Capability Maturity Model for Supply Chain Management

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ABSTRACT

Matured supply chain management (SCM) capability is critical to enterprise performance and success. SCM capability maturity capitalizes on the latest advances in information technology and systems (IT/IS) and business process best practices which include a collaborative and trusting relationship among supply chain partners, and senior management supports and commitment. This paper proposes a SCM capability maturity model, SCM-CMM, based on the similar model for software engineering CMM developed by Carnegie Melon. The proposed SCM-CMM has five maturity stages: Ad Hoc, Initial, Defined, Extended, and Network. Each maturity level is a defined position in an achievement scale that establishes the attainment of certain level of capability maturity in terms of best practices. SCM best practices can be grouped into three capability areas in terms of people, process and technology. The three areas of capability closely correlated and need to be improved simultaneously. The SCM-CMM helps companies focus their supply chain improvement efforts on the critical processes, allows them to assess their current level of maturity, identify realistic targets for improvement, and develop action plans for increasing their SCM maturity.

Keywords: Supply chain management, capability maturity model, best practice

1. INTRODUCTION

Supply chain management (SCM) is important for enterprise performance and business success. At its best, SCM capitalizes on the latest advances in information technology and best practices. Organizations wishing to improve their existing SCM performance need a framework against which to benchmark their current practices. Best practices can be measured in terms of maturity, usually reflecting increasing levels of sophistication together other features. It is recognized that companies generally make progress in sequence through certain stages, by building on the practices they have established at each stage. Attempts to advance without a base of firmly established practices are haphazard. In order to effectively manage the continual improvement and benchmarking process, A Capability Maturity Model (CMM) for supply chain management is proposed in this paper.

2. CMM: A STAGED APPROACH

CMM is a well-known comprehensive software engineering process improvement model developed by the Software Engineering Institute (SEI) at Carnegie Mellon University [1]. The original CMM has now evolved into CMMI (-Capability Maturity Model Integration of Systems Engineering/Software Engineering/Integrated Product and Process Development/Supplier Sourcing). The concept of process or capability maturity has been successful applied to many other functional management areas such human resource management, project management, and product development. There are also several supply chain management maturity models such as those proposed by McCormack [2], Performance Measurement Group (PMG) and Pittiglio Rabin Todd & McGrath (PRTM) [3]. This paper proposes a comprehensive composite SCM-CMM by taking into account the latest development in this area.

3. SCM BEST PRACTICES

Firms want to identify and apply best practices for their business. After all, finding a better way to deal with changes and adversity had been a proven strategy for success at least since the Greeks gave up frontal assaults on the Trojans and built the wooden horse. They adapted, worked smarter, not harder, and got a better result. Identifying and implementing best practices should be treated as a lifelong mission for every company and even individual. However, "best practices" does not mean always getting the latest merchandise on the market or doing exactly what the competition did last year. "Best practices" should be context dependent which means understanding your own business environment, competition, processes and operations, and your costs thoroughly, and aligning the practices with your business processes so as to achieve the best return on investment, and to better
satisfy your customers.

Effective best practices are highly business-specific, and successful application depends on choosing them with a thorough understanding of the business operations involved. Every operation has its own requirements and constraints that make it unique and set it apart from the others. Today's SCM best practices need to be fast, adaptable and integrated, but that will occur only after you have looked into all the nooks and crannies of your operations to see what they really tell you. For instance, when it comes to selecting and implementing warehousing technology, the first step is to define mission-critical functions and key business processes. Look hard at what you need to be able to do to meet customers' requirements. Take the example of a clothing retailer with a couple of hundred stores, who knows how to handle merchandise at its distribution center (DC), but wants to start an e-business that ships items directly to customers' homes. This is a different goal and operational requirements for picking and shipping. To make the transition to direct-to-home shipments, the company must have a clear picture of the operations its technology will have to handle.

A best practice for selecting any solution is to use return on investment as the touchstone. When it comes to material handling, the greatest need for integrated solutions is flexibility. Best material handling practices in today's economy minimize touch labor, handle diverse manufacturing or distribution scenarios, accommodate value-added operations, can be reconfigured with minimum effort and are highly technology-driven. Perhaps the best practice for material handling today is to make sure that solutions are just as logically integrated into your operation as they are physically integrated.

For instance, material handling solutions must be affordable and supportable. They must allow information to flow freely throughout the business and to its suppliers. In an economy that is ever faster paced and e-based, another best practice in material handling is to seek solutions that are Web-based and use off-the-shelf hardware and software. All tools and processes that are installed today have to be as fully integrated as possible with other processes in the business and with supply chain partners up and down the line. If not, even the best operation will be trapped in a "worst" practice of maximizing only itself as a lone link in the supply chain.

Flexibility is a key to logistics operations, where being able to adjust all the time is a best practice. The backbone of great supply chain performance is fulfillment—picking, shipping and delivering to customers. Calibrating fulfillment to ever-changing business needs is a prerequisite of great supply chain performance—that is what all best practices are aimed at achieving. One example is having the capability to provide your customers with product customization and differentiation through value-added services. The best practice is having an operation that does more than a good job. It does exactly what the customer needs. Companies today must strive for continuous improvement for today and tomorrow. Today's business has gone from monthly deliveries to daily deliveries, from truckloads and pallets to parcels or "Eaches". Customization has gone from being an extra to being a standard feature that the customer expects at reduced costs. Flexibility is essential so the operation can be reconfigured to meet shifting demands.

4. THE PROCESS, PEOPLE, TECHNOLOGY TRIANGLE

Supply chain success does not happen naturally. It takes focus and effort across the entire company organization and with outside suppliers and service providers. Logistics touches every part of a company. Therefore supply chain management must be multidimensional in its approach and scope. And this takes process, people and technology. This is true for wholesaler, retailer or manufacturer. In today's turbulent environment, it is vital to be agile, flexible and collaborative through the integration of process, people and technology. For the three dimensions, which is more important to supply chain success? The answer is that there is no single answer. Sure, you cannot do anything without the right people in place. But if you do not have the right enabling tools and the right organizational processes, the best people in the world will still come up short. Basically, we are talking about performing a balancing act among these three core elements.

4.1 Process

Process means a practice, a series of actions, done for a specific purpose, such as satisfying customers. Customers demand and expect more from their suppliers; that is a fact regardless the company size or industry. Supply chain management is critical to that customer satisfaction. Supply chain process is a flow of activities with the goal of meeting the requirements of a customer. It includes all internal functions, logistics, distribution, sourcing, customer service, sales, manufacturing and accounting. It also includes external companies and agencies. The series flows backward - from delivering each customer order as demanded back through the performance of suppliers to provide needed finished products, components, parts and assemblies.

Process has structure and is dynamic. The structure is represented a series of repetitive and standalone transactions as a set of standardizations and understanding of what must be done. The dynamics is given by the flexibility to handle exceptions and changes that are a reality of doing business.

4.2 People
People make and enable organizations and are important to supply chain success. They need to have functional expertise and skills. They need to know how to manage and operate warehouses, inventory, transportation, purchasing. They need both a tactical view for everyday business and a strategic vision of where and how their function fits in the supply chain and how to make it better. People success is also a function of the corporate culture-values and norms, how the company perceives itself, defines itself and operates, both internally and externally. The culture can be a facilitator of processes or an inhibitor. If the company has myopia, then it negatively impacts its ability to respond in all areas required. Similarly, organizations, with their hierarchical design, create barriers to supply chain process, which is horizontal. Organization silos can short circuit the supply chain process. Each silo can have its internal goals that create islands of operation when trying to work cross-functionally to the process. Even though the focus of the supply chain process is the customer, merchandising, logistics, finance and others may work to optimize their role and sub-optimize the process.

4.2 Technology

Supply chain management is sometimes incorrectly defined, in terms of technology. Process can be defined as technology, with an overemphasis on hardware and software, and neglecting the purpose of the process. Software may be "sold" as the answer, the means, to supply chain nirvana. That can lead to an over expectation by the user, which in turn can lead to disillusion with what is required to set up and operate the system and with the results actually achieved. In fact, technology must be combined with appropriate processes and people in organizations. Technology in SCM triangle refers to supporting hardware and software of the SCM processes, with an emphasis on communication techniques, IT infrastructure, and software platforms.

5. THE SCM-CMM

When a firm progresses through its logistics effort, it generally follows a transformation, which follows several stages of supply chain evolution. In this model, a hierarchy of five maturity stages is proposed: Ad Hoc, Initial, Defined, Extended, and Networked. Figure 1 presents the five stages and corresponding major characteristics. A firm can start from any initial position, to the most appropriate advanced level of logistics excellence.

Figure 1: Five stages of SCM capability maturity

5.1 Ad Hoc: Function Focused

The supply chain processes and the SCM practices remain unstructured and ill-defined. Individual heroics and “working around the system” are what make things happen. Organizational structures are based on the traditional functions, not horizontal supply chain processes. Functional departments within an organization focus on improving their own processes and use of resources. Managers typically focus on improving their individual department’s costs and functional performance. Process that cut across multiple-functions or divisions are not well understood, resulting in limited effectiveness of complex supply chain processes. Logistics decisions are made in an arbitrary manner, and are mainly based on individual experience. People are not conscious in reducing logistics costs. Communications are mainly through traditional information technologies based on stand-alone functional information systems.

5.2 Initial (Calibrate the Beginning)

In this stage, the basic SCM processes such as the order commitment, procurement and inventory management are defined and documented. They are available in flow charts, and changes to these processes must go through a formal procedure. Organizational structures remain traditional, but include some SCM aspects. Representatives from sales, manufacturing and transportation meet regularly to coordinate with each other, but only as representatives of their traditional functions. Similarly, functional representatives meet to coordinate schedules with vendors and customers.

People within the firm typically bring attention to its logistics costs, and began to focus on reducing the overall logistics costs from an internal control viewpoint. A company looks at its cost of shipping and receiving, the techniques used for loading and unloading at various sites, how order are managed, and how the firm can find better ways to control the amount of inventory used to support operations and customer satisfaction. People realize the importance of improving SCM practices, and the company provides formal training in SCM concepts.
and skills. For the technology, they take advantage of modern Information and Communication Technologies (ICT) and improve the communication and collaboration across departments.

5.3 Defined (Achieve Logistics Capability)

In this level, firms establish a SCM center where the total organization’s logistics costs are evaluated. One common indicator is the appearance of the title “supply chain manager”. As the firm begins to consider its ability to leverage transportation and storage the same way as purchasing volume, it moves closer to traffic optimization with attention turned to how the overall capability can be improved. This is the breakthrough level. Managers employ SCM with strategic intent and results. Cooperation between intra-company functions, vendors and customers takes form of teams that share common SCM measures and goals that reach horizontally across the supply chain. A well-defined demand/supply balancing process that combines forecasting and planning with sourcing and manufacturing is evident at this level. In short, the SCM function becomes a serious part of the firm’s strategic framework.

People become more responsive to customer requests and service level. Advanced planning and scheduling (APS) begins to occur at this level, as these providers are given access to actual planning schedules, so they can have the right equipment available and resource-alert at the right point of need. In terms of technology, software programs are applied to determine where the warehousing should be located, how much space should be involved, and which company should have ownership of the facility. Using data on where suppliers are located, where the manufacturing plants are located, and where key deliveries must be made, this analysis includes how much inventory is required to meet demand, how the goods should stored and retrieved. This often leads to the rationalization of the total system and installation of a Warehouse Management System (WMS). MRP/ERP systems are in place to coordinate the material requirements planning and handing, manufacturing and transportation. Optimizing mathematical tools and software are used to solve problems for optimal/satisfying solutions.

5.4 Extended (Cross-Enterprise Collaboration)

Stage 3 practices are now extended to the points of interface with external customers and suppliers. The company has identified strategic customers and suppliers, as well as the key information it needs from them in order to support its business processes. The company, its vendors and suppliers, take cooperation to the process level. SCM measures and management systems are deeply imbedded in the organization. Advance SCM practices take shape. Outsourcing, joint service agreements and the balanced scorecard practices are used, and corrective actions are taken when performance falls below expectations. With the assistance of key allies and data readily accessed internally and externally, the focus moves to the extended enterprise and the shipments and storage across many organizations. The major feature of this level is the “glass pipeline” that develops, through which the partners can view the entire supply chain flow, from the earliest important supplies to final consumption.

Cross-enterprise collaboration is the major characteristic of this stage. Firms create “win-win” situation through closer cooperation, frequent communication, and partnership. In terms of technology, inter-enterprise information and communication systems come into existence as the firm begins serious collaboration with its best suppliers and customers, often including some key distributors. E-fulfillment becomes common practice to improve efficiency and reduce cost.

5.5 Networked (Building an Competitive Edge)

In this highest stage, competition is based upon multi-firm supply chains. Collaboration between legal entities is routine to the point where advanced SCM practices that allow transfer of responsibility without legal ownership are in place. Trust and mutual dependency are the glue holding the extended supply chain together. A horizontal, customer-focused, collaborative culture is firmly in place. Customers and suppliers work to define a mutually beneficial strategy and set real-time performance targets. This stage is for the most sophisticated of networks, requiring the information of joint logistics models and involves full connectivity across the extended enterprise. Total logistics costs are evaluated through the connecting extranet communication system. Information technology now automates the integration of the business processes across these enterprises in support of an explicit supply chain strategy.

A robust integrated multi-tier capability is what distinguished the extended stage, as all key members are working together online, in real-time basis to match deliveries with actual demand. Tight upward and downward propagation with regard to plans and changes are a factor that brings further advantages. A big differentiator that wins customers over is high levels of service provided by extremely efficient and responsive supply chains. People are willing to accept change and innovative technologies, and be adaptive to the business environments.

The firms have applied activity based costing and balanced scorecard techniques to determine the costs per unit across the end-to-end network, they work together on the most cost-effective methodology while keeping customer rating at industry-best standards. The typical purpose behind supply chain management
initiatives is to improve efficiency and thus lower costs. Supply chain event management (SCEM) is adopted. SCEM is the process of simulating, responding to and controlling exceptions to planned and unplanned events in the supply chain.

Simulation techniques are applied to study, evaluate and test alternative delivery scenarios, and to alert partners of relevant changes occurring within the system. The internet is an ever expanding “pipe” connecting everything. Global Satellite Positioning (GSP) devices are used here to track shipments and storage of products. Radio-frequency equipment is mounted on warehouse trucks to link the communication right to the point of picking the correct items for any order. Virtual inventory management becomes a reality as the partners are operating closely to meet delivery needs without excess inventory. A summary of the SCM-CMM model is provided in Table 1.

<table>
<thead>
<tr>
<th>Table 1 Summary of the model</th>
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<tr>
<td><strong>General</strong></td>
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<tr>
<td>Functional focused</td>
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<tr>
<td>Unstructured supply chain management processes</td>
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<tr>
<td>Processes focusing on functional interests</td>
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<td>Decisions are arbitrary and based on experience</td>
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| **Process**                  | **Level 1** | **Level 2** | **Level 3** | **Level 4** | **Level 5** |
| Function focused             | Becoming aware to reduce logistics cost | Assignment of supply chain manager | Communication with supplier and customer | Accept change |
| Not responsible to customers | Be willing to improve customer service | Established supply chain management center | Collaboration with suppliers and customers | Adaptability |
| Communication is minimized   | Focusing on customer satisfaction and service level | Focusing on customer satisfaction and service level | Trust and mutual dependency | Customer satisfaction driven |
| Unconscious to reducing logistics costs | Communication and coordination within company | Communication and coordination within company | | Trust and mutual dependency |

| **People**                   | **Level 1** | **Level 2** | **Level 3** | **Level 4** | **Level 5** |
| Traditional communication facilities | Using modern forecasting method and optimization tools | Decision support software | Inter-enterprise communication facilities | Global Satellite Positioning (GSP) network connectivity |
|                               | Use information technology to improved communication | Optimizing/satisfying | Scorecard Method | Real-time communication |
|                               |                           | Warehouse Management System (WMS) | e-fulfillment | Simulation |
|                               |                           | Information sharing and communication based on Intranet | | |
The model can help companies assess their current supply chain capabilities and build a roadmap to improved performance. Within the model, a company’s maturity is assessed against the characteristics of the five stages. In order for the company to be considered operating within a given stage, it must meet the major characteristics of process, technology and people dimension.

Moving from one stage to another is not only a matter of selecting a set of desired processes, then making plans to put them in place. The desired level of maturity is a key driver of a company’s overall supply chain roadmap and a guiding force behind how each core processes is applied. Firms may use the maturity model to help select and implement the supply chain practices best suited to their business and their capabilities. The assessment provides a benchmark of the organization’s supply chain maturity as well as identifies areas for improvement. Benchmarking is a significant first step for a company as it gives them a baseline for how mature their functional areas and sub-processes are. Using this information, companies can focus their limited resources where they are needed most. The assessment tool also serves as a guideline for improving at each stage, so companies know immediately what would be needed to improve any sub-process.

6. CONCLUSION

In this paper, a Capability Maturity Model for supply chain management (SCM-CMM) is proposed which consists of five stages of maturity. Supply chain success involves process, people and technology which guide and enables supply chain participants to know what is required. This in turn provides agility to handle exceptions and to adapt to changes. The process-people-technology framework provides a useful basis for developing performance metrics. By helping companies break down their current supply chain practice maturity into core capability areas, the SCM capability maturity model helps companies focus their supply chain improvement efforts on the critical processes that lead to enhanced overall SCM maturity.

REFERENCES

