SUPPLY CHAIN MANAGEMENT AND LEAN SIX SIGMA IN A RETAIL ENVIRONMENT

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ABSTRACT

This qualitative research evaluated the as-is supply chain management and logistics retail processes of Dell, a manufacturing company that also has retail operations globally. Dell has an online channel capable of serving millions of customers annually. This research focused on Dell's retail operations in Canada and the United States and the challenges of managing the supply chain requirements of meeting customer demand. The goal was to identify issues with process execution leading to decreased service to customers and increased costs to the manufacturer. A literature review provided information regarding best practices in supply chain management and the leading process-improvement methodology. Results of the study revealed the factors hindering successful supply chain management and process execution: (a) velocity-focused operation, (b) organization and culture, (c) competency of staff, (d) lack of process improvement strategies, (e) departmental logistical collaboration, and (f) failure to integrate supply chain best practices specific to retail.

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DEDICATION

The author wants to dedicate this paper to the men and women who every day work in supply chain management for retailers across the globe in order to meet the demands of consumers. This paper is also dedicated to the faculty and staff of North Dakota State University.

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SECTION 1: THE PROJECT

The computer hardware business is a multibillion-dollar industry. Among the major players in the industry are Apple, Lenovo, Acer, HP, and Dell. Most manufacturers produce computer hardware ranging from desktop and laptop computers to low-, medium-, and high-end servers. Products are sold to businesses and consumers through retail stores, directly to consumers via Internet sales, and through business-account sales channels. Foremost among the challenges faced by manufacturers in the industry is how to deliver their products to their customers economically in accordance with the desired delivery dates. Dell has been especially challenged with fulfilling customer orders across multiple channels due to issues with their supply chain and their logistics operations. The focus of this comprehensive study project was a review of Dell's retail supply chain and logistics operations and of the impact on costs and customer experience for retail clients. The study resulted in a list of recommendations for the issues identified during the project that have the most impact on the ability of Dell to efficiently and cost effectively meet the needs of the retail clients.

Supply Chain Management at Dell

Dell is a manufacturer and retailer of high-quality laptops, desktops, servers, and peripheral computer-related products such as printers and software. In addition to having a reputation in production, Dell is known as a leader in supply chain management, as attested by Dell's fourth place finish on *The Gartner Supply Chain Top 25 for 2012* (Hofman & Aronow, 2012). Supply chain management is of critical importance to Dell because it must provide customers with a multitude of products across many different channels of distribution: online sales orders placed by consumers; business-to-business deliveries shipped in large quantities to corporate clients; and products sold to retailers such as Walmart, Best Buy, BJ's Wholesale,

Sears, Sixth Avenue Electronics, Staples, Microsoft Online, BrandSmart USA, Nebraska Furniture Mart, Guitar Center, Carrefour, Costco, Micro Center, Aaron's Rent-to-Own, La Curacao, Tiger's Direct, and Adorama. In addition, Dell owns and operates its own line of retail stores in select cities across the United States and Asia. Dell also holds a controlling interest in over 16 retailers and manufacturers as part of its private equity holdings and partnerships (Dell, 2011).

In the business operations of the company, the primary importance to Dell is the prompt delivery of merchandise within customer-mandated deadlines. The company applies to its shipping philosophy the word *velocity*, a term that refers to the speedy shipment of the maximum number of packages each day to consumers and swift delivery of pallets to retailers. Utilizing velocity as a metric, however, fails to adequately capture the views of the customer receiving the products that are being delivered (Chopra, 2011).

The goal of this paper was to analyze a growing trend across several well-known corporations within the high-tech industry and among retailers: multichannel distribution. I selected Dell for my research due to Dell's stellar reputation as a leader in online channel distribution and also to prove a working hypothesis that expertise in one form of channel distribution is not an indicator of success when adding additional channels. In the case of Dell, selling their products to customers through a distribution channel consisting almost entirely of big-box, brick-and-mortar retailers requires such radically different supply chain processes and execution that Dell's online channel's supply chain prowess would not be transferable. The impact would be that Dell would experience increased cost and complexity and decreased customer service levels to their big-box retail partners. Dell's reputation as a leader in online retailing and the fact that it had recently begun selling its products through traditional brick-and-

mortar retailers made Dell a logical choice for my research as little information was available on the topic thus making my research relevant to the topic. The central research questions that I intended to answer in this nonexperimental research project were the following:

1. Could Dell utilize the same supply chain and logistics processes to fulfill orders to big-box, brick-and-mortar retailers such as Walmart, Carrefour, and Target that they utilize for servicing their online channel customers?
2. What constraints, if any, would become evident across the supply chain when trying to fulfill orders to two separate channels, big-box, brick-and-mortar retailers and online-channel customers?
3. Would the application of Lean Six Sigma identify defects across the big-box retail supply chain and provide a methodology for removing the defects, thereby reducing costs and increasing service levels to big-box retail customers?
4. What supply chain best practices could be implemented to reduce costs and increase service levels to big-box retailers?

Research Objectives

The objectives of my research were as follows:

1. Document Dell's big-box order-fulfillment as-is process with a focus on supply chain and logistics processes.
2. Identify the factors (defects) that increased costs or decreased service levels that negatively impacted order fulfillment to big-box retail customers.
3. Evaluate the operational performance between Dell's vaunted and established online fulfillment channel with that of Dell's big-box order-fulfillment process and identify gaps in costs and service.

4. Apply the design, measure, analyze, improve, and control (DMAIC) methodology and supply chain best practices to design and implement a future big-box order-fulfillment model that reduced costs and complexity and that increased supply chain performance.
5. Convince Dell to implement the recommendations identified and outlined in a future ("to-be") order-fulfillment model specific to big-box retailers.

Definition of Terms

The following definitions from Vitasek (2006) and Chopra (2011) are provided to ensure that the reader can understand the flow of the paper and topics herein outlined and discussed. Each of the terms listed below was researched, assessed, measured, or considered during the completion of the comprehensive study project. Therefore, it is recommended that the reader refer to this section when necessary.

Cost-to-serve optimization has a scope across all functional areas in the supply chain and is intended to accurately assess the total profitability of an individual product being sold to a customer. Cost-to-serve models incorporate all activities necessary to complete customer deliveries and collect product revenues. It models how each major supply chain activity affects the complete end-to-end cost to serve a customer or total landed cost for a product. Stated differently, it is the determination of the total cost of servicing each individual customer at the SKU level and at the designated level of service (Chopra, 2011).

Less-than-truckload (LTL) refers to a shipment from suppliers to customers in trailers considered smaller than a full truckload. LTR transports can range from small cargo vans to 53-foot trailers carrying products from multiple shippers to multiple customers (Vitasek, 2006). Vitasek (2006) explained, "LTL shipping is focused on the movement of small quantities of

products to a customer. Manufacturers rely heavily on the use of LTL carriers to make deliveries to consumers, business and retail customers" (p. 85). A *truckload*, conversely, is

> the movement of products from suppliers and shippers to customers in trailers that can range from 48′ to 53′ in length. The goal of shipping products in truckload quantities is to reduce costs by putting more products in the trailer and thus reducing the total number of loads required to ship and deliver the products to the final customer. Manufacturers rely heavily on the use of truckload carriers to deliver products from suppliers as well as deliver products to their business and retail customers. (Vitasek, 2006, p. 150)

Lean, according to Kiemele, Murrow, and Pollock (2007), is the core idea "to maximize customer value while minimizing waste. A lean organization understands customer value and focuses its key processes to continuously increase it" (p. 12). The goal is to provide value to the customer through a value-creation process that has zero waste (Kiemele et al., 2007). Kiemele et al. identified the primary causes of waste within an organization not using lean practices as excess transportation, inventory, and waiting; unnecessary movement of people and products; and overprocessing. Lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers (Kiemele et al., 2007). Because of the focus on end-to-end process management, Lean has become embraced by leading corporations globally and is increasingly being used throughout a corporation's supply chain from sourcing to final delivery of products to customers (Kiemele et al., 2007). Lean and Six Sigma have increasingly been implemented together by corporations that want to increase their ability to reduce costs and complexity while increasing product quality and overall corporate performance. Therefore, the term *Lean Six Sigma* has

become interchangeable with *Lean* or *Six Sigma*. The term *Six Sigma* is trademarked by Motorola.

Six Sigma describes quantitatively how a process is performing and whether or not a process is capable of meeting the needs of customer, internal or external. To achieve Six Sigma, a process must not produce more than 3.4 defects per million opportunities; for example, if a company manufacturers 1 million cars, fewer than four cars would have any defects (Kiemele et al., 2007).

Vitasek (2006) defined *logistics* as follows:

> Logistics means planning, implementing, and controlling the efficient, effective forward and reverse flow and storage of goods, services, and related information between the manufacturer and the consumer. Logistics management activities typically include overseeing inbound and outbound transportation, warehousing, materials handling, order fulfillment, logistics network design, inventory, supply/demand planning, and third-party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution—strategic, operational, and tactical. Logistics management is an integrating function that coordinates and optimizes all logistics activities as well as integrates logistics activities with other functions, including marketing, sales manufacturing, finance, and information technology. (p. 88)

Multichannel distribution is the chain of businesses or intermediaries through which a good or service passes until it reaches the end consumer. A distribution channel can include wholesalers, retailers, distributors, and even online sales and purchasing (Chopra, 2011).

Parcels are "individual packages shipped to customers and more often than not delivered by UPS, FedEx, or DHL. The leading parcel carriers manage billions of shipments annually" (Vitasek, 2006, p. 106).

Supply chain management was defined by Vitasek (2006) as follows:

> Supply chain management encompasses the planning and administration of all activities involved in sourcing, procurement, and conversion and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, or customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply chain management has a primary responsibility to link major business functions and processes within and across companies into a cohesive and high-performing model. It also includes manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance, and information technology department. (p. 139)

Supply chain network optimization "focuses on creating the optimal supply chain network design at the lowest cost given a set of constraints. Network optimization is typically divided into three segments: sourcing, manufacturing, and distribution optimization" (Vitasek, 2006, p. 139). Practical applications for network optimization include

- manufacturing site selection, capacity utilization, and product allocation;
- distribution-center site selection and identifying the number and size of required distribution centers;
- customer-service territory assignments to distribution centers and plants;

- sourcing strategy development to optimize total landed cost;
- merger-and-acquisition network synergies development (for example, identifying the optimal supply chain for a portfolio of companies owned by a private equity firm);
- global network expansion to new markets; and
- strategic master planning for manufacturing and inventory optimization.

Theoretical Framework

After understanding the terminology, it is also necessary to look at the theories that formed the foundation of this study. Various researchers condemned the gap between available theories of supply chain management (Halldorsson, Kotzab, & Skjott-Larsen, 2003; Ketchen & Hult, 2006; Lavassani, Movahedi, & Kumar, 2009). Halldorsson et al. (2003), Ketchen and Hult (2006) and Lavassani et al. (2009) attempted to provide a theoretical framework in conceptualizing the elements of supply chain management using the theories of organization. Among the theories that are applicable in analyzing supply chain management was the resource-based view.

The resource-based view proposes that the disparity in competitive markets is a result of the variation of resources and capabilities among firms (Roudini & Hassan, 2012). The resources and capabilities of the business firms are assets that provide the potential for competitive advantage. For example, a supply chain could be considered an asset. However, in the global business environment, the capabilities and resources of every organization are insufficient in gaining competitive advantage and in creating value to the organization (Roudini & Hassan, 2012). The valuable assets every organization has may need to be recognized and developed by management to gain competitive advantage and future value creation (Sirmon, Hitt, & Ireland 2007). For instance, Apple leadership recognized in 2000 that they had a talent

and design advantage over their competitors but not a competitive cost advantage due to their supply chain (Simchi-Levi, 2010). Apple invested hundreds of millions of dollars in training for their designers and programmers as well as their supply chain. The investments led Apple to becoming the top-ranked high-tech manufacturer and also the top-ranked supply chain, all within 10 years (Chopra, 2011).

Value creation happens as firms surpass their competitors' ability to respond to the needs of their clients while subsequently achieving financial performance (Morrow, Sirmon, Hitt, & Holcomb, 2007). The ability of a firm to surpass the competition is the result of superior market awareness, product development, quality, and (most importantly) an efficient and cost-effective supply chain (Chopra, 2011). Simchi-Levi (2010) stated that the resource-based view was crucial in understanding supply chain management due to the importance of identifying the assets most critical to gaining competitive advantage: products, innovation, tax and financial acumen, and process execution. In turn, Simchi-Levi (2010) stated that as a whole, corporations that have supply chains capable of executing at a higher level than that of their competitors, as well as having superior products, operate from a significant advantage point. The competition cannot compete on price or quality—the attributes most important to consumers.

Roudini and Hassan (2012) stated that management capabilities within the resource-based theory weighs more heavily than the actual assets, because a manager must have the actual skills needed to acquire, recognize, or develop the assets. In other words, great products and great companies happen as a result of skilled leaders with the vision to identify a market and hire management capable of turning the vision into a reality.

Lu, Zhou, Bruton, and Li (2009) stated that the resource-based view gives a business the competitive advantage by creating value through unique products and services to clients. Lu et

al. remarked that the resource-based view reveals that capabilities generate the main source of unique and sustainable competitive advantages of the firm, because such skills can generate superior services and products for the clients. If business managers have the ability to attain, absorb, organize, and incorporate resources from outside organizations, external networks, and trusted business partners, they can transform products into superior performers (Lu et al., 2009).

The views of Lu et al. (2009) were similar to those of Roudini and Hassan (2012) by stressing the importance of transforming products or assets into superior performers through superior business models and management. Lu et al., however, placed more emphasis on the importance of supply chain execution and the necessity of assigning skilled management in supply chain roles with the required insight to develop and grow supply-chain-specific assets.

Grant (2001) noted that resource-based theory treats knowledge as a general resource but does not elaborate on the specific characteristics of how knowledge and learning may result in a competitive advantage. Zhang, Tansuhaj, and McCullough (2009) concluded that the resource-based view may be the most sufficient theory in the body of literature that can explain how capabilities are developed and leveraged, because evolutionary economics expound on organizational capabilities. Zhang et al. noticed from previous authors that the resource-based view can detect specific knowledge and capabilities that can be valuable, unique, and hard to duplicate. The ability to recognize, develop, and leverage difficult-to-duplicate assets is a primary requirement for achieving a competitive advantage in business. Chopra (2011) reinforced this point by stating that companies with poor products and low market share will not benefit from a superior supply chain; however, a company that can leverage superior assets and a difficult-to-duplicate supply chain will create a significant competitive advantage.

Review of Supply Chain and Lean Six Sigma Literature

The review of available literature regarding supply chain management in retail and manufacturing firms is crucial in determining the available empirical gap. Online research databases, scholarly books, journal articles, consulting research reports, and supply chain analysts' research documents were useful in gathering the germane information regarding supply chain management, leading-edge retail and manufacturing best practices, best practices in retail logistics, and process-improvement techniques such as Lean Six Sigma. The review of literature on supply chain management and Lean Six Sigma in a retail environment was critical to the study of Dell in order to ensure relevance. The topic of supply chain management is very broad, as is the topic of Lean Six Sigma. However, retailers have specific supply chain requirements that are unique to their industry and should avoid embracing non-retail-specific solutions or techniques from the literature that may add complexity and cost (Chopra, 2011). For example, an article on supply chain management for a chemical company will not be relevant to a retailer such as Dell due to the differences in products and industries. In addition to the importance of supply chain management, Lean Six Sigma plays a crucial role at Dell and has received significant investments from the corporation, hence the importance of researching the topic of Lean Six Sigma as diligently as the topic of supply chain management. In addition, since the purpose of the comprehensive study project was to identify issues and solutions within Dell's retail supply chain, the solutions recommended to correct the issues identified must be backed by proven research in order to justify the recommended methodologies related to the supply chain and Lean Six Sigma.

Supply Chain Management

Supply chain management is a network of facilities that source raw materials for the purpose of manufacturing products that can be distributed via multiple channels to customers for purchase (Lee & Billington, 1992). The objective of supply chain management is to optimize performance by adding as much value and the least cost possible in meeting customer demand (Lee & Billington, 1992). Of all the activities required for operating a successful business, especially for manufacturers and retailers, supply chain management is the most critical (Lee & Billington, 1992). It is of vital importance to understand that supply chain requirements differ by industry and corporate requirements. Lee and Billington (1992) stated that effective supply chain management can only be achieved if corporations understand the needs of their customers, design and implement processes capable of performing all tasks required for providing products and services to customers, and design and implement a supply chain and logistics network capable of effectively manufacturing and transporting products to customers.

Chopra (2011) stressed the necessity of viewing the supply chain from the eyes of the customer and creating a supply chain capability using reverse planning, a technique Chopra called shelf-backwards supply chain management. Chopra, along with Lee and Billington (1992), stated that effective supply chain management can only be achieved when focus is placed on the most critical aspects of the supply chain most focused on providing actual products and services to customers. Among the critical aspects identified are the following:

1. Answer these questions: Who is the customer? Is it a business, an individual consumer, or a retailer requiring high-volume shipments on a daily, weekly, or monthly basis?

2. What does the customer require in order to be satisfied that all needs have been understood and met?
3. Are all processes in manufacturing and logistics capable of processing and delivering products damage free and according to customer-service requirements?
4. Are the correct metrics in place to measure logistics performance?

Chopra (2011) stated that even with large sources of data and literature available regarding best practices in supply chain and logistics management, many corporations fail to understand the critical aspects outlined above. Chopra continued that a failure to understand such basic facts as who is the customer and what the customer needs is rampant among corporations, leading to severe issues across corporate supply chains. Chopra, along with Lee and Billington (1992), stressed that corporations must take a holistic view of their supply chains to identify the processes, policies, and procedures required to meet customer demand versus placing too much focus on one aspect of supply chain management, such as velocity. Figure 1 demonstrates the parts of a supply chain.

Shukla, Garg, and Agarwal (2011) identified that a focus on only one aspect of supply chain management, in this case velocity (manufacturing and shipping products as fast as possible), without a process for preventing product damage or measuring customer satisfaction, is a recipe for increased costs and complexity within the supply chain and a decrease in customer experience. Shukla et al. provided examples of corporations that viewed velocity as the only metric necessary for evaluating their performance. In every instance, velocity-focused corporations had faster order-to-cash cycles but also higher levels of refused customer orders as a result of damaged products, higher remanufacturing costs for having to remanufacture orders for

customers, and much higher transportation costs as remanufactured orders had to be expedited to customers (Shukla et al., 2011).

Figure 1. Graphic overview of a supply chain.

Supply chain performance must be measured from sourcing to final delivery, and velocity can only be effective if all processes and areas within the corporation are capable of operating at the same speed to eliminate bottlenecks (Kiemele et al., 2007). Most importantly, a quality process such as Lean Six Sigma must be utilized to eliminate variance across all supply chain processes and to design and implement processes that can eliminate refused orders due to product damage and create an operating model whereby orders are manufactured, packaged, and transported according to customer needs on a consistent basis (Kiemele et al., 2007).

Harland (1996) was among the scholars who defined supply chain management within the field of business development by asserting that supply chain management was a business process participated in by suppliers, manufacturers, retailers, and customers as if linked by a

chain. Supply chain management and logistics focus on the products and services that the business organizations provide to their end customers and thus require more than just a general understanding of the interactions and processes involved in successfully managing the supply chain (Harland, 1996). Harland stressed that corporations should view the supply chain not as merely the process for delivering products and services to meet customer demand but instead as an opportunity for gaining market share and achieving a competitive advantage. Harland predicted that corporations of the future would compete not just at the store level but also at the shelf level; what would matter is which corporation could deliver its products to the shelf better, faster, cheaper, and more consistently.

Halldorsson, Kotzab, Mikkola, and Skjott-Larsen (2007) articulated common elements that exist within supply chains and thus require extensive research and understanding of how to manage each link in the supply chain. The elements identified were the process of designing, planning, forecasting, manufacturing, distributing, transportation, controlling, and monitoring all of the supply chain activities to ensure effective logistical support of transactions within supplier–consumer relationships, which can create business value and competitive advantage. Halldorsson et al. (2007) further refined the recognized elements within the supply chain to six core indicators of supply chain performance: (a) facilities (manufacturing plants, distribution centers, warehouses, cold chain centers, etc.), (b) inventory, (c) transportation, (d) data management and mining, (e) pricing, and (f) procurement.

Kumar (2012) explored the increasing emphasis business professionals place on understanding and effectively managing supply chains. Kumar defined these practices as a series of activities within organizations that effectively and efficiently promote the smooth operation of the supply chains. These activities include (a) increasing visibility and understanding of how

supply chains can create a competitive advantage up and down the chain of command, (b) investing in software and analytical tools capable of performing sophisticated analysis of supply chain costs and performance, (c) targeting the demands of customers to ensure the supply chain is capable of providing the desired goods and services, (d) evaluating logistics processes required for preparing and transporting products to customers, (e) recognizing the importance of standardized processes across the supply chain and implementing Lean Six Sigma, (f) creating metrics dashboards that measure and display costs and performance data, and (g) increasing the level of skills and education required in order to work in a supply chain role (Kumar, 2012). Various researchers, such as Simchi-Levi (2007) and Chopra (2011), and supply chain analysis firms, such as Gartner (Hofman & Aronow, 2012) and Kennedy Consulting (Simon, 2012), provided additional research and insight that expanded upon the list provided by Kumar, adding customer segmentation; effective and efficient transit of products; integration and collaboration of business ideas and innovation between suppliers, retailers, manufacturers, and customers; and the employment of supply chain and logistics specialists and engineers to improve the performance of logistics and the supply chain.

Importance of Organizational Infrastructure

Engineered organizational infrastructure produces real costs and benefits to an organization (Hrebiniak, 2005). There are ways to structure an organization to increase efficiency by standardizing processes through such methodologies as Lean Six Sigma and business process reengineering (Hrebiniak, 2005). Corporations that invest in the use of a process methodology such as Lean Six Sigma instill a quality philosophy that eliminates duplication of resources and efforts, reduces costs and complexity, and increases the ability of the corporation to operate at a higher level of efficiency (Hrebiniak, 2005). Hrebinak (2005)

stated that the need for Lean Six Sigma and a focus on quality and process speed have escalated with the growth of technology and the ability of consumers to have access to information any day and any time.

The increase in access to information has raised awareness among consumers related to quality and performance and has impacted consumer behavior (Kiemele et al., 2007). Kiemele et al. (2007) stated that customers are no longer willing to pay for the cost that is automatically built into products and services due to structures and processes that do not support how they want to do business. Kiemele et al. observed that consumers are becoming savvy in understanding what does and does not add value to their shopping and purchasing requirements, forcing corporations to eliminate the waste in their processes that adds cost to consumers.

Both efficiency and effectiveness can be achieved through the use of Lean Six Sigma, as long as corporations are capable and willing to view the use of Lean Six Sigma from a cost and strategic point of view (Hrebiniak, 2005). Costs are incurred when implementing a Lean Six Sigma program, which often dissuades corporations from pursing the program. Kiemele et al. (2007) reinforced that corporations should take a long-term view of what can be achieved through the use of Lean Six Sigma and the importance of putting focus on strategy. The strategic drivers of organizational infrastructure encompass strategy, the need for efficiency and effectiveness, market and technological changes, organizational size and anticipated growth, developed and emerging market strategies, and the operational and supply chain requirements for providing customers with products and services (Hrebiniak, 2005).

Kiemele et al. (2007) stressed the importance of creating an organization that can best execute all of the tasks required to provide customers with products and service at the lowest costs and at the highest velocity. According to Kiemele et al., corporations often place their

focus on velocity as it relates to manufacturing and shipping products, without taking into account the importance of creating an organization that can operate across all areas of the corporation at the same pace. Velocity in one area of a corporation will invariably cause bottlenecks and increased complexity in other areas within the corporation, hence the need for balancing velocity. Kiemele et al. used the example of a manufacturing company that can manufacture products for all customer orders on a daily basis, without realizing that the focus on velocity within the four walls of the plants is causing shortcuts to occur at the dock level, as the shipping department cannot keep up with the volume of orders. To keep pace, the shipping department implements a "load and go" process, whereby trailers are loaded as quickly as possible with no concern for preventing damage to products. Although all orders are shipped, a large number of orders are refused by customers due to damage caused during the loading and transportation process. In order to rectify the matter, the manufacturer expedites a replacement order for the customer and agrees to pay for the expedited shipping. This example of the manufacturer clearly demonstrated that even if a corporation achieves a high level of velocity in one area of operations, a focus solely on velocity can skew the true picture of how well a corporation is operating (Kiemele et al., 2007).

Customer Focus

At the core of quality is the customer; therefore, an essential element to quality is meeting the customer's expectations (Hofman & Aronow, 2012). Organizations that are customercentric and understand how the customer interacts in the marketplace can have a sustainable competitive advantage. Furthermore, organizations that invest in the resources to secure and analyze customer-driven data can predict and anticipate customer expectations to a much greater extent than companies that do not invest in analytics (Hugos, 2011). Analytics focused on customer

data and changing consumer trends help organizations to provide their customers an improved customer experience by further personalizing their products and or services and by making interactions simple yet meaningful (Hofman & Aronow, 2012).

Supply chain management is also important for achieving a positive experience for customers, as customers are becoming more demanding in terms of their service requirements and are less apt to be a repeat customer for firms that fail to meet their needs for service (Hugos, 2011). Just as focus should be placed on providing products customers want, corporations must place equal focus on ensuring that their supply chains operate efficiently enough to deliver products to customers exactly as they desire (Christopher, 2011). The need for meeting customer expectations is often expressed in the following manner (Vitasek, 2006): the right product to the right customer at the right time, at the right place, in the right condition, in the right quantity, and at the right cost.

Retailers are sustained by the ability of manufacturers to provide them with the products they need to meet customer demand (Deloitte, 2012). Unless retailers can receive product in shelf-ready condition, they run the risk of not only losing sales but also alienating customers who may never return. Therefore, supply chain management and error-free logistics are of paramount importance to retailers (Deloitte, 2012). To help manufacturers provide better service to retailers, many retailers have implemented a methodology known as *the perfect order* that is focused on the following (Marien, as cited in Blanchard, 2006): the right product in the right quantity, from the right source to the right destination, in the right condition, at the right time, with the right documentation, and for the right cost. Blanchard (2006) reported that the perfect order methodology is an effective strategy for retailers, but that many manufacturers fail to

accurately follow the requirements for perfectly fulfilling orders to retailers, thus negatively impacting retail sales and customer experience.

Supplier Quality Management

The supply chain of an organization is of significant importance, as are the quality of the suppliers and how quality is managed. According to Mettler and Rohner (2009), supplier quality management is an all-inclusive method to effectively and efficiently handle an organization's relationship with its suppliers. As a result, supplier quality management seeks quality-related improvements concerning the flow of information, products, services, and workforce capabilities (Mettler & Rohner, 2009). A lack of discipline in supplier quality management can be devastating to an organization's bottom line and thus requires that corporations place the required focus on their supplier strategy (Hugos, 2011). Hugos (2011) stated that established methodologies such as supplier relationship management and supplier performance management become part of a corporation's standard operating processes in order to ensure the proper measurement and oversight of suppliers as well as to reduce the risk that suppliers will fail to meet the needs of the corporation. Supplier quality management attempts to do the following (Hugos, 2011):

- Establish positive, productive working relationships with suppliers to increase product quality, customer service, and reduced costs.
- Create a common frame of reference to enable effective communication between an enterprise and suppliers who may use different business practices, terminology, and technology and that may lack a defined quality process.
- Increase the efficiency of the processes associated with acquiring goods and services, managing inventory, and processing materials.

Linking Quality to Business Strategy

Effective strategy execution is complex. It requires solutions leadership and the intricate and dynamic interplay of people, resources, and market forces (Allio, 2005). Organizations must work diligently to ensure that all members of the organization understand how they contribute to the overarching goal of achieving quality (Deloitte, 2012). In an effort to articulate strategy implementation, leaders must speak the same language as everyone else. This is critical in terms of measuring progress toward the broader set of actions undertaken to attain successful implementation of total quality management (TQM) and Six Sigma principles (Allio, 2005).

Moreover, it is imperative to employ a balanced approach inclusive of metrics toward effective implementation to determine whether quality is effectively being managed and disseminated (Deloitte, 2012). Most importantly, leadership must find ways to focus on short-term goals as well as continue to position the organization to attain long-term quality goals as part of an overall strategic planning process (Deloitte, 2012). Spencer and Kneebone (2007) stated that quality is not a program within a corporation; rather, quality is a mindset that must be reinforced at all levels of the corporation. Spencer and Kneebone recommended that corporations link quality to strategy and measure quality as rigorously as most corporations measure their financial performance to achieve a successful strategic-quality culture. Unless a corporation can effectively measure quality across products and performance, especially performance across the supply chain, corporations cannot declare that they have embraced a quality-first mindset (Deloitte, 2012).

Incorporating Quality Tools and Techniques

According to the research of Halldorsson et al. (2007), the tools and methodology associated with Lean Six Sigma are essential to a successful deployment of a quality program

and the production of quality products. Halldorsson et al. (2007) stated that at a minimum, all members of a firm must be required to complete a high-level overview of the most frequently used quality tools; learn how to use the quality tools in use; and understand the purpose, focus, and deliverables from each phase of a project. Empowering employees with some basic knowledge of what the organization is about to embark upon will set the stage for the effective implementation of a Lean Six Sigma quality program.

Lean Six Sigma: An Approach for Reducing Cost and Complexity

The conceptualization of Six Sigma as a business management strategy has been documented since 1986 by a multitude of authors and researchers. Bill Smith, an engineer at Motorola, is credited as being the father of Six Sigma and the first to recognize the complementary aspects of Lean and Six Sigma (Sehwail & DeYong, 2003). The love of Lean Six Sigma was passed on to Bill Smith's stepdaughter, Marjorie Hook, who worked with her stepfather until his death. I was trained and certified as a Lean Six Sigma Master Black Belt by Ms. Hook in 2006. Figure 2 demonstrates the type of wastes Lean Six Sigma targets and eliminates.

Jack Welch, a business executive and former chief executive officer of General Electric, was the first chief executive of a major corporation to embrace Lean Six Sigma (Sehwail & DeYoung, 2003). Mr. Welch was the most vocal proponent of incorporating Lean Six Sigma across all areas of a corporation by using Lean visual aids to display steps in completing job tasks, linking Lean Six Sigma to overall corporate strategy planning and execution, and visually displaying the results of how successful Lean Six Sigma is being utilized. General Electric claimed that Lean Six Sigma saved the company in excess of $4 billion over a 10-year period (Sehwail & DeYong, 2003). Lean Six Sigma is in use by nearly three quarters of the

corporations listed on the Fortune 500 and more than half of all companies operating globally (Capgemini Consulting, 2012).

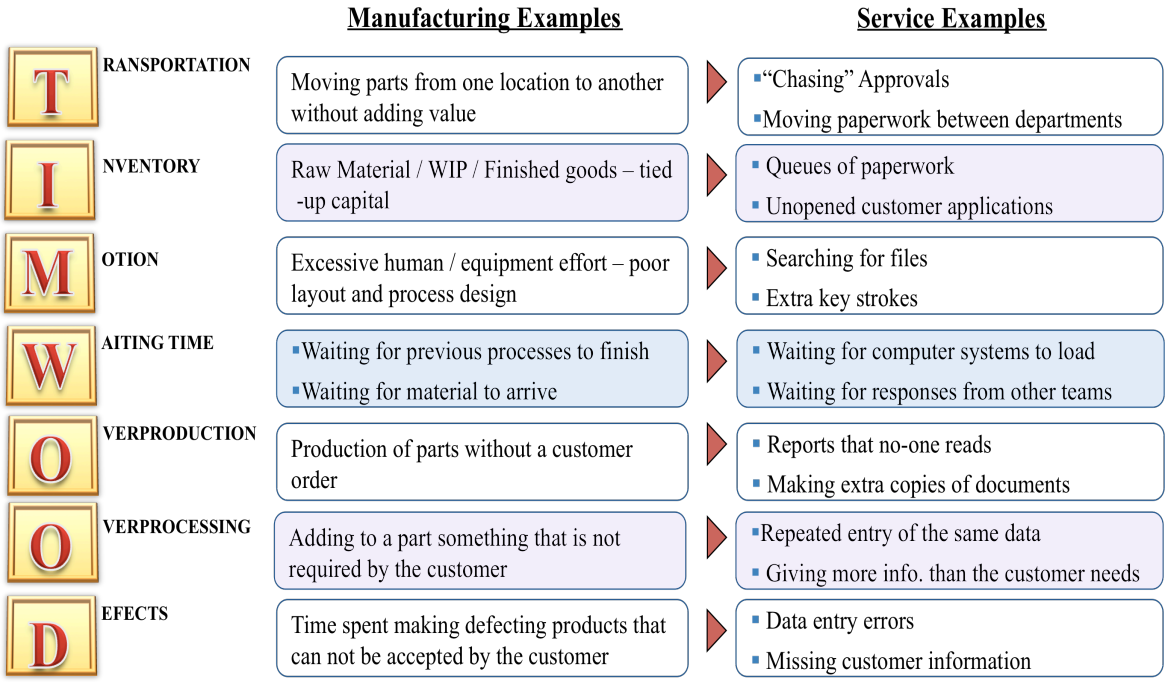

Figure 2. Lean graphic listing the wastes Lean is focused on reducing and eliminating.

As a management method for ensuring delivery of process, Lean Six Sigma incorporates the use of statistics in the analysis of process errors and the identification of all waste within a process (Groeber, 2012). Lean Six Sigma principles follow sequential steps that target the reduction of costs and increase in profits as well as identifying opportunities for increasing collaboration (Groeber, 2012). Due to the highly technical analysis components within Lean Six Sigma, companies that use Lean Six Sigma often utilize software that is designed to perform the required mathematical and statistical calculations (Kiemele et al., 2007). Groeber (2012) stated that corporations often create a department staffed primarily by statisticians and engineers who are experts in analyzing Lean Six Sigma data and identifying trends.

The success of Lean Six Sigma in manufacturing and process industries has been the leading reason for other industries to emulate the principles and practices of Lean Six Sigma.

Lean Six Sigma as an analytical tool can define both facilitating and hindering factors that shape customer satisfaction and prevent corporations from achieving their financial and operational goals (Sehwail & DeYong, 2003). Figure 3 shows the complementary approaches in Lean Six Sigma.

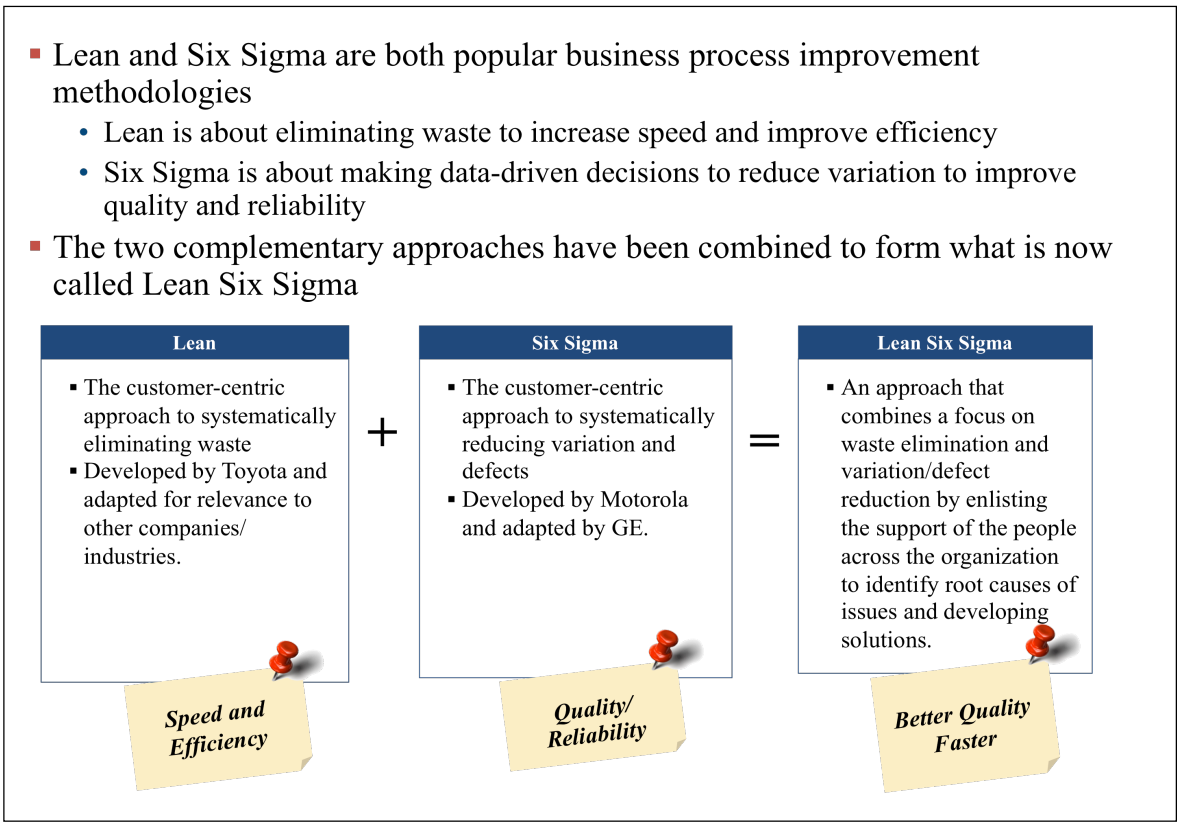

Figure 3. Lean Six Sigma graphic.

The principles of Lean Six Sigma can be utilized in any industry. For example, health care firms adopted Six Sigma in 1998 after evaluating the impact of Lean Six Sigma on cost reduction and performance improvements in traditional manufacturing companies (Sehwail & DeYong, 2003). One of the renowned health care companies that implemented Lean Six Sigma was Commonwealth Health Corporation. The company reported substantial accomplishments with the implementation of Lean Six Sigma, such as improving patient processing and discharge,

reducing medical errors, reducing costs and complexity across their supply chain, improving job performance through the use of visual aids, capturing and measuring metrics, and displaying actual performance measures for all to see (Sehwail & DeYong, 2003).

Due to the applicability of Lean Six Sigma to nearly any industry, corporations that are experiencing issues with cost, quality, or service find that implementing Lean Six Sigma is often the fastest, most sustainable method for correcting their issues, increasing customer service, and optimizing their supply chains (Kiemele et al., 2007). Leading consulting firms such as McKinsey, Deloitte, Bain & Company, and Booze Allen have reported that the Lean Six Sigma methodology provides the foundation upon which they evaluate a company's performance: organizational design, product quality, supply chain management, logistics, innovation, finance, market share, and customer satisfaction (Palagyi, Hamelynch, & Mehta, 2003). The use of Lean Six Sigma provides proven tools and techniques to evaluate, measure, and improve areas within a company that are inefficient or have poor outcomes, such as costs or products not being delivered on time or being delivered damaged (Palagyi et al., 2003). Moreover, Palagyi et al. (2003) stated that consulting firms have identified that personnel certified in Lean Six Sigma have a greater capability for identifying problems and resolving issues than consulting resources or corporate personnel that have not been trained in Lean Six Sigma. This fact has led consulting firms to institute mandatory Lean Six Sigma training for their consultants and clients (Palagyi et al., 2003). The research from Palagyi et al. identified that manufacturers and retailers, including the suppliers of each, achieved the most immediate benefit from implementing Lean Six Sigma, as manufacturers and retailers traditionally have higher levels of cost and complexity within their organizations.

Mainstreaming of Lean Six Sigma

Dr. William Edwards Deming and Joseph Juran, two highly respected quality pioneers, advocated the principles and importance of quality and process optimization, leading them to coin the term TQM, the precursor to Lean Six Sigma (Lemak, Mero, & Reed, 2002). Their belief in the importance of quality and process optimization was based upon three basic concepts: (a) focus on the external and internal customer, (b) collective effort by all members of the organization to create a competitive advantage through leading products and services, and (c) a central focus on process reinforced by continuous improvement and learning (Drake, Sutterfield, & Ngassam, 2008). The central focus of TQM involves recognizing and solving business issues while training all members of the organization to focus on enhancing quality and was proven successful when Deming and Juran led efforts to rebuild Japan's manufacturing capabilities after World War II (Drake et al., 2008). The results of TQM in Japanese manufacturing companies proved that the principles of quality and process optimization could indeed provide corporations with a competitive advantage, as long as executive leadership ensured their employees placed a focus on quality throughout the process of providing goods and services to customers (Drake et al., 2008).

TQM was the precursor to many other movements, including just-in-time and material-requirements planning; however, the aforementioned methods were not holistic in their approach and failed to achieve the desired goals of reducing costs and increasing performance as completely as hoped (Drake et al., 2008). In addition, TQM, although proven, was identified as having flaws by Bill Smith of Motorola, who was able to generate greater levels of savings and improvements across Motorola's manufacturing through the use of a methodology he called

Lean Six Sigma (Drake et al., 2008). Lean Six Sigma is best expressed through the seven wastes and the DMAIC model for problem identification and solving (see Figure 4).

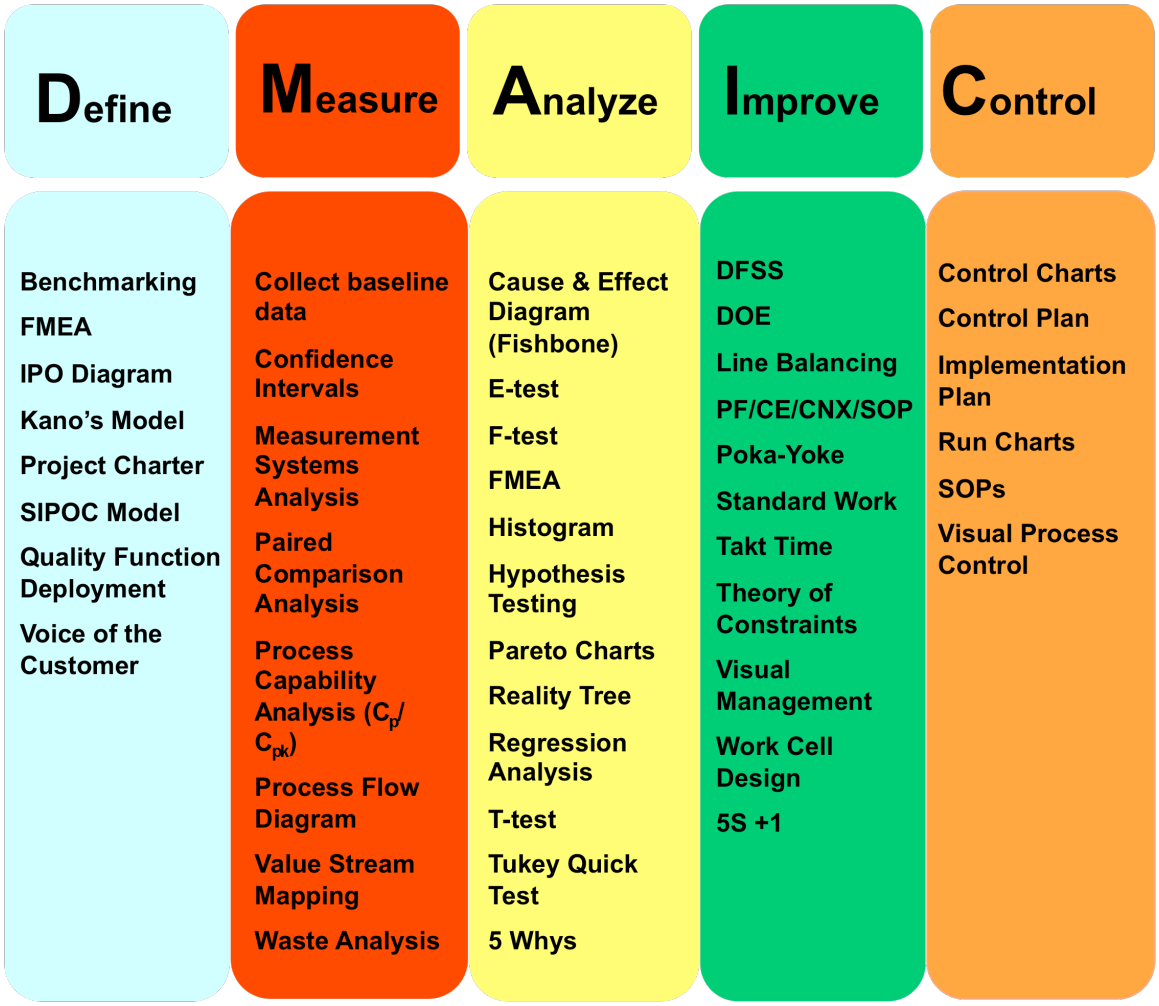

Figure 4. Overview of the define, measure, analyze, improve, and control (DMAIC) methodology and tools. FMEA = failure modes and effects analysis; SIPOC = suppliers, processes, outputs, and customers diagram; DFSS = design for Six Sigma; DOE = design of experiments; PF = process flow diagrams; CE = cause and effect diagrams; CNX = constant, noise, experimental (i.e., controllable causes, noise too difficult or expensive to control, and experimental factors); SOP = standard operating procedures; 5S = sort, straighten, shine, standardize, and sustain.

According to Motwani (2001), the implementation of TQM and Lean Six Sigma is a substantial change that mandates a major commitment to transforming the organization in the following key areas: culture, process, and strategic objectives. As with any major paradigm

shift, the organization's leadership must ensure that key, critical success factors are in place to support and encourage the transformation. When leadership is absent, or when corporations fail to place emphasis on measuring and monitoring performance across all processes required to meet customer demand within their culture, the strategic objectives of the company are not aligned with the actual ability of their company to execute the stated objectives, thus leading to a failure to meet the needs of customers. Motwani stressed that as Lean Six Sigma success stories became more prevalent in the media, corporations became more aware of the importance of quality across processes versus quality in the traditional sense of product quality. This realization helped usher in the mainstreaming of Lean Six Sigma in the United States and internationally.

Interestingly, although the term *Lean Six Sigma* had supplanted the term TQM in most literature by 2000, some locales continued to refer to all quality programs as TQM, especially in India. Kakkar and Narag (2007) conducted research to develop an implementation model for TQM for Indian organizations. Kakkar and Narag, although trained in Lean Six Sigma, referred to their model as TQM, even though Lean Six Sigma formed the foundation of their principles. The sample used for their research consisted of MBA students from an array of organizations that included manufacturing, service, and governmental agencies. A questionnaire was utilized to collect the data, and a response rate of 84% was achieved. The significant contribution from this research was the identification of the four pillars of focus, which represent the foundation of a successful quality deployment: (a) process and efficiency, (b) customer-focused performance, (c) people management and team building, and (d) business-partner development (Kakkar & Narag, 2007).

The first pillar, process and efficiency, represents cost and waste reduction, resource allocation, and safety (Kakkar & Narag, 2007). Collectively the elements have a substantial effect on the sustainability of the organization. Overall, continuous improvement of critical processes is dependent upon a relentless focus on value-added activities and process efficiency across the organization.

The second pillar, customer-focused performance, is attained through developing quality products, serving customers with quality processes, and meeting the customer's demand for a competitive price (Kakkar & Narag, 2007). The result of successful execution of customer-focused performance is the acquisition of new customers, increased market share, and a marked improvement in business results.

The third pillar, people management, involves winning the hearts and minds of those needed to successfully implement improvement to quality and operations (Kakkar & Narag, 2007). Commitment, communication, and engagement are essential to leading organizational members through successful deployment of quality programs (Kakkar & Narag, 2007). People management also involves training, which is essential in ensuring that the quality principles introduced to the organization are sustained throughout deployment. Sustainability is achieved through using visual aids outlining how employees need to conduct each aspect of their job; training employees on the language of quality, TQM, and Lean Six Sigma; training employees on how to use quality tools; and measuring performance of all processes, especially the processes directly responsible for providing products and services to customers (Kakkar & Narag, 2007).

The fourth and final pillar, team building and business-partner development, encompasses a cohesive approach to problem solving (Kakkar & Narag, 2007). This approach is initiated by executive-level leadership and involves an array of personnel assigned to process-

improvement teams cross functionally across the organization. Process-improvement teams play a major role in engaging employees and business partners in the deployment process of quality programs as well as leading initiatives to solve problems. Additionally, business-partner development is vital to a holistic approach to quality, as most corporations are dependent upon business partners outside of their organizations to provide products and services vital to the corporation. Unless efforts are made to develop business partners, issues specific to business partners will continue; thus, training business partners to understand and use quality methodologies such as Lean Six Sigma is vital (Kakkar & Narag, 2007). Open communication between the organization and business partners during deployment is a requirement for sustainability and increases collaboration.

The research conducted by Kakkar and Narag (2007) identified areas of focus for a successful quality implementation. However, due to the small sample size, it is important to note that generalization of the study's findings should be done with care. Furthermore, the study focused only on Indian organizations. A more significant contribution to the body of knowledge lies with the application of the four pillars across countries and industries, which was conducted in a joint research project by Jauhar, Tillasi, and Choudhary (2012) with firms in Europe, Asia, and the United States. Results of the study affirmed that quality-improvement programs can successfully be implemented across geographies and achieve the desired improvements in cost, quality, and performance.

In today's global market, organizations must be in a position to take action in response to the changing needs of the customer. At the core of an organization's competitive advantage is its ability to keep the pace of change (Chopra, 2011). It is clear that an organization can outperform its competitors only if it can create and sustain a competitive advantage. Lean Six Sigma

principles can give an organization the ability to create competitive advantages based on customer needs, ease of access, and improved products and services (Cesnovar, 2006). The central focus is on strategic positioning, which includes the forecasting of customer needs and wants and creation of sustaining vital success factors such as processes and a supply chain capable of meeting customer demands (Cesnovar, 2006). As a result, there is significant evidence in the literature that critical factors should be considered when implementing a customer-focused strategy such as Lean Six Sigma.

Cesnovar (2006) noted significant benefits for an organization that successfully implements a proven strategy such as Lean Six Sigma: (a) the unified effort toward organizational goals and priorities; (b) clear strategic direction; (c) consistent framework for decision-making; and (d) an intensified focus on the external environment and development of a methodical, problem-solving approach. Cesnovar further cited that the foremost reason for ensuring that the critical success factors are in place before deploying Lean Six Sigma as a strategy is to make certain the organization masters the complexity of the global business environment in a disciplined, systematic way. This is especially critical for organizations that manufacture and ship products via multiple channels to their customers, such as online and physical retailers, due to the increased level of complexity and costs serving customers via multiple channels. Cudney and Kestle (2008) stated that Lean Six Sigma is the ideal methodology for conquering cost and complexity within the supply chain and for resolving issues centered around the physical movement of products via tractor-trailers, such as an inability to meet service-level requirements, excessive damage to products during loading or transportation of products, and failure to meet routing-guide requirements of retailers.

Hahn and Powers (2010) analyzed how the relationship between Lean Six Sigma and implementation capability affected organizational performance. The implications of their study were clear. Hahn and Powers noted that a high-quality strategic plan involving the principles of Lean Six Sigma that is soundly executed is directly related to high organizational performance. The study further indicated that cost leaders have perfected this strategy and place continual importance on maintaining a reserve of extremely well-trained and experienced associates who receive advanced-quality focused training, education, and institutional learning (Hahn & Powers, 2010). Hawn and Powers's study was a pivotal initial endeavor to examine the correlation between quality management principles and implementation capability and their impact on organizational performance. The research outcomes indicated a noteworthy performance advantage connected with quality management principles and implementation capability (Hahn & Powers, 2010). Organizations that reported both high use of quality management principles and high implementation capability produced statistically higher return on assets in comparison to organizations that reported low use of quality management principles and low implementation capability (Hahn & Power, 2010).

The foundation for an organization's successful deployment of TQM and Six Sigma principles begins with leadership understanding and supporting a data-driven approach to achieving results (Kolar, 2007). Most leaders utilize data, but rarely do they lead decision making with data (Kolar, 2007). According to Kolar (2007), leaders can create value in the decision-making process at four levels by using data: (a) collection, (b) summarization, (c) analysis, and (d) synthesis. Data collection generates value by answering basic questions about the business; the leader's role is to leverage his or her intuition and experience to make certain that the appropriate data are collected (Kolar, 2007). Summarization illustrates what is

happening now and isolates what facts warrant further investigation (Kolar, 2007). Analysis creates meaning and is the bridge from what is happening to why it is happening (Kolar, 2007). Synthesis is the level at which strategic direction is vital and meaning and application are critical (Kolar, 2007). This philosophy of leading with data is a key precursor to employing quality management principles successfully.

Furthermore, the transition toward data-driven leadership would enable an organization to effectively implement Lean Six Sigma principles. Data-driven leadership is a core requirement for strategy formulation, execution, innovation, and any change initiative; hence, this requirement is not satisfied with just any leader. Surie and Hazy (2006) offered new insights into the type of leadership that enables execution of Lean Six Sigma principles within an organization. Surie and Hazy defined this type of leader as a generative leader or a solution-focused leader, one who fosters execution, innovation, organizational adaptation, and high performance over time. Surie and Hazy further stated that a critical element of this type of leadership is the ability to seek out, foster, and sustain relationships that yield new learning relevant for strategy execution, innovation, and change. The authors concluded that this type of leader has an understanding of the environment and an ability to structure situations and manage strategy and interactions.

Surie and Hazy (2006) indicated that the following elements are required to foster successful implementation of Lean Six Sigma principles, innovation, and readiness for change: (a) a diversity of experience, expertise, and affect to allow pooling of relevant knowledge from various sources; (b) repeated practice or cognitive search; (c) champions who insulate the group from everyday pressures and provide resources to permit sustained and focused activity on specific projects; (d) a challenge on which organizational survival depends; and (e) exploitation

of innovations through rapid market testing to gain feedback, make modifications, and determine whether to continue pursuing specific innovation trajectories. The research by Surie and Hazy also stressed the importance of understanding the impact of decision making on the customer, taking great care to ensure that programs supposedly designed to add value do not end up hurting the customer. Examples include failing to understand the type and quality of products desired by customers, failing to meet customer expectations from order to delivery, and failing to implement processes capable of ensuring that products ordered and delivered by customers are delivered on time and damage free.

Davila, Epstein, and Shelton (2006) surveyed senior technology officers in the United States, Asia, and Europe in 1997 and again in 2002. The researchers found that management reported and ranked executive leadership support as the most important competency for implementation of Lean Six Sigma principles, change, and innovation.

Loewe and Dominiquini (2006) stressed the importance of visionary leaders and the members of the organization aligning with common definitions of quality, change, and innovation. This alignment is the foundation on which successful deployment of Lean Six Sigma is built.

Another important factor impacting the paradigm shift toward successful implementation of quality principles is culture. As a result of wide-ranging theoretical and empirical research, culture is described as the principles, convictions, and norms that direct behavior in organizations (Lemak et al., 2002). Quality gurus W. Edwards Deming and Phillip Crosby (as cited in Lemak et al., 2002) spoke of a call to action in regard to quality and an authentic conviction by members of the organization in the value of quality craftsmanship, superior designs, and service. The knowledge-based theory of the organization implies that similarly

shared values and common knowledge play a role in shaping organizational culture (Lemak et al., 2002). Lemak et al. (2002) noted a study conducted in 1996 by Grant, which suggested that the incorporation of knowledge disseminated throughout the organization, by way of communication, shared knowledge and meaning, and acknowledgement of individual expertise, permits all members to share uncommon practices. Grant (as cited in Lemak et al., 2002) further stated that the integration of knowledge results in a breakdown of barriers that would impede the implementation of quality principles. Lemak et al. concluded that a culture with shared knowledge of Lean Six Sigma builds an advantage in successful implementation. In turn, the culture places extraordinary focus on understanding the exact requirements necessary for providing exceptional customer service from order to delivery.

Saraph, Benson, and Schroeder (1989) conducted a synthesis of the quality literature; the critical factors identified for successful implementation of Lean Six Sigma were derived through a process that involved examining the critical requirements for quality management that have been prescribed by eminent quality practitioners and academics. Through this exhaustive review, Saraph et al. identified eight critical factors of quality management: (a) the role of leadership and quality, (b) the role of the quality department, (c) training, (d) product or service design, (e) supplier quality management, (f) process management, (g) quality data and reporting, and (h) employee relations.

The role of leadership in effective quality management has a common thread of commitment, purpose, and philosophy across prominent quality leaders, such as Deming, Juran, and Crosby (as cited in Saraph et al., 1989). This common thread sets the stage for the successful implementation of quality programs that focus on balancing cost, quality, and service. Additionally, organizational members see the commitment, purpose, and philosophy through the

acceptance of quality responsibilities, participation in quality improvement efforts, and comprehensive quality planning (Saraph et al., 1989).

Most quality leaders agree that all members own quality; nevertheless, there should be a formal department that helps drive quality for the organization (Saraph et al., 1989). Hence, the role of the quality department is significant in implementing a sustainable quality program. Moreover, the focus of the quality department is two-fold: to assist in creating a culture of continuous improvement and to educate members of the organization in the form of training and problem solving (Saraph et al., 1989).

Although training is one focus of the quality department, it is imperative that training is also a foundational component of any quality implementation strategy (Saraph et al., 1989). Training should be conducted simultaneously with implementation inclusive of all organizational members. Training should encompass problem solving and the use of data to make sound decisions. To sustain the success of the quality program, training should not be an event but should be continuous to deepen the understanding application of quality principles.

Product or service design speaks directly to the organization's understanding of the customer's requirements (Saraph et al., 1989). The emphasis is on quality. Indicators of success in this area include an organization's quality and service-delivery performance in terms of timeliness, errors, costs of quality, responsiveness, and customer satisfaction throughout the process, with special focus placed on understanding the absolute importance of providing error-free logistics in delivering products to customers (Brah, Wong, & Rao, 2000).

Supplier quality management strengthens the relationship between the organization and its suppliers; as a result, both are focused on providing the customer with the best possible product or service for a competitive price. It also ensures that the purchasing policy has a

balanced approach to quality and price, which in turn benefits both the organization and supplier. As with the other critical success factors, supplier quality management is key to a successful implementation strategy and sustainability (Brah et al., 2000). The research by Brah et al. (2000) can be summarized as follows:

1. Understand the needs of customers in terms of products and services they purchase.
2. Understand the supply chain and logistics requirements necessary for providing customers with the products and services they purchase.
3. Ensure the manufacturing and delivery process are free from errors that will impact the customer experience. For example, implement processes that prevent damage from occurring to products during transportation and delivery, ensure the right products and quantity are delivered, and execute the process flawlessly regardless of the volume of orders.
4. Invest in training and methodologies that instill a quality of culture within an organization.

The review of the literature provided many significant insights into supply chain management and Lean Six Sigma that could be utilized to identify gaps across Dell's supply chain and operational processes. However, the gap I saw after reviewing the literature included examples of actual projects that take into account real-world challenges facing corporations that have operated with a single channel to meet customer demand and then transitioned to an additional channel utilizing the same supply chain. The research at Dell is focused on providing such a review.

The Research Methodology

This qualitative evaluation study (a) evaluated Dell's as-is supply chain and logistics retail process to identify any issues related to costs or service with regard to fulfilling orders to retail clients, (b) evaluated the operational and organizational aspects of how Dell fulfills orders to retail customers to identify whether the needs of customers are met, (c) compared and contrasted Dell's retail supply chain operations to the information gained during the literature review, and (d) applied the lessons learned from the literature review to design and implement solutions to eliminate any discovered problems in the big-box retail channel through improved supply chain management and logistics and the implementation of Lean Six Sigma. Based on the extensive literature review on supply chain management and Lean Six Sigma, the qualitative evaluation design was deemed appropriate in this study, which sought to identify a process to eliminate any problems related to the retail supply chain and then design and implement solutions to reduce errors negatively impacting customers and reduce costs for Dell. In achieving the goals of the study, I evaluated Dell's as-is retail supply-chain process and consequently proposed solutions to address issues related to poor customer service, product damage, failure to understand the importance of end-to-end process quality, and metrics.

As-Is Operational Assessment

I chose to focus on the logistics aspects of Dell's supply chain because the logistics of facilities, inventories, and transportation are the primary drivers of costs across the supply chain (Chopra, 2011). More importantly, customer experience is most influenced by the level of execution across logistics (Semchi-Levi, 2010), for logistics are directly responsible for ensuring that products desired by consumers are in stock at retail locations or delivered as requested when

ordered online. The goal of assessing the logistics capabilities was to identify issues that were negatively affecting customer experience and increasing costs and complexity.

The Six Sigma DMAIC methodology was selected for my assessment due to the rigor of the methodology. In addition, I needed to have a system that could identify improvement of processes internal and external to Dell that were not meeting customer needs. Below is a summary of how I applied the DMAIC methodology, outlined by Kiemele et al. (2007) to complete the as-is assessment process:

1. Define the problem or project goals that needed to be addressed by creating value-stream maps of the as-is big-box order-fulfillment processes, identifying bottlenecks or defects, observing fulfillment processes specific to supply chain and logistics, and collecting data related to costs and levels of service.
2. Measure the problem and the process from which it was produced by applying the measurement-system analysis framework within DMAIC to identify gaps between big-box retail cost and service-level requirements and actual cost and performance of the as-is process. Collected data were utilized to create the as-is process baseline.
3. Analyze cost (transportation, material) and performance data specific to the fulfillment of orders and apply the use of Pareto charts, performance-measurement and time-series graphs, and the cost of poor quality matrix to identify the root cause of each identified error and gaps between contracted costs and actual fulfillment costs. A quality function deployment was utilized to graphically display all costs disparities along with defects and their root causes. This step is of vital importance as it provides stakeholders with an easy-to-understand view of where there are defects

within the as-is process and how the defects are negatively impacting costs, performance, and customer experience.

4. Improve the supply chain and logistics fulfillment process by analyzing the as-is value-stream maps and the quality function deployment to design and implement a to-be big-box fulfillment process that would remove the identified defects in the process that were preventing Dell from meeting cost and service expectations of their big-box retail customers. Results of the to-be design process were incorporated as part of the overall to-be process design and implementation phase covered later in the paper.
5. Control the improvements made to the big-box fulfillment process upon the implementation of the to-be recommendations by applying measurement-system analysis and customer service costs and performance metrics to sustain the improvements.

SECTION 2: THE EXPERIMENT

Until 2007, Dell operated exclusively as a manufacturer that sold their products to individual consumers and business customers who utilized Dell's online channel to place their orders. In 2008, Dell made a strategic decision to add a retail channel for selling its products, but the company leaders did not implement the retail channel as extensively as they desired until 2011 due to contractual negotiations with retailers and suppliers (Dell, 2011). The decision to add a retail channel by Dell was embraced by many retail and high-tech industry analysts, who viewed the additional channel as being a strategic game changer for Dell.

Sensing an opportunity, I chose Dell as the subject of my comprehensive study project for the purpose of researching whether a company like Dell with an established online channel could effectively transition its supply chain to a multichannel environment to meet customer demand. Dell has garnered a reputation as having a world-class supply chain for online sales and a focus on quality through the use of the process-improvement methodology, Lean Six Sigma (Kiemele et al., 2007). Dell agreed to allow me to conduct research but, due to constraints for completing the comprehensive study project and writing the required research paper, it was agreed that my research would focus on Dell's retail supply chain operations and processes in the United States and Canada. In addition, since I was not a Dell employee, I could not physically perform any work functions at Dell but instead was given permission to observe Dell personnel across all areas of the retail supply chain and meet with retail partners and carriers to identify areas of improvement and formulate solutions to the issues I uncovered. I was also given permission to take an active role in working with Dell personnel to implement the recommendations that resulted from the comprehensive study project.

The review of the literature for supply chain management and Lean Six Sigma provided me with a foundational methodology upon which to approach the comprehensive study project: DMAIC. As learned during the review of the literature and during my own training in Lean Six Sigma, all projects begin with an as-is process assessment, which is how I began the project at Dell. The comprehensive study project began on the docks of Dell manufacturing facilities located in several locations that manufactured products shipped to Dell retail partners. The as-is assessment was focused on evaluating the organizational, cultural, logistical, strategic, and quality processes across the retail supply chain. During the as-is assessment, I continuously referred back to the information I had uncovered during the review of the literature to validate that I was placing the proper focus on each aspect of Dell's retail supply chain. During the course of the as-is assessment, I discovered many issues within Dell's organization, culture, factory operations, and supply chain, which I present in the following pages.

Foremost among what I discovered during the as-is assessment was a lack of a capable and robust quality program to prevent a significant number of products (televisions, laptops, desktop computers, servers) being damaged during the trailer-loading process in each factory that I visited within Canada and Texas. Customers ordering products online were not experiencing high levels of damage due to the maturity of the online ordering process and the level of logistical capabilities of FedEx and UPS. Retail partners, however, were being heavily disrupted as a result of severe damage to many boxes occurring at the hands of Dell's core LTL and truckload carriers responsible for transporting products to Dell's retail partners. Because of the damage to the products, retail partners were refusing entire trailer loads of freight worth $1 million or more apiece, and 1 in 6 orders was being remanufactured for expedited delivery at much higher costs.

The value of utilizing Lean Six Sigma for the assessment was that each step in the retail logistics process had to be evaluated, thus identifying problems and pointing my efforts toward conducting root cause analysis to identify the key issues, which were themes throughout the literature review. In performing an assessment of the trailer-loading process at the factory level, the following observations were made:

1. Trailer loading had been outsourced to third-party, temporary-labor companies. The use of third-party labor led to extreme variance of quality in the trailer-loading process from shift to shift.
2. There were no standards defining how pallets were to be loaded or positioned, resulting in damage to multiple pallets in each trailer.
3. To reduce costs, factories chose to shrink-wrap each pallet with only one layer of stretch wrap. Moreover, the shrink-wrap was only wrapped around the boxes on the pallets instead of being wrapped around the base of the pallet to secure all of the boxes on the pallet.
4. Pallets were double stacked and unsecured in each trailer. When the trailers traveled from the factory to the local LTL terminal or to the final retail customer, the shrink-wrap tore away from the pallets, allowing the products to fall on the trailer floor and resulting in damage to boxes and products. To reduce costs, the factories chose to utilize Grade B pallets. Grade B pallets are constructed of lightweight materials with missing and damaged boards that reduce the effectiveness of the pallet.
5. When Dell's retail partners received their shipments, they were so shocked at the amount of damage to the boxes that they refused to accept not just the damaged

product but the entire shipment, as they were unwilling to take the risk that the products in the boxes had not been damaged.

6. When retail partners did accept a shipment, the Grade B pallets often collapsed in their distribution center or storeroom, causing the retailers extra work to move the boxes to a new pallet.
7. Refused shipments were returned to a designated return location by a carrier with a "reverse logistics" transportation charge added on top of the outbound transportation charge. Under accounting rules, Dell is required to scrap the product once the product has been refused by a retailer.

A cost-benefit analysis was conducted as part of the as-is assessment process that clearly identified the impact of the current processes in terms of driving costs across logistics. The results of the cost-benefit analysis were instrumental in convincing Dell's leadership that severe issues existed within the as-is retail process. Because of Dell's operational model and reliance on outsourcing, not enough visibility existed across Dell's logistics network to properly identify and correct the issues.

The following is an example of the cost-benefit analysis that was performed. The primary delivery method of products to Dell's retail partners uses 53-foot trailers carrying 52 double-stacked pallets. Therefore, the cost of just one load being refused by a customer is significant, as shown in Table 1.

Figure 5 shows examples of the trailer-loading process at the factory level within Dell's logistics network discovered during the as-is assessment. These pictures illustrate why Dell leaders are sensitive about the information uncovered during my comprehensive study project

and want to ensure that none of the material in this paper is used in industry journals or publications.

Table 1

Examples of Cost of Refusal of a Load of 52 Pallets

Cost item	Houston to Dallas, TX: Desktop computers	Round Rock, TX, to Los Angeles, CA: Notebook computers
Value per pallet	$20,500	$60,000
Total value of refused load	$1,066,000	$3,120,000
Transportation	$345	$1,200
Return transportation	$295	$712
Remanufacturing	$347,156	$509,593
Expedited transportation	$1,500	$2,369

Note. Numbers are not exact due to a nondisclosure agreement.

Moreover, what makes the pictures in Figure 5 especially shocking is that trailers in the pictures were bound for delivery to a Walmart distribution center. Walmart is considered one of the most detailed and demanding retailers in terms of product deliveries, with a reputation for being unforgiving when suppliers fail to follow Walmart guidelines (Cohen & Lee, 1998). Note that heavy pallets are placed on smaller, lighter pallets so that boxes are crushed during loading (see Figure 5). A sampling of trailers at every loading door in six factories found the exact same process and the resulting damage occurring repeatedly. Given that most factories ship on average between 40 truckloads and 110 LTLs per day, the magnitude of the trailer-loading problem was abundantly clear to Dell.

Figure 6 is a photo of deliveries made to two retailers; each load was refused by the retailers, so the product was out of stock during a heavily advertised promotion of Dell's products. One retailer was so incensed by Dell's lack of professionalism that they fined Dell

$250,000 and canceled the remaining orders until Dell could prove that products would be delivered on time and undamaged.

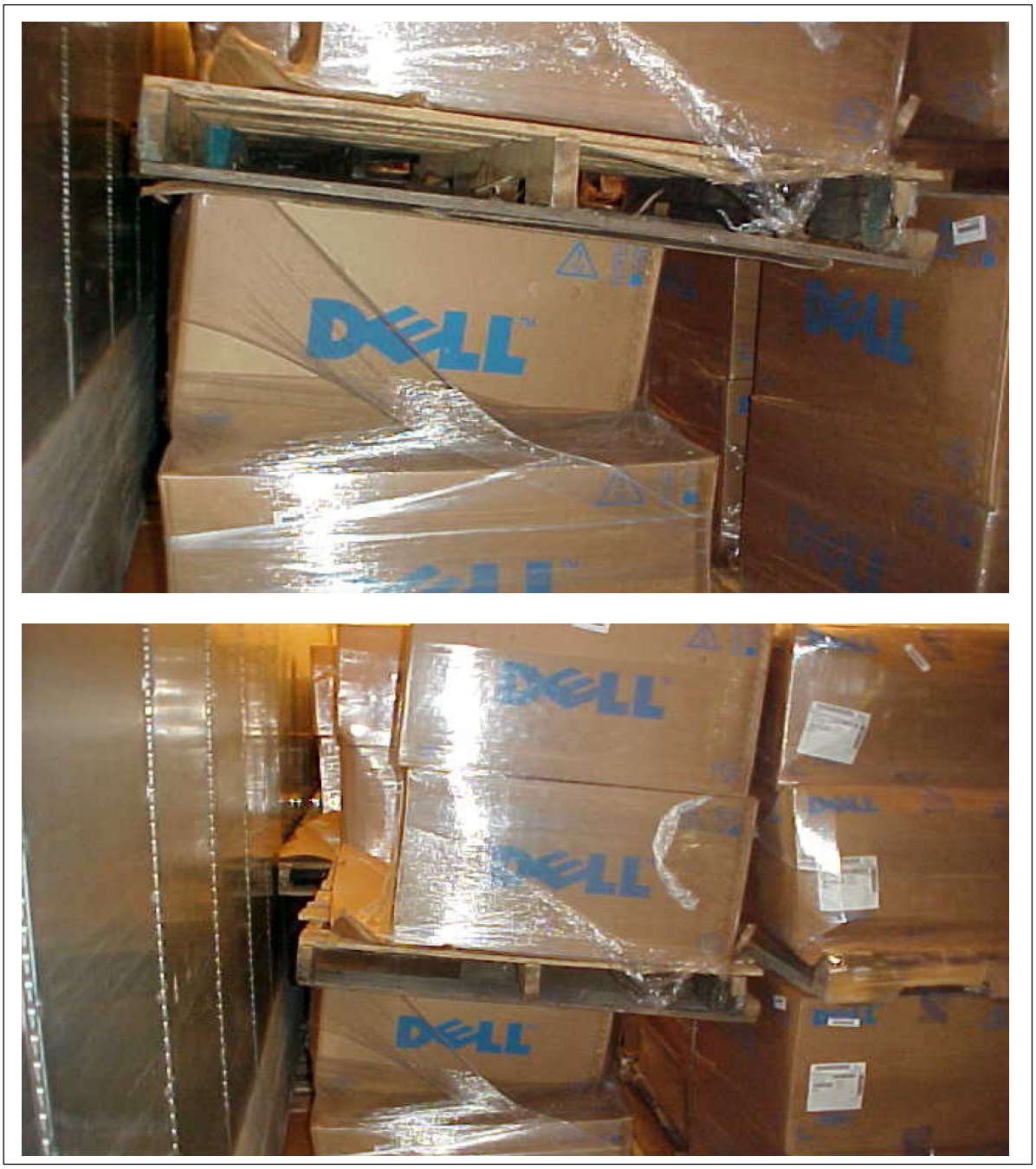

Figure 5. Picture taken by the researcher of desktop computers and servers stacked on top of laptop computers, causing damage.

Figure 6. Pictures of Dell computers that fell off of pallets while in transit.

The results of the as-is assessment were met with extreme concern by Dell's executive ranks, not only because of the cost of errors in the process (in the millions of dollars) but, more importantly, because of the impact on Dell's retail partners and consumers. Dell accepted the findings of my assessment and authorized me to work with operational personnel within each Dell factory due to my work globally as a supply chain consultant and my prior experience working with high-tech clients. Dell also authorized me to work with third-party logistics providers and carriers who had been negligent in reporting issues to Dell due to my experience managing transportation and logistics for such companies as Michaels Stores and Walmart.

To-Be Process Design and Implementation

Just as the DMAIC methodology was utilized in the as-is process phase, it was also utilized for the to-be phase. To ensure buy-in and support from stakeholders, a cross-functional team consisting of factory managers, dock supervisors, dock workers, business process-improvement personnel, and even representatives from Dell's retail partners was established based on the recommendations from Cesnovar's (2006) research. Value-stream mapping, a

technique used in Lean Six Sigma, was used to map out the processes involved in the end-to-end retail logistics network, to great effect (see Figure 7).

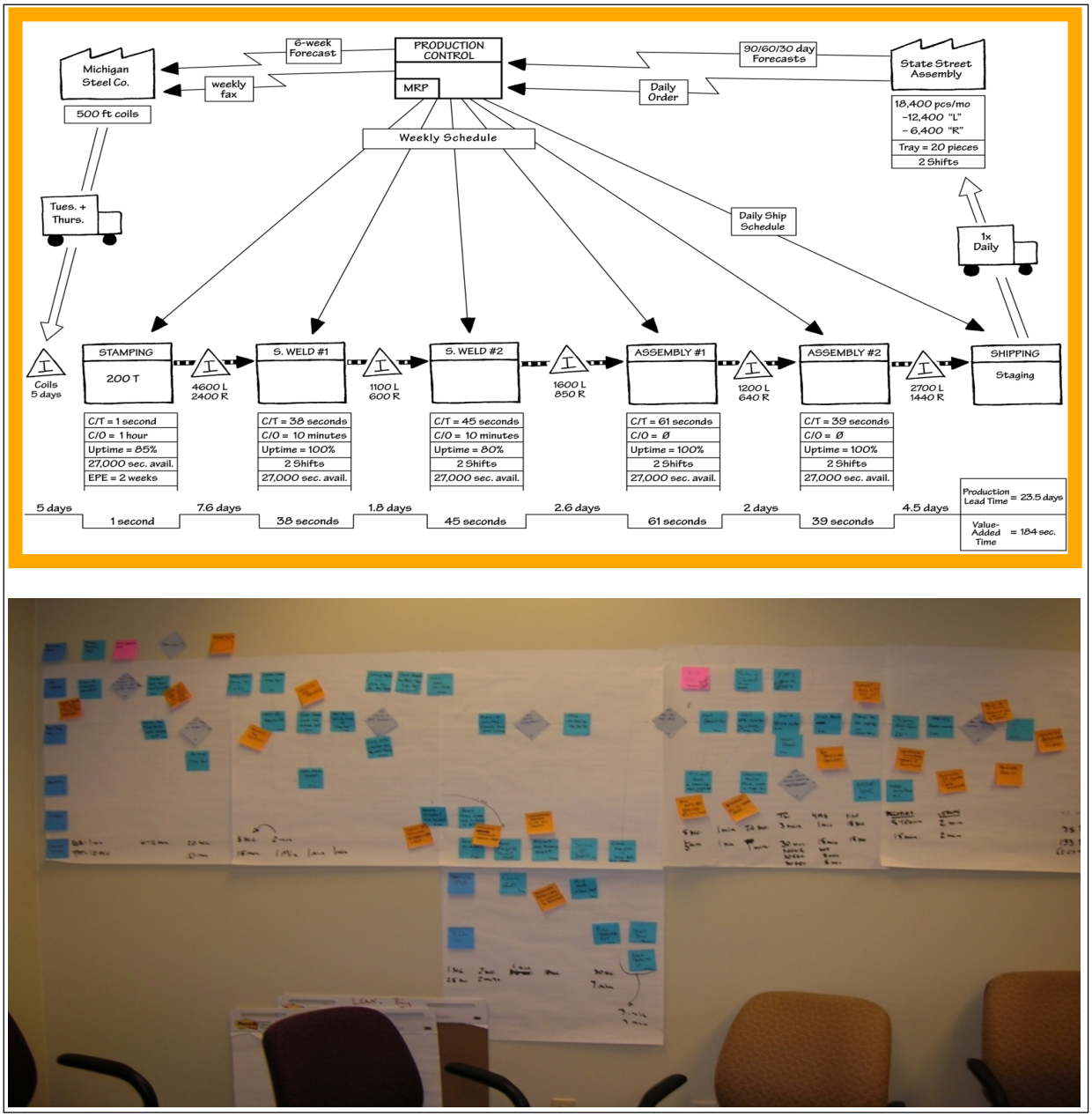

Figure 7. Value-stream mapping exercise conducted as part of the comprehensive study project.

By mapping out the procedures, the team was able to identify non-value-added steps and processes that could not meet Dell's needs. As a result, many new processes were identified and

implemented. The value-stream mapping identified the following root causes that led to damages and unhappy retail partners:

- No trailer-loading instructions were ever written, so each shift in every factory was loading trailers differently.
- Forklift drivers were only given 1 hour of training on how to load the trailers.
- Forklift drivers were given incentives to load trailers quickly, leading to unconcern about damages.
- Supervisors had no experience loading trailers; they were line supervisors who had been asked to devote some time to watching the trailers being loaded whenever they had the chance to make sure the third party was working.
- Pallets were not being shrink-wrapped to the wood on the pallet, only around the boxes, making it easy for the pallets to fall apart.
- The carriers responsible for moving the freight had no interaction with Dell personnel. All trailers were loaded beforehand, and drivers only needed to pull up, hook up to a trailer, and depart.
- Carriers had been selected based on price, so the majority had older equipment and trailers that lacked Air Ride systems to minimize vibration in transit.

Possible solutions presented included the following:

- Write a trailer-loading playbook for all trailer types.
- Set the LanTech machines to shrink-wrap the pallets all the way to the wood to provide better stability.
- Reduce the dependence on third-party labor to load trailers; instead, staff the dock and trailer-loading areas with Dell employees only.

- Conduct trailer-loading classes and require a certification process to ensure that trailers are loaded correctly by product and by trailer type.
- Reduce the use of low-cost carriers and instead utilize affordable carriers that also offer the best trailers and equipment.
- Implement the use of metrics to ensure that costs and performance are measured and that any negative trends are immediately identified and corrected.
- Dell's retail partners should implement an immediate zero-tolerance program for all Dell shipments to ensure that all mistakes are identified and brought to Dell's attention.
- Conduct supply chain network optimization to identify the optimal logistics network for Dell's retail partners rather than try to fulfill retail demand utilizing the online logistics network.

As members of the team focused on the areas they were assigned to correct, I focused my efforts on solving the issues with transportation and trailer loading, as these issues were having the biggest impact on Dell's retail partners, based on the findings gleaned from Chopra (2011), Simchi-Levi (2007, 2010), Surie and Hazey (2006), Fisher (1997), and Christopher (2011). When shipping any fragile or high-value freight, the rule is to eliminate any type of adverse weight issues, such as those that occur from placing a heavy pallet on top of a pallet containing lighter, more fragile freight (Stolarczyk, 2011). Based on personal observation and a review of the photos, the primary issue to be solved entailed protecting Dell products from damage once they had been loaded into trailers. Discussions were held with Dell's third-party logistics providers, who recommended the use of logistics beams as the best way to reduce damage (see Figure 8). Once two pallets have been loaded onto the floor of the trailer, two beams are placed

over the top of the pallets. Two more pallets are then loaded into the trailer on top of the logistics beams, allowing pallets to be double-stacked without having the pallets physically touch one another and cause damage (Stolarczyk, 2011).

Figure 8. Picture of logistics beams in a trailer that can be adjusted to any height necessary and that can support up to 2,000 pounds in weight.

A review of the literature on the topics of Six Sigma and supply chain management highlighted the importance of not stopping at the first solution when attempting to solve a problem but instead continuing root-cause analysis to find the real problem increasing costs and complexity (Agarwal & Shankar, 2002). The literature review further stressed the importance of always putting the customer first and ensuring that all recommended solutions for problems are repeatable, reproducible, and thoroughly acceptable to customers (Desouza, Chattaraj, & Kraft,

2003). Utilizing the suggestions from the literature review led me to contact HEB, Woolworth's, and Coles to find out about their processes for shipping fragile products such as glass. An executive from HEB invited me to tour the company's distribution center in San Antonio, Texas, to see firsthand how HEB prevents damage to fragile merchandise. Upon taking the tour, I discovered that, similarly to Dell, HEB used logistics beams in its trailers. However, HEB went further and installed inflatable air bags to add an additional measure of protection (see Figure 9).

Figure 9. Picture of an air bag placed in a trailer at an HEB distribution center.

The use of air bags was a new concept to me and added to the knowledge I had gained from the literature review (Spencer & Kneebone, 2007). Figure 9 depicts inflated air bags gently pushing pallets against the sides of the trailer, locking the pallets in place. HEB leadership had discovered that many companies do a good job of loading their pallets with logistics beams but

fail to realize that pallets rub and vibrate against other pallets while the load is in transit, causing damage to the pallets. Air bags prevent the pallets from rubbing together.

Upon completing the evaluation of Dell's core carriers and comparing those carriers with the best-in-class in-transit shipping carriers used by HEB, I made the recommendation to the Dell team that all of the carriers currently used by Dell in the retail logistics network should be replaced with carriers that had logistics-beam and air-bag capabilities. This included Canada retail operations as well.

To replace Dell's retail carriers, the team and I met with the vice president of procurement to walk him through my discoveries in the as-is assessment. I chose to seek out executive support due to the extensive importance of doing so as recommended by Saraph et al. (1989), Lemark et al. (2002), Krakkar and Narag (2007), Davila et al. (2006), and Loewe and Dominiquini (2006), to name a few. The team's presentation contained the pictures that I have posted in this paper along with the cost-benefit analysis. Very little discussion was necessary once the vice president saw the pictures of how freight looked upon arrival to the customer (Figures 5 and 6). He put our team in contact with the director of supply chain procurement, who assigned members of her team to research and contact a list of carriers that could provide Dell with the desired equipment. Moreover, the selected carriers would need the equipment capacity and geographic coverage required to meet the delivery expectations of Dell's retail clients.

Factory Pilot

When I originally approached Dell about the comprehensive study project, I explained the project's focus and goals. However, as the PowerPoint presentation showing all of the pictures of trailers using logistics beans and air bags began to circulate among the members of

the executive committee, a decision was made to build upon my initial as-is and to-be assessments and include in the modeling the implementation of operational improvements within Dell's pilot factory.

I met with the factory improvement team in late August, when we outlined the equipment requirements for piloting the use of logistics beams and airbags as HEB did. Based on discussions with HEB staff, we discovered that conducting a pilot would cost less than $20,000, including all equipment and the connection of an air line to a compressor in the factory. An additional step in the process was implemented based on material gathered during a review of the literature. Because turnover was traditionally high on the loading dock, a visual aid was recommended to ensure that clear instructions were visible on how to load each type of trailer and how to use the air compressor and air bags (Womack, 2012). Visual aids are inexpensive methods for offering positive reinforcement and instilling confidence (Womack, 2012). Figure 10 displays the equipment and visual aids that were installed in the pilot factory.

Thanks to assistance from HEB, all required equipment was installed and operational at one dock door within the Dell pilot factory in Texas and Canada. Moreover, the carrier assigned to the factory provided three trailers with logistics beams to complete the equipment needs. A series of tests was completed to evaluate the efficiency of the new equipment and loading process. Results are presented at the end of the paper.

The Trailer-Loading Playbook

Aside from visual job aids, the as-is assessment identified a lack of knowledge regarding methods of loading the different trailers in use at Dell, 53-foot van trailers and 28-foot LTL pup trailers. The 53-foot trailers were primarily intended to shuttle products from the factories to the local LTL terminals, and the 28-foot pup trailers were used for shipping freight to customers in

direct lanes (i.e., loading freight into a 28-foot pup trailer, securing it with a locked seal, and driving it directly to a customer).

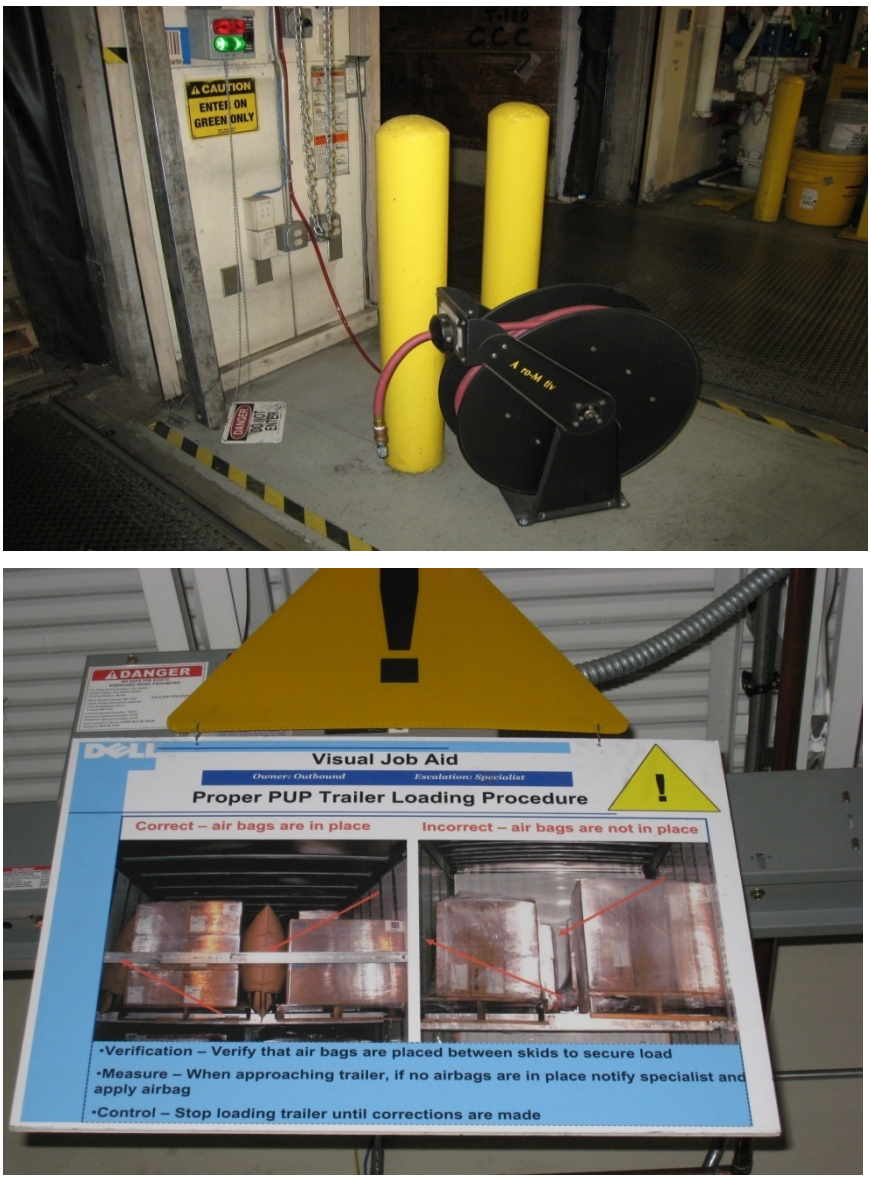

Figure 10. Picture of an air bag hose reel and visual aid from Dell pilot factory.

The possibility of using direct lanes to reduce costs was identified during the modeling of the network, leading to a decision to increase the use of direct-lane trailer loading at each factory. The literature indicated that transportation can account for 50% or more of a corporation's total

logistics costs; therefore, every effort must be made to reduce transportation costs through network optimization (Chopra, 2011).

The literature also identified the importance of providing laborers with easily understood instructions to supplement visual aids (Womack, 2012). To ensure that the dock laborers would know exactly how to load each trailer, I worked with the dock manager in the pilot factory to create a trailer-loading playbook with assistance from representatives of each carrier (see Figure 11). The playbook became the primary training aid for the dock laborers, also providing material for the trailer-loading visual aids. An example from the playbook is shown in Figure 11.

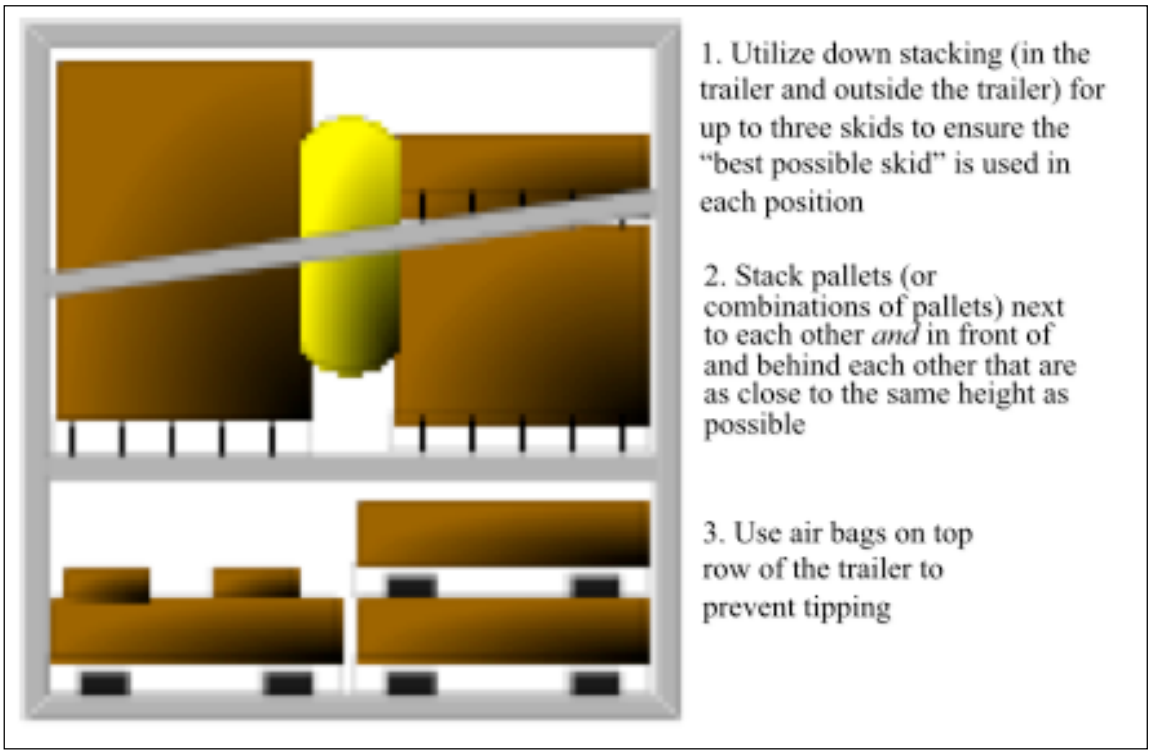

Figure 11. Graphic displaying a page out of the trailer-loading playbook.

Multiple training sessions were held in the pilot factory to train and certify the dock personnel in the new procedures. Because the pilot factory operates three shifts, training sessions had to be held for each shift. To make the training as realistic as possible, pup trailers with logistics beams and air bags were utilized for all training sessions. Each carrier also

provided a trailer-loading expert to assist company personnel with training and to help identify any potential issues related to loading or building pallets.

The most important participants were team members from three retailers we contacted to demonstrate the new procedures and to secure their sign-off that the new procedures would indeed reduce damage in transit. Including personnel from the retailers was of significant importance and was supported by recommendations in the literature. Establishing new policies and procedures without ensuring that the changes will be supported by customers can do more harm than good, leading to decreased confidence on the part of the customer (Christopher, 2011).

The Creation of Metrics

To ensure that the processes implemented will remain capable of meeting the needs of Dell and its retail partners, key metrics were identified through a collaborative effort with the factories, operations, and retailers. Among the metrics that were identified as being critical to the retailer were the following:

- on-time performance (minimum of 98% required);
- cost of transportation as a percentage of cost of goods sold;
- customer delivery satisfaction with carrier (minimum of 98%);
- missing, wrong, and damaged (maximum 1% for any factory);
- percentage of correct labels (minimum 98%);
- deliver to target (measures precision of deliveries);
- freight cost per unit shipped;
- outbound freight costs as percentage of net sales;
- inbound freight costs as percentage of purchases;
- claims as percentage of freight costs;

- mode selection versus optimal (all modes—ocean, rail, LTL, truckload, parcel);
- percentage of truckload capacity utilized;
- on-time pickups; and
- truck turnaround time.

Metrics are now taken daily and plotted to identify trends related to damage for a particular product, at a specific location, by a specific carrier, as well as to ensure that each retailer is being serviced according to its agreement with Dell. The goal is to use the data to model and reinforce behaviors that will provide continuous improvement and prevent a return of bad habits (Womack, 2012).

SECTION 3: THE RESULTS

On October 12, 2012, the first trailers were loaded and shipped under the new processes and procedures to three of Dell's retail clients located in Canada and the United States. Prior to this implementation, nearly 40% of all trailers arriving at Dell's retail partners arrived with some form of damage to the products, resulting in loads being refused, stores being out of products, and fines for Dell. As a result of the analysis and recommendations from this comprehensive study project, damage was reduced to less than 1% on all test deliveries. Once the loads arrived, there was an immediate positive response from Dell's retail partners. Common comments were, "I've never seen a better-looking load," and "I never thought I would live to see the day that I received freight that wasn't damaged from Dell." Moreover, Dell's retail partners began contacting their Dell account representatives to express their shock and pleasure at the improvement in how loads were delivered.

The photos in Figure 12 clearly demonstrate the significant difference that just a few months of collaborative effort can have on a company and its customers. More importantly, the pictures demonstrate the importance of taking the time to fully understand the impact that product deliveries have on retailers and the dangers of relying on a single metric such as velocity to judge success (Simchi-Levi, 2010). On many occasions during the completion of this project, I heard executives and employees ask whether all of the effort undertaken was worth it. Whenever I heard such comments, I would show pictures of the deliveries to Dell's retail partners to reinforce the idea that, for Dell's retail partners, the closest many of them would get to Dell was at the time a delivery was made. In essence, the quality or lack thereof in the deliveries was the face of Dell to those retailers. It behooved the company to ensure that the interaction between Dell and its retailers was as professional as possible.

Figure 12. Before and after pictures of Dell products transported in trailers.

In addition to the improved customer experience experienced by Dell's retail partners, there was a significant financial impact as a result of the comprehensive study project and resulting Dell focus on implementing the identified solutions. Regardless of my personal feelings with respect to Dell's failure to adequately manage its logistics operations associated with its retail partners, this project was a success as measured by the following:

- Damage to products delivered via the pilot factory decreased from 41% to less than 1%.
- Customer experience surveys regarding shipment deliveries and appearance indicated an increase in satisfaction from 60% to 96.8%.
- Modeling identified the potential for Dell to decrease shipping costs by $6 million annually through network optimization, funneling more freight into lanes, and increasing the density of palletized shipments.

- Modeling identified the potential for reducing truckload shipping costs by $8.5 million annually. Network optimization identified multiple lanes where equipment utilization was less than 25%, so those lanes could be eliminated.

SECTION 4: CONCLUSIONS

As stated earlier in the paper, this qualitative evaluation study (a) evaluated Dell's as-is supply chain and logistics retail process to identify any issues related to costs or service with regard to fulfilling orders to retail clients, (b) evaluated the operational and organizational aspects of how Dell fulfills orders to retail customers to identify whether the needs of customers are met, (c) compared and contrasted Dell's retail supply chain operations to the information gained during the literature review, and (d) applied the lessons learned from the literature review to design and implement solutions to eliminate any discovered problems in the big-box retail channel through improved supply chain management and logistics and the implementation of Lean Six Sigma. The comprehensive study project was successful in achieving the identified objectives by completing the following:

1. As-is value-stream maps were created of Dell's big-box order-fulfillment supply chain and logistics processes.
2. Defects were identified in the big-box order-fulfillment process and a root-cause analysis was conducted. Transportation, material costs, and service-requirement data were analyzed to identify defects across contracted and actual processes.
3. Dell's online channel and big-box order-fulfillment process were analyzed to identify cost and performance issues negatively impacting big-box retail customers.
4. The Lean Six Sigma DMAIC model and supply chain best practices were applied design a to-be big-box order-fulfillment model that reduced costs and complexity while increasing service-level performance to big-box retail customers.
5. I gained support from Dell to implement the to-be big-box order-fulfillment model.

In addition, I took extreme care to be respectful and mindful of the impact my suggestions would have on personnel throughout Dell, as well as during interactions with Dell's retail partners. Some resources within Dell had no choice but to accept the fact that their decisions had caused Dell to lose money, but instead of focusing on the negative aspects, I focused on using the comprehensive study project to teach and encourage as well as involve executive leadership early in the process as recommended by the authors I researched. In addition, I was able to articulate very clearly to Dell resources the tenets of information I gleaned from a review of the literature and research, such as identifying the key assets that drive competitive advantage, not placing focus only on one metric within the supply chain such as velocity, and the absolute necessity of understanding the needs of customers. The review of the literature and previous research allowed me to determine gaps between Dell's practices and the most recent best practices supported by the research, enabling me to make recommendations to change Dell's practices.

What made this project unique was that I was able to work with a leading online retailer that recently added a traditional retail channel to meet customer demand and introduce a new business model. Although experts at online sales and distribution, Dell clearly had challenges understanding the unique nature of retailing, which led to the issues outlined in this paper. In addition, it is clear that based on the extensive and exhaustive review of the literature and available research, Dell's executive leadership failed to understand the leading supply chain tenets as outlined by the myriad of authors I researched. Below is a summary of the reasons that problems arose in the first place and a list of the steps implemented to ensure continuous improvement with Dell's retail partners based on a review of the literature and research:

1. As an industry, many high-tech manufacturers focus on velocity. The problem with utilizing velocity as the primary metric is that it puts all of the focus on internal operations, such as building and shipping, without concentrating on the customer. Implementing new processes, technology, or carriers will not completely solve the issues I identified during this project. Instead, factories need an incentive to build pallets and load trailers with the *external* customer in mind. Metrics that do not measure customer satisfaction and retention mean very little.
2. Many people at Dell had a severe case of "we're different," which created a mindset in which it was assumed that if the company was doing something, the company must be right. This notion, of course, is completely untrue. This project was successful because best-in-class processes from outside the company were implemented, and associates and managers learned to feel comfortable looking outside their own four walls for ideas and embracing change.
3. The project uncovered that the company made a mistake by promoting people from within the company with absolutely no logistics experience to decision-making positions. I can best illustrate this by relaying a conversation I had with the director of dock operations in which I pointed out that his workers were loading the trailers by placing heavy pallets on top of smaller, lighter pallets, thus creating damage. He replied, "We have to load trailers that way, as it's faster, and besides, any freight shipped in a trailer will have some form of damage." Unless companies are willing to hire only experienced, well-qualified individuals, they will have a very difficult time preventing vital processes from eroding and negatively affecting shareholders and customers. The only exception to this rule occurs when companies are willing to

train their employees thoroughly, which I highly recommend. I cannot stress enough the importance of ensuring that associates are engaged and trained on a continuous basis.

4. Too much emphasis is placed on firefighting, with nearly zero focus placed on fire prevention. For the project to sustain monetary gains, Dell must maintain the process-improvement strategies that were implemented.
5. Too little emphasis was placed on the "how" in terms of getting things done. Emphasis on collaboration across all departments was identified as an area of improvement.

As with all projects, however, long-term success will depend solely on the ability of managers and employees to reinforce the need to follow the new processes day in and day out. Prior to my departure from Dell, I asked the team members I worked with one very simple question based on Figure 12: What do you think the customers prefer, the "before" photo or the "after" photo? The answer, in unison, was, "The 'after' photo!"

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