the third party logistics companies and distributors through collaborative processes. They also need to do warehousing and inventory management decisions at their distribution centers. One of the main functions of a brand manufacturer is marketing and selling. During the "market & sell" process customer segments and pricing decisions will be made, demand forecasts will be generated, markdowns will be planned, and finally customer orders will be managed. Customer service is another crucial process that helps to ensure repeat customers.

4. Teaching Based on the SCM Process Map Framework

The proposed framework has been successfully deployed by the Center for Intelligent Supply Networks (C4ISN, http://www.som.utdallas.edu/c4isn) at the University of Texas at Dallas (UT Dallas) and by the Engineering Management Program (http://www.coe.uncc.edu/mem) at the University of North Carolina at Charlotte (UNC Charlotte). At C4ISN, the SCM Process Map framework has been applied in the core course modules of a professional certificate program in supply chain management over the past two years. These core modules, which are listed below, are aligned with the SCM Process Map framework:

- Supply Chain Fundamentals
- Supply Chain Design
- Supply Chain Planning
- Supply Chain Execution

The Supply Chain Fundamentals module includes an introduction to supply chains defining what a supply chain is, and introduces the SCM process map. In addition, additional fundamental topics such as the Bullwhip Effect, Benchmarking and Constraint-based Thinking are introduced. In this program, each of these modules contain approximately 16 hours of materials.

A second implementation of this SCM framework was done at the Engineering Management Program at the UNC Charlotte in the EMGT 6090 Lean Supply Networks class. The class discussions were organized in four parts as described above. This class includes additional discussions on the origins of "lean" and on "lean" processes in the fundamentals section, discusses each process under design, planning and execution from a "lean' philosophy perspective, and contrasts it with more traditional mass-production techniques. The execution section of the Lean Supply Networks class also focuses on quality management, discusses Six-Sigma techniques, and illustrates how lean and Six-Sigma complement each other.

Currently, a certificate program similar to the one in C4ISN is being deployed by the Center for Lean Logistics and Engineered Systems (CLLES) at the UNC Charlotte using the SCM Process Map Framework as well (http://www.coe.uncc.edu/mem/CLLES-home).

All the programs mentioned above use adult learning principles extensively. While the certificate programs offered by C4ISN and CLLES are more practice oriented, a more balanced coverage of theory and practice is applied in the EMGT 6090 Lean Supply Networks course. All these courses emphasize industry drivers, best practices, trends, tools and techniques for designing, planning and executing supply chains. Effective teaching techniques are used such as case study analysis, business simulation games, operations related videos, company visits and class projects. When possible, the class projects are chosen in collaboration with the industry.

4.1. Student Feedback

At the end of each module of the C4ISN SCM Program, the students are asked to fill out a course evaluation form. While the course evaluation aims to get feedback on various aspects of the course, the several questions that are related to the course content are given below:

- The course met my expectations.
- The subject matter covered is/will be useful to me.
- The course materials were helpful.

Students score for these questions on a scale of 1 to 5, where 1 corresponds to "Poor or Strongly Disagree", and 5 corresponds to "Outstanding or Strongly Agree". The average scores have been ranging between 4 and 5 indicating the effectiveness of the SCM Process Map framework.

The EMGT 6090 Lean Supply Networks course was offered during the Fall of 2005. The course evaluation form asks 23 questions that are also scored on a scale of 1 to 5. Some of the course content related questions are:

- The course has effectively challenged me to think.
- Lecture information is highly relevant to course objectives.
- Course topics are dealt with sufficient depth.
- My technical skills are improved as a result of this course.
- Overall, this course was among the best I have ever taken.
- Overall, I learned a lot in this course.

The average score of 4.5 for these questions confirms once again that the SCM Process Map framework provides an effective means to teach supply chains.

4.2. Teaching Challenges

Throughout our teaching of SCM using the SCM Process Map framework, we have encountered several challenges. Here we will elaborate on some of the major ones.

Extensive Content: The discussion topics described in the SCM Process Map represent a comprehensive list. Depending on the detail of coverage, it might be challenging to cover all these topics in one semester. Several approaches can be taken to deal with this challenge: the course can be offered in two semesters in two parts to provide an in-depth understanding of SCM to the students. On the other hand, if this course is offered as an introductory course, then each topic can be skimmed through in one semester, similar to some operations management courses offered in business schools. Yet, another approach is introducing the SCM Process Map in the fundamentals, as we did in our programs but emphasizing only certain topics under design, planning and execution. For example, during the coverage of design, strategic sourcing and distribution network design can be emphasized; during the planning discussions, demand planning, supply planning and inventory planning can be addressed; under the execution section order management, production and transportation scheduling can be discussed.

Textbook: Unfortunately, the number of good SCM textbooks is limited. Although there is no textbook, which covers the proposed SCM Process Map, Chopra and Meindl[1] is one of the books that come close for this purpose. We have developed our own materials over the years and we are also in the process of writing a textbook on this topic.

Prerequisites: Depending on the blend of theory and practice, the prerequisites will change. We have conducted this course without any prerequisites, but completion of introductory courses in Operations Research, Statistics and Decision Analysis could be required for more advanced coverage of these materials. We usually cover the basic spreadsheet-based modeling techniques for optimization, forecasting and decision making in our classes.

5. Summary and Conclusions

SCM can be taught from many different perspectives. Some programs emphasize strategy, some operations, some design, some planning, some theory and some others applications. We believe that effectively teaching SCM requires end-to-end coverage of the supply chain processes and decision phases, as described in the proposed SCM Process Map. A good SCM course or program should apply a blended learning technique combining theory and practice including industry drivers, best practices, trends, tools and techniques for designing, planning and executing supply chains. Effective teaching techniques should be used such as case study analysis, business simulation games, business and operations related videos, and class projects. We have successfully deployed courses based on the SCM Process Map at both UT Dallas and UNC Charlotte. Based on student feedback, we believe that the SCM Process Map provides a clear and comprehensive definition of SCM and therefore provides an effective means to teach SCM.

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