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Designing a Supply Chain Management System according to the Product Characteristics

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Abstract

Winning over the competition in the marketplace requires more than just the application of new technologies to improve supply chain performance. This paper discusses the important issues that need to be considered when designing the right supply chain for a particular product. Examples of companies operating world-class supply chains are used to illustrate these design considerations.

Key Words: supply chain design, product-supply-chain matching

An effective supply chain is considered to be an indispensable medium for achieving short-term economic benefits and gaining long-term competitive advantages. Competing through better supply chains is becoming a more and more important strategy for most companies. It is of paramount importance that each company needs to identify the competitive advantages of each group of its products in the marketplace and to align its capabilities with those of its partners so as to form a seamless virtually integrated supply chain to meet consumer needs. As it is impossible for a supply chain to excel in every aspect, every partner of the supply chain needs to strengthen its capabilities that can sharpen the competitive edge of the product groups by proper investment, training, research and development and marketing.

To win over the competition in the marketplace, a company must ensure that its supply chain capabilities can support its ability to satisfy the targeted customer segment. Thus, it is imperative that a company must identify the needs of customer segment being served. The customer needs are an important input to the formulation of the competitive strategy of a company. The needs of customers shopping at 7-Eleven are different from those of customers shopping at supermarkets. The major differences between customer demands from different segments are as follows (Chopra and Meindl 2001):

* The prices of the product. 7-Eleven's customers are less price sensitive than supermarkets' customers.
* The variety of products needed. Supermarkets' customers demand a much larger variety of products than 7-Eleven's customers.
* The service level required. 7-Eleven's customers expect a very high level of product availability.
* The response time that customers are willing to tolerate. Dell's customers buying customized PCs are willing to tolerate a longer response time than those customers buying

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PCs with standard off-the-shelf configurations.

* The desired level of innovation in the product. Customers shopping at Seibu expect a lot of innovation and new designs in the store's apparel whereas Wal-Mart's customers are less demanding.

Satisfying the needs of different customer segments entails the identification of the right performance objective for a supply chain. The four ways of competing through supply chains are as follows (Dornier et al 1998).

1. Cost
   * Initial Cost: The cost of acquiring the product.
   * Life-cycle Cost: The cost of acquiring, maintaining and disposing of the product.
2. Quality
   * Design Quality: The features, styling, and other product attributes that enhance fitness for use.
   * Conformance Quality: Product conformance to established product standards.
3. Service
   * Delivery Speed: Ability to produce and deliver products quickly, with short turn-around time.
   * Delivery Reliability: Ability to produce and deliver products within a consistent time frame, according to contractually specified time intervals.
   * Availability: Ability to maintain high-level of products availability.
4. Flexibility
   * New-Product Flexibility: Ability to introduce new products quickly and effectively.
   * Customization: Ability to produce a large variety of products that match the needs of a highly segmented market.
   * Product-Mix Flexibility: Ability to efficiently and effectively adjust the production mix in response to product demand fluctuations.
   * Production Ramp-Up Flexibility: Ability to rapidly expand the production process to accommodate rapid mass production.

The relative importance of the four supply chain performance objectives is usually different for a given product or service and the management of a company needs to distinguish winning criteria from qualifying criteria. Winning criteria are factors that directly and significantly help products to win in the marketplace. Customers regard such factors as key reasons for buying that product or service. Qualifying criteria are factors that are regarded by the market as basic performance standards.

Two world-class supply chain management companies are used to illustrate the relationship between their competitive strategies and their winning and qualifying criteria. Wal-Mart is the world's largest retailer, selling US $ 285 billion worth of goods in 2004. Most products sold at Wal-Mart are consumer products that are also sold by a large number of competitors. Wal-Mart aims to provide high availability of a variety of reasonable quality products at low prices. Thus, Wal-Mart's winning criteria are cost and product availability and its qualifying criterion is quality. Dell is one of the world's largest computer companies with sales revenue of over US $ 50 billion in 2004. Dell's competitive strategy is to provide a large variety of customized computers at reasonable prices. A Dell customer places great emphasis on product variety and customization. Thus, Dell's winning criterion is flexibility and its qualifying criteria are cost, quality and service.

Wal-Mart and Dell formulate their competitive strategies based on how their customers prioritize product cost, product delivery or response time, product variety and product quality.

Table 1

	Wal-Mart	Dell
Life cycle	＞ 2 years	12 months
Demand pattern	Predictable	Unpredictable
Product variety	Low（10-20 per category）	High（more than 100 per category）
Average stock-out rate	Low	High
Lead time for Make-to-order	Not applicable（long lead time）	Short（1 week）
Product category	*Functional*	*Innovative*

Besides their differences in winning and qualifying criteria, the nature of the products sold by the two companies also exhibits some drastic differences. The table below highlights these major differences.

Wal-Mart's products are functional products that satisfy the basic needs of consumers, which do not change much over time. The products have stable, predictable demand and long life cycles, and the products varieties are limited. Dell's products are highly innovative with short product life cycles and large variety. It is difficult to forecast the products demand.

As Wal-Mart's winning criteria are cost and availability, it places special emphasis on the efficiency of its supply chain. Costs incurred in its supply chain, such as the costs of production, transportation and inventory, are high. Moreover, these costs eat into a major portion of its revenue and its profit margin is less than 4%. As the predictable demand makes it easier for Wal-Mart to achieve a good match between demand and supply, Wal-Mart focuses exclusively on minimization of inventory and maximization of production efficiency in its supply chain. The diagram below shows the essence of Wal-Mart's supply chain.

Sales data captured by Wal-Mart's point-of-sales（POS）system in each store are compiled on a regularly basis and are sent to its suppliers through its private satellite communication system. This data enables the suppliers to have a clear picture of sales at all of its 4,000 stores. In addition, Wal-Mart has a dedicated fleet of over 2,000 trucks, each equipped with

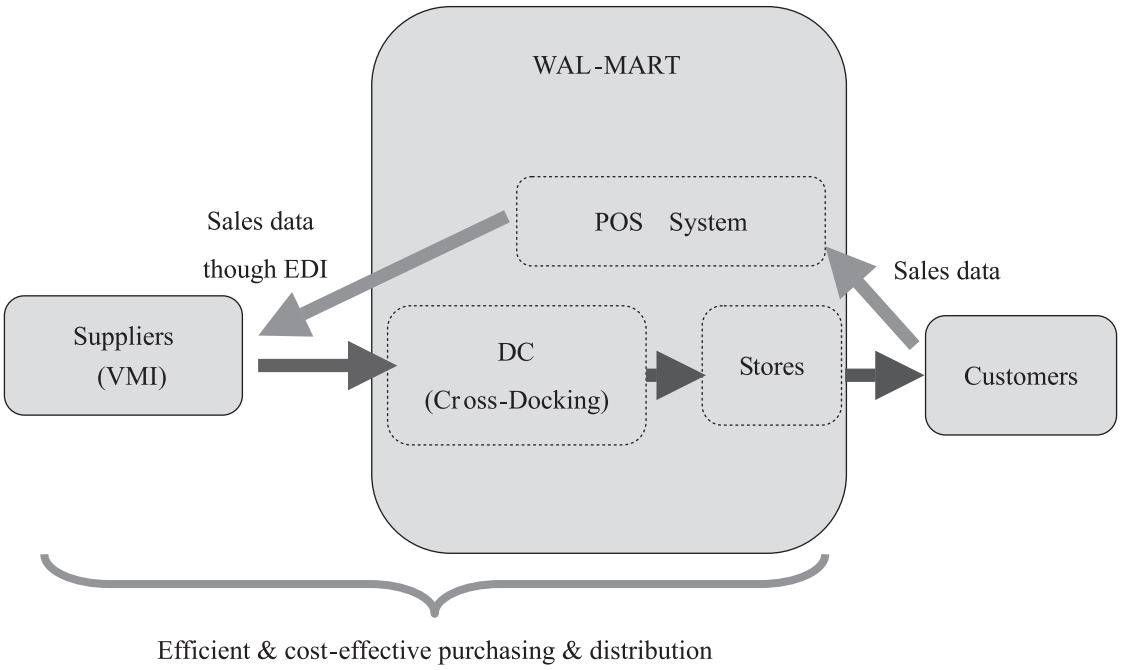

Figure 1

a global positioning system（GPS）, to move goods between its distribution center（DC）and stores. Cross-docking is widely practiced in Wal-Mart and over 85% of items are cross-docked.

The diagram below shows the cross-docking operation. Under cross-docking, DCs function as inventory coordination points rather than as inventory storage points. Wal-Mart's DCs, stores, and suppliers are linked by an advanced information system to achieve high supply chain visibility. In Wal-Mart's cross-docking system, items arrive at DCs from suppliers spend very little time in storage at the DCs. Workers at a Wal-Mart's DC unload items from incoming trucks and then sort, repack and load them into outgoing trucks in less than 12 hours. DC Cross-docking limits inventory costs and decreases lead times by decreasing storage time.

Dell wins over the competition in the marketplace by achieving an exceptionally high

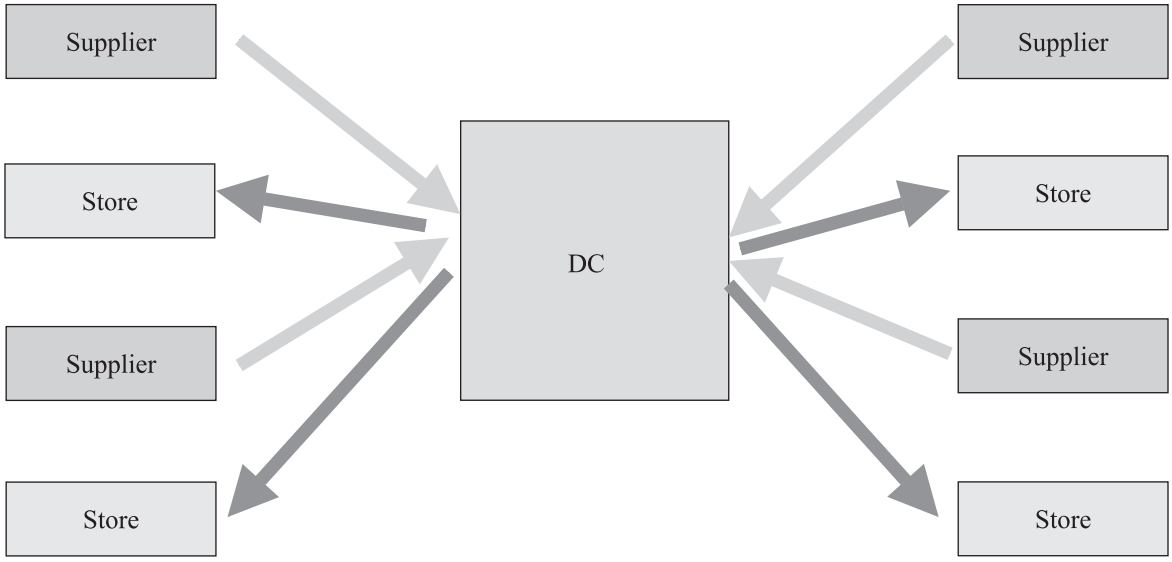

Figure 2

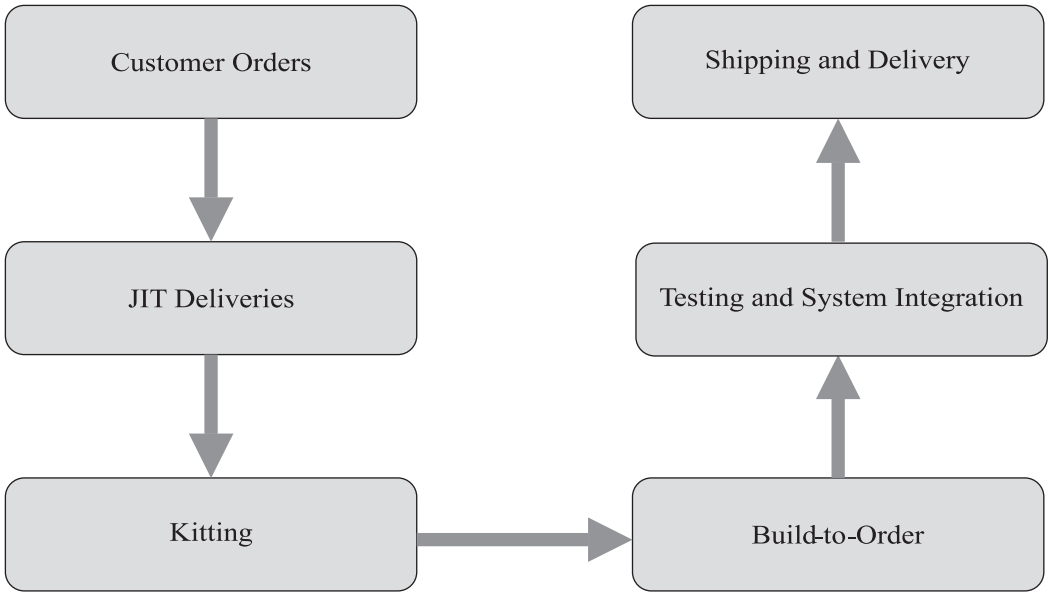

Figure 3

degree of flexibility in its personal computer（PC）manufacturing. Dell's PCs are built to customers' specifications upon receipt of an order, thus eliminating the need to forecast customer demand. The diagram below shows a simplified Dell's build-to-order process.

Dell customers communicate and buy from Dell through three typical channels — the Internet, telephone and face-to-face. After receiving customer orders, Dell informs its suppliers to deliver only the materials required to build the PC specified in the customer orders just-in-time（JIT）to its manufacturing plants. Associated with each custom-built PC is a document that contains all of the PC's unique configuration information. This document travels with the PC throughout its assembly and shipping processes. Based on the document, all the internal parts and components required to assemble the PC are picked and placed into a container. A team of Dell workers uses the kit from the Kitting process to assemble and initially test the PC. The PC is extensively tested, and standard or custom hardware and software is factory-installed and tested in the Testing and Integration process before the PC is shipped out to a Dell DC. The build-to-order cycle takes less than five hours from start to finish.

Seamless virtual integration is Dell's unique way to achieve high degree of flexibility（Magretta［1998］）. The following diagram highlights the essence of virtual integration in Dell's supply chain.

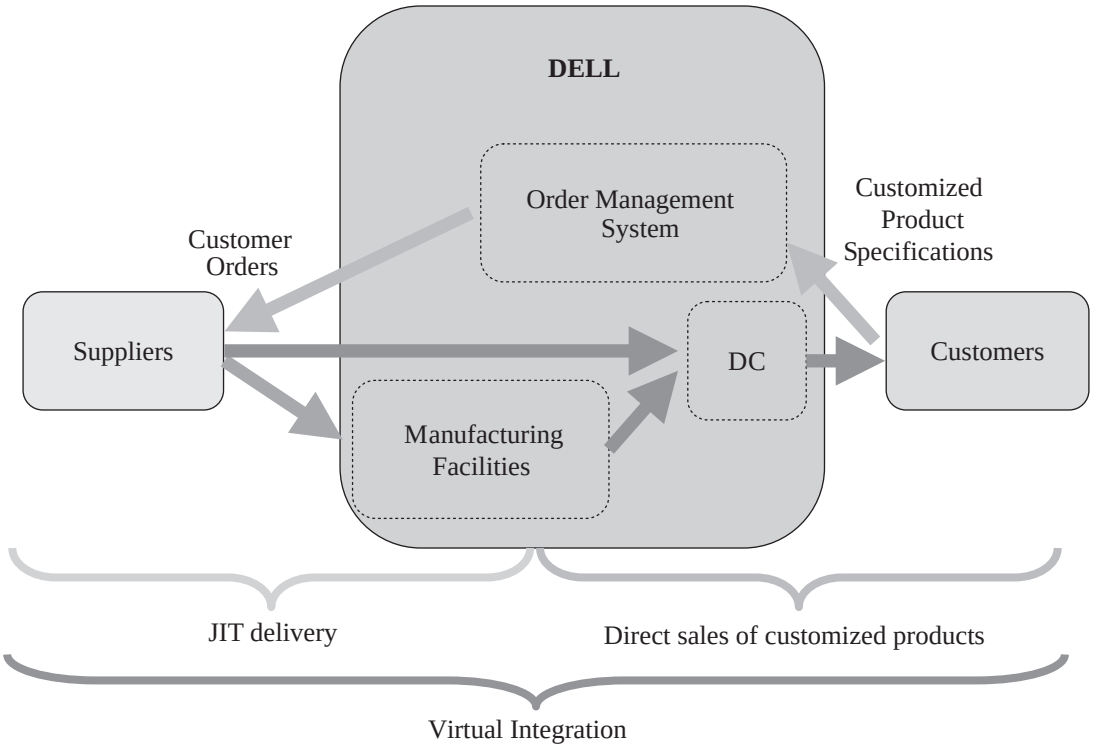

Figure 4

Dell's virtual integration sets a direction linking together different business strategies, like customer focus, supplier partnership, mass customization, just-in-time manufacturing and delivery. Virtual integration basically means stitching together a business with partners that are treated as if they are insiders of the company. Technology is used to enable coordination across company boundaries to achieve new levels of flexibility and productivity. Dell sells most of its PCs directly to the final customers, largely bypassing the reseller channel that accounts for most of the world's PC sales. Dell's direct sales model allows it to tailor its

offerings to customer needs, offer add-on products and services, and use the Internet to offer a variety of customer services.

Dell focuses on a few strategic activities and outsources non-strategic activities. Dell works closely with suppliers to produce its PC products and to offer its customers an array of additional products and value-added services. To manufacture its products, Dell coordinates a global production network that combines in-house final assembly with heavy reliance on outside suppliers and contract manufacturers for JIT delivery of PC components like disk drives, CD-ROM drives, semiconductors, add-on cards, monitors, keyboards, speakers, etc. Dell also relies on outside partners for services such as system integration, installation, on-site repairs and consulting.

Fisher（1997）proposes that supply chains should be managed according to the nature of the product being supplied. He distinguishes two types of products — "innovative" and "functional" products — on the basis of demand patterns. He then argues that managing the supply of these two types of product requires two completely different types of supply chains; namely, physically efficient supply chains and market responsive supply chains. The major differences between the two types of supply chains are listed in the table below.

Fisher（1997）suggests that supply chain should be efficient for functional products, whereas they should be built to be responsive for innovative products. A physically efficient

Table 2

	Physically-efficient Supply Chains	Market-responsive Supply Chains
Primary goal	Supplying predictable demand efficiently at the lowest cost	Responding quickly to unpredictable demand in order to minimize stock-outs or overstock
Manufacturing strategy	Lowering costs through a high average utilization rate	Maintaining excess buffer capacity to meet unexpected demand
Inventory strategy	Minimizing inventory to lower cost	Maintaining buffer inventory to meet unexpected demand
Lead-time strategy	Reducing lead-time as long as it doesn't increase cost too much	Investing aggressively in ways to reduce lead time
Approach to choosing suppliers	Selection based on cost & quality	Selection based on speed, flexibility & quality
Product-design strategy	Maximizing performance & minimizing cost	Using modular design in order to postpone product differentiation

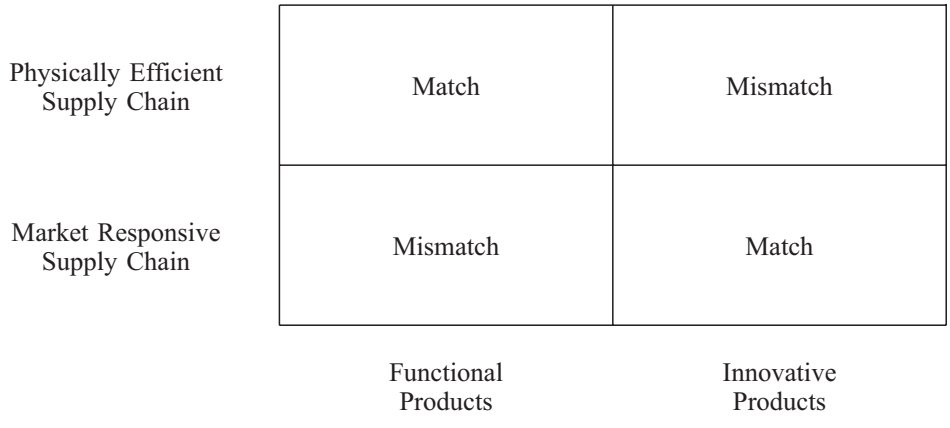

Figure 5

process can supply predictable demand efficiently at the lowest possible cost, whereas a market responsive process can respond quickly to unpredictable demand in order to minimize stock-out, forced markdowns and obsolete inventory. This is illustrated in the table below.

After identifying the right supply chain for a particular product, one needs to adopt the right strategy to build the required type of supply chain. Traditionally, there are two strategies for building supply chains: a push strategy and a pull strategy. In a pushed-based supply chain, production and distribution decisions are based on long-term forecasts. Typically, the manufacturer bases demand forecasts on orders received from retailer's warehouses. Therefore, it takes a much longer time for a push-based supply chain to react to changing demand, leading to product obsolescence, excessive inventories, an unacceptable service level, and excessive production variability.

In a pull-based supply chain, production and distribution are demand driven, and they are coordinated with true customer demand rather than forecast demand. Hence, such a supply chain responds to specific customer orders. Better coordination leads to reduced lead time, decreased inventory levels at retailers and manufacturers, decreased system variability and better response to changing markets. However, pull-based supply chains are often difficult to implement when lead times are long and such supply chains are more difficult to take advantage of economies of scale in manufacturing and transportation.

A push-pull supply chain is a hybridized version of push-based and pull based supply chains. The diagram below depicts such a supply chain.

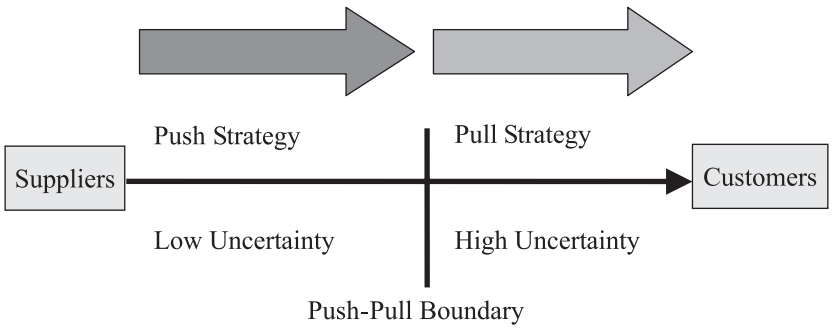

Figure 6 Supply Chain Time Line

In a typical push-pull supply chain, the initial stages are operated in a push-based manner for processes with low uncertainty while the remaining stages with high uncertainty use a pull-based strategy. The interface between the push-based stages and the pull-based stages is known as push-pull boundary. The push-pull boundary indicates the point in time when the firm switches from using push strategy to using pull strategy.

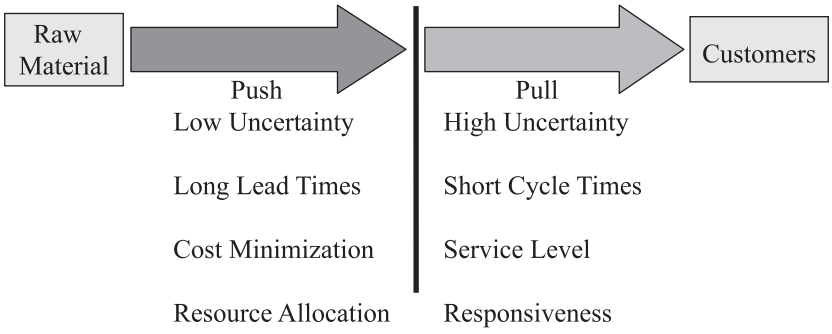

Figure 7

The following diagram shows the characteristics in the two different segments of a push-pull supply chain.

Determining the best push-pull boundary depends on the level of demand uncertainty that a company needs to deal with. The diagram below shows such a boundary for companies facing different levels of demand uncertainties.

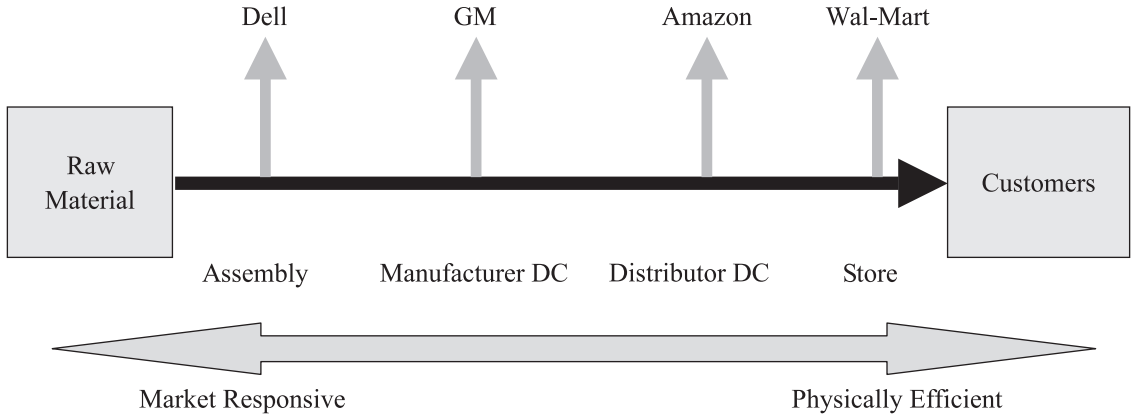

Figure 8

For Dell, the portion of its supply chain prior to assembly is push, while the pull part of the supply chain starts with assembly and is performed based on actual customer demand. In Wal-Mart's supply chain, the major portion of its supply chain is push and the pull portion starts with store inventory replenishment process.

This paper has discussed the important issues to be considered when designing supply chains for different products. A simple, easy-to-use framework has been proposed for identifying and designing the right supply chain for a product.

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