LEAN, AGILE AND DEMAND-DRIVEN STRATEGIES FOR SUPPLY CHAIN PERFORMANCE

Richard W. Monroe, Coastal Carolina University, Wall College of Business, Conway, SC 29528 USA, Email: rmonroe@coastal.edu; (843) 349-2527

ABSTRACT

Supply chain management is an organizational function that is critically important for organizational performance in today's global business environment. Organizations are formulating various strategies to enhance supply chain performance and are continually seeking ways to gain a competitive advantage. This paper explores three widely acclaimed strategies: Lean, Agile and Demand-Driven approaches for supply chain management. Main benefits and suitable environments will be discussed for each of the three strategies.

Introduction

The complex and competitive nature of today's global business environment is characterized by shorter product life cycles, more demanding customer requirements and a variety of supply chain risks. In this environment, organizations seek new competitive approaches to achieve an advantage and formulate adaptations of strategies to enhance their supply chain performance. In the supply chain many exchanges occur in the overall process of planning, sourcing, making and delivering products, services and the related supply chain information. As these exchanges occur and the material moves through a series of providers and ultimately reaches consumers, the efforts of several parties need to be aligned – this is referred to as the supply chain [26].

The following definition for "supply chain management" offers further clarification:
"Supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders" [10].

The important fact to take away from this description is the need to coordinate across the entire network of companies in the supply chain. Superior supply chain performance cannot be achieved without superior performance along each link of the supply chain. Superior performance requires integrated strategies to achieve the high degree of coordination.

In the next sections we discuss the three main approaches: Lean, Agile and Demand-Driven, as leading strategies for enhancing supply chain performance.

Lean

Lean is a manufacturing management philosophy that has been well documented through the publications by Womack, Jones and Roos [28] and Womack and Jones [29], [30], [31]. Among the publications by these authors there are several company examples that describe some of the early successes that were achieved by applying lean principles to improve their businesses (e.g. LanTech and Danaher) [31].

"Lean is about doing more with less" [4]. Lean principles are based on the Toyota Production System (TPS) [28][30][31]. The primary aim of Lean is to eliminate waste of all kinds

throughout a production process or in this case all supply chain processes. The Japanese word for waste is muda. Lean thinking is a "powerful antidote for muda" [31]. When companies apply Lean techniques, they "specify value, line up value-creating actions in the best sequence, conduct these activities without interruption … and perform them more and more effectively" [31, p. 15].

In order to accomplish those objectives, companies apply the following five major principles of Lean:

- Specify value (i.e. what is value for the customer);
- Identify the value stream;
- Flow (make the value-creating steps flow);
- Pull (let the customer "pull" for the product); and
- Perfection (waste of effort, waste of space, and waste of all types of resources can be reduced in an ongoing fashion by pursuing "perfection") [31].

Due to the complex, multiple tier nature of supply chains a complete value stream map is a major undertaking. For this reason, value stream maps focus on internal processes and then extend only to a few suppliers of critical items rather than every supplier.

Another supply chain approach is the Supply Chain Operations Reference (SCOR®) model from the Supply Chain Council [27]. Utilizing the SCOR® model, the "Configuration Level" provides an excellent opportunity to employ the waste reduction techniques of Lean. This level is where core process strategies are established and where companies align their supply chain with their overall operations strategy. In the terminology of SCOR®, this is where the process can be "configured-to-order" [27]. Lean bases the configuration on eliminating waste. So the choice of "make-to-order" or "engineer-to-order" is based on eliminating the waste of finished goods inventory that is not needed to satisfy current demand. These choices are also based on the market and they are "demand-driven" [20]. "Make-to-stock" is a possible option under the scope of SCOR® but it is not a viable option under Lean [20]. A summary of benefits and environments will compare the three strategies later in the paper.

Agile

Flexibility is a key element for agility. What began as manufacturing flexibility has been extended broadly into the business context including organizational structure, information systems, logistics processes and organizational mindsets [4]. The Agility Forum is credited with the extension and spread of the agile concepts in the early 1990s [22].

Agility in the supply chain is described as being able to "respond to sudden and unexpected changes in markets. Agility is critical, because in most industries, both demand and supply fluctuate more rapidly and widely than they used to. Most supply chains cope by playing speed against costs, but agile ones respond both quickly and cost-efficiently" [16]. Clearly, a one dimensional response by an organization is not acceptable and does not constitute agility.

The concept of Design for Supply Chain Management (DFSCM) and its use by Hewlett-Packard (HP) was first introduced by Lee and Billington [11] and further explained by Lee [12]. Based on these references, the idea of DFSCM was well-established at HP in the early 1990s. The primary issues that were addressed dealt with inventory issues and were based on a global supply chain inventory model [11][13][14]. Embedded within DFSCM at Hewlett-Packard were many different supply chain strategies aimed at various supply chain issues that HP was attempting to address. Included among the list of supply chain strategies are:

- Delayed product differentiation
- Commonality
- Standardization
- Process steps switching
- And Postponement [11][12][13][14][15][7].

Many of these strategies or principles are aimed at flexibility, agility and logistics cost reduction. First among the issues addressed by HP were the combined factors of product design, inventory placement and design for localized markets [13].

While the intent of many of these supply chain initiatives at HP has been to provide flexibility and to move towards being more agile, the success of agility tends to be exposed when there is an adverse condition related to either supply or demand. There are several excellent examples of supply chain agility where the agile firm succeeded while the firm that lacked agility failed. Nokia and Ericsson were faced with a supply chain disruption due to a fire at a facility a radio frequency (RF) chip in New Mexico in March 2000 [16]. Nokia executed design changes, quickly worked with alternate suppliers and implemented their contingency plan within a five day period after the fire [16]. Ericsson was caught without a plan and was in the midst of eliminating alternate suppliers [16]. They lacked a coherent contingency plan, experienced drastically reduced production levels for months and delayed a new product introduction [16]. Nokia gained market share through their agile response and at the expense of Ericsson [16].

In 1999, an earthquake in Taiwan disrupted the supply of computer components to the United States and significantly impacted major computer makers including Apple, Gateway and Compaq [16]. While those companies were unable to make computers, Dell changed prices and altered their offerings to promote those computer configurations that could be made without the components sourced from Taiwan [16]. This agile response to the disruption by Dell also led to an increase in market share at the expense of the competitors who were not agile [16].

Lee offers the following list of characteristics or "six rules of thumb" for designing agility into the supply chain:

- "Provide data on changes in supply and demand to partners continuously so they can respond quickly. … Ensuring that there are no information delays is the first step in creating an agile supply chain.
- Develop collaborative relationships with suppliers and customers so that companies work together to design or redesign processes, components, and products as well as to prepare backup plans.
- Design products so that they share common parts and processes initially and differ substantially only by the end of the production process. I call this strategy "postponement." … This is often the best way to respond quickly to demand fluctuations because it allows firms to finish products only when they have accurate information on consumer preferences.
- Keep a small inventory of inexpensive, non-bulky components that are often the cause of bottlenecks.
- Build a dependable logistics system that can enable your company to regroup quickly in response to unexpected needs. (this can be accomplished through an alliance with a third-party logistics provider).
- Put together a team that knows how to invoke backup plans" [16].

These elements have been utilized successfully by such companies as Hewlett Packard [11] [14] [15] and Dell Computer [19].

Several characteristics are present in the "agile supply chain" [4]. "The agile supply chain is market sensitive. … The use of information technology to share data between buyers and suppliers is … creating a virtual supply chain. … Shared information between supply chain partners can only be fully leveraged through process integration. … The idea of the supply chain as a confederation of partners linked together as a network provides the fourth ingredient of agility" [4]. To summarize briefly, the four elements are market sensitivity, the virtual nature of the supply chain, process integration and the network based arrangement of supply chain partners. The summary later in the paper will compare Agile with the other two strategies.

Demand Driven

AMR Research has publicized the term "demand-driven supply network" in the course of their research with 2003 as an originating point [2]. They also use the term within the criteria that is evaluated to determine the Top 25 Supply Chains on an annual basis [1].
The criteria for selection to the Top 25 list are as follows: "The first component of the ranking is publicly available financial data and is weighted at 60% of the total score, with return on assets and inventory turns each accounting for 25%, and trailing 12 months growth accounting for 10%. The second component of the ranking is AMR Research's opinion, which is weighted at 40% of the total score. The opinion component is based on a structured voting methodology across AMR Research's team of analysts" [1].

A demand-driven supply network (DDSN) "is a system of technologies and business processes that sense and respond to real-time demand across a network of customers, suppliers and employees" [2]. "DDSN leaders are 'demand sensing,' have more efforts for 'demand shaping,' and focus on a profitable 'demand response' [2].

One of the leading promoters of the "demand driven" concept is AMR Research and their Top 25 Supply Chain list. According to AMR: "The report identifies the top 25 manufacturers and retailers that exhibit superior supply chain capabilities and performance. Supply chain leaders are able to shape demand, instantly respond to market changes, and crush their competitors. According to AMR Research benchmarking data, leaders carry 15% less inventory, are 60% faster-to-market, and complete 17% more perfect orders. These advantages separate predators from prey" [25].

The criteria for selection to the Top 25 list are as follows: "The first component of the ranking is publicly available financial data and is weighted at 60% of the total score, with return on assets and inventory turns each accounting for 25%, and trailing 12 months growth accounting for 10%. The second component of the ranking is AMR Research's opinion, which is weighted at 40% of the total score. The opinion component is based on a structured voting methodology across AMR Research's team of analysts" [25]. Companies in the Top 25 for two years are listed in Table 1.

Table 1. Top 25 Supply Chains from AMR Research

Rank	2004 Companies	2005 Companies
1	Dell	Dell
2	Nokia	Procter & Gamble
3	Procter & Gamble	IBM
4	IBM	Nokia
5	Wal-Mart Stores	Toyota Motor
6	Toyota Motor	Johnson & Johnson
7	Johnson & Johnson	Samsung Electronics
8	Johnson Controls	Wal-Mart Stores
9	Tesco	Tesco
10	PepsiCo	Johnson Controls
11	Nissan Motor	Intel
12	Woolworths	Anheuser-Busch
13	Hewlett-Packard	Woolworths
14	3M	The Home Depot
15	GlaxoSmithKline	Motorola
16	POSCO	PepsiCo
17	Coca-Cola	Best Buy
18	Best Buy	Cisco Systems
19	Intel	Texas Instruments
20	Anheuser-Busch	Lowe's
21	The Home Depot	Nike
22	Lowe's	L'Oreal
23	L'Oreal	Publix Super Markets
24	Canon	Sysco
25	Marks & Spencer	Coca-Cola

Sources: [1] & [25]

To better understand the Demand-Driven Supply Chain we discuss one leading company from the AMR Top 25 list. Proctor & Gamble is the company selected.

Proctor & Gamble (#2): Proctor & Gamble is the country's leading manufacturer of household products. It has 35 manufacturing plants, 30,000 suppliers, and 5,000 retailers. Its supply chain continues to be one of the most complex and well-managed in the world. In the past, P&G used the traditional 'push' method where their products were produced and delivered in large quantities and at times that are determined by the company, and then they are shelved at retailers for immediate sale. This became a problem due to the fact that nearly 60% of P&G's products are sold by retailers under promotion [23][24].

When stockouts occurred during promotions, P&G knew they had to change. They began bringing retailers and suppliers into the demand forecasting side of the business and switched to the demand driven 'pull' method of the supply chain. P&G has also put into effect an initiative the company calls "Efficient Consumer Response II." This will help them reduce cycle time to 65 days from the original 130 days seen in the 1980's. According to Steve David, Proctor and Gamble CIO, he stated that "currently we have 4,000 internal websites, 25,000 organizational nodes, 70,000 materials, 200,000 products, 500,000 customers, and 1 million parts…..but we still need to clean up our act" [9].

We think that the "Demand Driven" strategy has not been thoroughly researched and is limited primarily to the publications from AMR Research. Companies utilizing the Demand Driven approach need to be explored in greater depth to create a better understanding of the successful approaches. More in-depth empirical research about performance for the Top 25 Supply Chains would also be a fruitful research avenue.

Some example topics that can be associated with individual companies from the Top 25 list include [25]:

- Demand driven supply network (DDSN) – Dell and Best Buy
- Consumer-driven supply chain – Procter & Gamble
- Innovation for multiple channels – Johnson & Johnson
- Innovation for industrialization and commercialization – GlaxoSmithKline
- Demand shaping – L'Oreal

These are just a few examples of potential topics for future research to provide a deeper understanding of DDSN.

Summary of Three Strategies

A further literature search utilizing Google Scholar was employed to determine the top 20 articles in each topic area. "Lean and Supply Chain," "Agile and Supply Chain" and "Demand Driven and Supply Chain" were the phrases used to conduct the searches. A summary of those results appears in Table 2:

Table 2. Frequently Cited Articles on Lean, Agile and Demand Driven

	LEAN	AGILE	Demand-Driven
[21] Naylor, Naim & Berry, IJPE 1999	1	2	10
[5] Christopher & Towill, SCM: AIJ 2000	2	3	2
[4] Christopher, IMM 2000	6	1	1
[6] Christopher & Towill, Management 2001	-	10	6
[17] Mason-Jones, Naylor & Towill, IJPR 2000	9	8	-
[18] Mason-Jones, Naylor & Towill, IJAMS 2000	10	6	-
[8] Fisher, HBR [pages.stern.nyu.edu] 1997	11	12	11

Note: The #'s represent the ranking in each respective set of search results from Google Scholar. These results are based on a search conducted on August 22, 2008. Results will vary as number of citations and other factors change the rankings.

These seven articles are rated highest due to the multiple listing in at least two of the search results. Four of the articles do appear in all three search results. We use these articles along with other references to further compare the three strategies.

Lean and Agile have been described as clear dichotomies in some instances [3]. While some of the objectives may be similar for the two, the operational choices may vary significantly. "Demand-Driven" is not clear and distinct from either Lean or Agile. In fact the research for this paper indicates that Demand-Driven either overlaps or is partially embedded within both Lean and Agile. When we add the AMR Research viewpoint, Demand Driven does appear to be separate due to the intense information technology applications that are utilized by companies with successful DDSNs. The success of DDSN is clearly enabled by technology more so than the Lean or Agile successes.

Christopher [4] has argued that Lean is best suited to an environment characterized by relatively stable or predictable demand and with low variety. By comparison, Agile strategies are best suited for an environment characterized by volatile demand and a customer expectation for a wide range of variety [4]. Christopher [4] goes on to say that the decoupling point is the critical issue for determining the application of Agile and Lean strategies. He suggests that Lean strategies should be used up to the decoupling point and Agile strategies should be used beyond the decoupling point. The Lean side of the decoupling point is also described as being "driven by demand" [4].

From another perspective, Mason-Jones, Naylor and Towill [17] offer the "Market Winners" and "Market Qualifiers" that relate to both Agile and Lean. These are presented in a similar format as the original in Table 3.

Table 3. Market Qualifiers and Market Winners for Agile and Lean

	Market Qualifiers	Market Winners
Agile Supply	Quality Cost Lead Time	Service Level
Lean Supply	Quality Lead Time Service Level	Cost

Sources: [17] [32]

Summary

In summary, we offer a brief sketch of each of the three strategies. For Lean, the appropriate environment is one with predictable demand [4], the main focus will be on eliminating waste in the supply chain [20][31] and the market winner will be cost [17][32]. For Agile, the environment will be one with more volatile demand and more demands for customization [4][6]. Agile strategies may take many forms as seen in the examples presented in this paper [7][11][12] [13][14][15][16] and the market winner will be 'service level' [17][32]. At this time, the broader literature does not indicate a clearly distinct Demand Driven strategy that can be separated from Lean and/or Agile. But based on the AMR Research materials [2] we believe that there is a growing distinction among companies that subscribe to the DDSN approach. Companies employing the DDSN strategy are dealing more directly with the end customer and they have utilized technology applications in an optimal way to enhance their DDSN capabilities. We believe that this trend will continue and that DDSN will become a more prominent strategy going forward. Further research will help solve the 'conundrum' of Lean, Agile and Demand Driven.

REFERENCES

[1] AMR Research. Online, 2006: http://www.amrresearch.com/Content/View.asp?pmillid=18895&nid=2558&rid=1104301503

[2] Cecere, L., Hofman, D., Martin, R. and Preslan, L. 2005. The Handbook for Becoming Demand Driven. AMR Research, Inc.

[3] Christopher, Martin. Logistics and Supply Chain Management, 2e, 1998, Prentice-Hall, Financial Times, London.

[4] Christopher, Martin. 2000. The Agile Supply Chain: Competing in Volatile Markets. *Industrial Marketing Management*, 29, 1: 37-44.

[5] Christopher, M. and Towill, D.R. 2000. Supply chain migration from lean and functional to agile and customized. *Supply Chain Management: An International Journal*, 5, 4: 206-213.

[6] Christopher, M. and Towill, D.R. 2001. An integrated model for the design of agile supply chains. *Management,* 31, 4: 235-246.

[7] Fetzinger, Edward and Lee, Hau L. 1997. "Mass Customization at Hewlett-Packard: The Power of Postponement," *Harvard Business Review*, January-February, 116-121.

[8] Fisher, M.L. 1997. What is the right supply chain for your product? *Harvard Business Review*, March-April, 1997, 16 pages.

[9] InfoWorld online. Proctor and Gamble reworks its supply chain. March 13, 2001. http://www.infoworld.com/articles/hn/xml/01/03/13/010313hnpng.html

[10] Lambert, Douglas M., Cooper, Martha C., and Pugh, Janus D. Supply Chain Management: Implementation Issues and Research Opportunities. *The International Journal of Logistics Management*, 9:2, p. 1, 1998.

[11] Lee, Hau L. and Billington, Corey. 1992. "Managing supply chain inventory: Pitfalls and opportunities," *Sloan Management Review*, 33, 3, 65-73.

[12] Lee, Hau L. 1993. "Design for supply chain management: Concepts and examples," In R. Sarin (editor) Perspectives in Operations Management, Kluwer, Boston, pp. 43-65.

[13] Lee, Hau, Billington, Corey, and Carter, Brent. 1993. "Hewlett-Packard gains control of inventory and service through design for localization," *Interfaces*, 23, 4, 1-11.

[14] Lee, Hau L. and Tang, C. S. 1997. "Modelling the costs and benefits for delayed product differentiation," *Management Science*, 43, 1, 40-53.

[15] Lee, Hau L. and Sasser, Marguerita M. 1995. "Product universality and design for supply chain management," *Production Planning & Control*, 6, 3, 270-277.

[16] Lee, Hau L. 2004. "The Triple-A Supply Chain," *Harvard Business Review*, October, 2004.

[17] Mason-Jones, R., Naylor, J.B., and Towill, D.R. 2000. Lean, Agile or Leagile? Matching your supply chain to the marketplace. *International Journal of Production Economics*, 62: 107-118.

[18] Mason-Jones, R., Naylor, J.B., and Towill, D.R. 2000. Engineering the leagile supply chain. *International Journal of Agile Management Systems*, 2, 1: 54-61.

[19] Monroe, R.W. and Martin, P.R. 2008. "Designing Agility into the Supply Chain," ICAM International Conference on Agile Manufacturing Proceedings, Kalamazoo, MI.

[20] Monroe, R.W. and Mehta, M. 2007. Supply Chain Improvement Utilizing the SCOR® Model in Combination with Lean Six Sigma. *International Journal of Agile Manufacturing*, 10, 1: 75-80.

[21] Naylor, B.J., Naim, M.M . and Berry, D. 1999. "Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain", *International Journal of Production Economics*, 62, 107-118.

[22] Preiss, Kenneth. 2005. "Agility – the Origins, the Vision and the Reality," *International Journal of Agile Manufacturing*, 8, 2, 3-14.

[23] Procter & Gamble. Online: http://www.pandg.com/investors/sectionmain.jhtml. 2006.

[24] "Procter & Gamble: Delivering Goods." Baseline; July 2004.

[25] Purchasing Magazine online, Supply Chain's Top 25, January 13, 2005. http://www.purchasing.com/article/CA497322.html

[26] Stock, James R. and Lambert, Douglas M. Strategic Logistics Management, Fourth Edition, McGraw-Hill/Irwin: New York, 2001.

[27] Supply-Chain Council, 2005, Supply-Chain Operations Reference-model. SCOR Version 7.0 Overview, Supply-Chain Council, Washington, DC.

[28] Womack, James P., Jones, Daniel T. and Roos, Daniel (1991; 1990) The Machine that changed the world. HarperCollins Publishing: New York.

[29] Womack, James P. and Jones, Daniel T. (1994) From Lean Production to the Lean Enterprise. *Harvard Business Review*, March-April, 1994.

[30] Womack, James P. and Jones, Daniel T. (1996) Beyond Toyota: How to root out waste and pursue perfection. *Harvard Business Review*, Sept.1, 1996.

[31] Womack, James P. and Jones, Daniel T. (1996) Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Simon and Schuster: New York.

[32] Towill, Denis and Christopher, Martin. 2003. The Supply Chain Strategy Conundrum: To be Lean or Agile or to be Lean and Agile? *Supply Chain Practice*, 5, 2: 30-45.