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Research Results on the Japanese Approach to Supply Chain Management: Reliance on integration

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Abstract
This paper deals with the application of quantifying lean manufacturing and its effectiveness in Japanese automobile industry. Case studies were carried out on Japanese automobile industry on the application of lean production, regarding the Japanese approach to the Supply Chain management approach to Supply. The Research results on the Japanese Approach to supply Chain Management are illustrated in the following sections

1. Introduction

The high level of economic development observed in post-war Japan has drawn the attention of scholars to the practices adopted by Japanese automakers and their approach to supply chain management, which became known as the Lean Production System. The practices used under the Lean Production System, so-called Lean Practices, are meant to bring continuous improvements to manufacturing processes through the commitment of the work force towards the reduction of non-value-added tasks.

Such practices should be considered principles that direct the way workers conduct their jobs, rather than simply techniques, and they aim to achieve an ideal situation of perfection (Imai, 1986; Liker, 2004). Moreover, they are only optimized when jointly implemented with all firms in the supply chain network. Take the example of genryo-seisan (production plans based on dealers" order volume), which is focused on reducing the gap between dealer's orders and the production of vehicles to zero.

In as much as this perfect match could be considered ideal, genryo-seisan functions as a guiding principle that directs the negotiations between automaker and dealers, so that they can make a joint effort to constantly improve the system (Fujimoto, 1999). In this manner, Lean Practices can be defined as: guiding principles focused on reducing non-value-added tasks which are optimized when jointly utilized by an automaker and its supply chain network.

One of such practices are the kaizen activities, in which workers on the shop floor are constantly trying to improve the manufacturing process by implementing minor changes in their daily work. Kaizen is connected to the idea of "ongoing improvement, involving everyone", including top management, managers and workers and is based on incremental rather than radical innovation. The philosophy of kaizen, therefore, assumes that the product and work processes can always be improved and the entire workforce should be constantly committed to finding ways to promote ameliorations.

2.Kaizen activities

Participation in kaizen activities develops new knowledge, skills, and abilities that may be applied to subsequent problem-solving tasks (Farris et al, 2009; Imai, 1986). Hence, kaizen creates an environment and organizational culture which compels the workforce to constantly improve the company's products and internal processes, even in periods of prosperity and without any apparent external threat.

Education and training are essential to develop such an organizational culture and to create a mind-set in the workforce which continually identifies and finds solutions for manufacturing problems. In fact, a high level of involvement of blue-collar workers can only be achieved through a mixture of on-the-job and off-the-job training that goes far beyond the acquisition of basic knowledge of electronics and mechanics.

During on-the-job training, blue-collar workers in Toyota learn much of what is deemed white-collar work, so that they can develop a wide range of skills that go from the repetitive work of operating machines to handling minor maintenance tasks and dealing with unforeseen situations (Koike, 1988). Moreover, the Japanese approach to quality control involves the entire workforce in all areas of the firm, as well as suppliers and dealers. The responsibility to maintain and enhance quality standards is delegated from inspection and quality control personnel to workers on the shop floor (Cusumano, 1985; Imai, 1986).

Due to the important role played by blue-collar workers, Lean Practitioners acknowledge the necessity to provide real-time information for workers at the shop floor. This information is available through the practice of Visual Management, which is based on the use of numerous charts and signboards scattered throughout the factory to supply data about the production process for both managers and blue-collar workers. The so-called Andon Signboards, for instance, located above assembly lines, provide real-time feedback of production troubles and are an efficient mechanism for defect detention and on-the-spot inspection (Fujimoto, 1999).

3. KANBAN System as applied to Japanese approach to Lean manufacturing

The KANBAN system and just-in-time manufacturing are Lean Practices that demonstrate the relevance of a close relationship between the automaker and its supply chain network. The KANBAN system is a production and inventory control system in which the downstream station obtains just enough components as needed and the upstream station produces just enough to replenish what has been used.

The optimization of the KANBAN system requires the adoption of just in-time manufacturing, or synchronized delivery, in which components are supplied at exactly the same time as the body sequence in the assembly line. Just in-time manufacturing demands a close relationship with suppliers, since components are delivered in frequent and small lot size. The Lean Production System promotes a high level of integration among all firms in the supply chain network by interconnecting all stages of the production process, including product development, manufacturing, purchasing and after sales services. One of the clearest advantages of such an integrative approach to supply chain management is the optimization of just-in-time manufacturing and consequent decrease of inventory costs.

Moreover, production problems such as machine failures, defective production, time-consuming machine setups, long transportation distances, might create the need for buffer inventories. Inventory reductions will make those problems visible and when they are solved, a rise in productivity and quality can be expected (Flynn et al, 1999). Lieberman and Demeester (1999) present empirical evidence of an increase in productivity due to inventory reductions in a survey conducted in the Japanese automobile industry.

Dyer and Nobeoka (2000) also affirm that "the cost and quality of a vehicle are a function of the productivity of a network of firms working in collaboration." Their research emphasizes the advantages of integration in Toyota suppliers‟ network for knowledge sharing and collaborative improvements. In fact, the close contact and face-to-face interaction between automaker and supplier is said to facilitate tacit knowledge transfer, to reduce communication errors and make feedback more effective (Dyer, 1996). Since this type of integrative supply chain management favors the accumulation and sharing of knowledge within the network, the automaker will not lose the expertise of an activity outsourced to its suppliers.

Regarding this topic, Takeishi (2002) distinguishes "task partitioning" from "knowledge partitioning." While the former indicates which organization is responsible for the tasks of manufacturing a specific component, the latter designates "who has knowledge for the tasks among organizations." He advocates that an automaker should "keep the knowledge of the outsourced task within the firm, rather than outsourcing the knowledge together with the task." This discussion is relevant for this paper because it illustrates the problem of focusing on coordination rather than integration in supply chain management. By focusing on coordination, automakers outsource both tasks and knowledge to their first tier suppliers.

There are no joint efforts in problem-solving and knowledge is not shared. In an integrative approach, the automaker keeps the knowledge even when outsourcing the task. Integration, therefore, favors information sharing and creates conditions for enhancing productivity and quality of the whole supply chain network.

This knowledge sharing and accumulation might become a competitive advantage for the supply chain network (Dyer, 1996). Moreover, one should also consider the risks involved in excessive specialization on the core competence, since the firm might lose "both assets and talents as a result of outsourcing of manufacturing operations and just coordinating product flows to markets" (Kemppainen and Vepsäläinen, 2003).

By keeping a high level of knowledge sharing within the supply chain network firms might avoid this problem of overspecialization, because, at the same time that they focus on their core competence, relevant information remains available and can be more easily shared at the inter-firm level.

Additionally, Japanese automakers recognize the importance of considering public policies and the relationship between public and private sectors for successful strategic planning. The pattern of communication between the government and firms is close and intense, focused on promoting collaboration to achieve mutual objectives (Evans, 1995; Dore, 2000). One should note that the capacity of managers and public officials to design efficient strategies or policies is limited by bounded rationality. Not only is it difficult for them to comprehend all the forces at play in the world's economic environment, but also to anticipate the effects of the interaction of such forces (Simon, 1991; Conner and Prahalad, 1996). Accordingly, a constant and close pattern of information exchange between public and private sectors is necessary for designing effective policies and for readapting such policies to unpredicted changes in the economy.

4.KANBAN Planning and Execution

KANBAN is a method for maintaining an orderly flow of material. KANBAN cards are used to indicate points at which material should be ordered, how much material is needed, from where the material should be ordered, and to where it should be delivered. With IFS' KANBAN solution, you can perform an advanced KANBAN calculation using an actual demand profile to determine whether an inventory stock out is likely to occur with the current system settings. The system can calculate KANBAN quantities or the number of KANBANs based on past usage of parts. You can recalculate and redeploy your KANBAN circuits within a day when demand shifts IFS' KANBAN solution lets you perform stock out simulations by retrieving demand from a variety of sources and for different time spans to determine whether you KANBAN quantities are balanced You can use either visual or electronic signals for replenishment. KANBAN replenishment can be from supplier, a sister plant, an inventory location, a location group or a production line. Options for demand type, KANBAN formula, safety factor, signal type, and replenishment type let you adjust the use of KANBANs to best match your environment

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IFS' KANBAN solution helps you maintain your KANBAN cards. You can easily keep track of the number of cards used in the system, add or subtract cards during seasonal changes in demand, or print or replace cards

5. Review of Toyota's approach to lean manufacturing

In the mid-1980's, U.S. auto industry was in crisis. It was rapidly losing market share to Japanese competitors. The Japanese automakers were able to make better quality cars with fewer defects resulting in better customer satisfaction and thereby creating an image of excellence across the globe. Toyota Motor Company, which despite 1973 oil crisis increased its earnings, was able to continue increase its market share. Even today, Toyota is one of the world's most successful automakers that have perpetually outperformed their competitors in terms of quality, reliability, cost, delivery, after sales service etc. Japanese manufacturing systems have been rigorously researched by global academia.

The famous book "The Machine That Changed the World" written by Womack, Jones, and Ross (1990) awoke the US manufacturers. Over the last two decades, many researchers have studied Toyota Production System (TPS) and have documented various principles and practices used by Toyota (Womack and Jones, 1994; Liker, 1998; Adler, 1993, Spear and Bowen, 1999; Sobeket al. 1998). Researchers, who studied and documented TPS in the 1980's, termed the total approach as "lean manufacturing" although the principles behind lean are not in themselves new; which can be traced back to the work of pioneers such as (Deming, 1986; Taylor, 1911; Skinner, 1969); because of its ability to attain and realize so much more in terms of final outcomes with the deployment of fewer resources. The ideas were adopted because the Japanese companies developed, produced, and distributed products with less human effort, capital investment, floor space, tools, materials, time, and overall expenses (Womack et al., 1990).

Lean manufacturing was accepted as an innovative paradigm-that eliminates waste in any form, anywhere and at any time, relentlessly strives to maintain harmony in the flow of materials and information, and continually attempts to attain perfection. Ohno (1988), Shingo (1989), Womack et al. (1990), Monden (1997) and many other researchers made wide ranging contributions to popularize the lean approach. Stunned by the Japanese growth, many companies in the US and developed countries pursued ways to develop and make products more quickly and efficiently, tried very hard to imitate or implement TPS.

These manufactures started using various tools and shop-floor practices identified as key elements of lean approach such as Just-in-time, KANBAN, setup time reduction, production leveling, production cells, quality circles etc. Strangely, despite their power and ability to greatly improve operational performance, these tools have not been very effective in lean implementation.

Many of the companies that report initial gains from lean implementation often find that improvements remain localized, and the companies are unable to have continuous improvements going on. One of the reasons, we believe, is that many companies or individual managers who adopted lean approach have incomplete understanding and, as a result, could not be able to gain all the benefits as Toyota enjoys. Frustrated by their inability to replicate Toyota's performance, these companies assume that secret of Toyota's success lies in its cultural roots.

But Toyota has successfully introduced its production system all around the world, including in USA, and New United Motor Manufacturing Inc. (NUMMI) is a well known example to narrate the success story (Adler 1993). The objective of this paper is to report some learning by way of understanding and evaluating the lean implementation practices in some major companies in India, USA, and UK.

Stemming from the view of lean manufacturing, as an area of professional practice, there is a need yet to define lean approach: the content or subject matter of implementation. This consists chiefly of the models, methods and techniques, tools, skills and other forms of knowledge that go into making up any practice.

6.Overview of the Toyota Production System

The wastes noted above are commonly referred to as non-valued-added activities, and are known to Lean practitioners as the Eight Wastes. TaiichiOhno (co-developer of the Toyota Production System) suggests that these account for up to 95% of all costs in non-Lean manufacturing environments. These wastes are:

• Overproduction – Producing more than the customer demands. The corresponding Lean principle is to manufacture based upon a pull system, or producing products just as customers order them. Anything produced beyond this (buffer or safety stocks, work-in-process inventories, etc.) ties up valuable labour and material resources that might otherwise be used to respond to customer demand.

• Waiting – This includes waiting for material, information, equipment, tools, etc. Lean demands that all resources are provided on a just-in-time (JIT) basis – not too soon, not too late.

• Transportation – Material should be delivered to its point of use. Instead of raw materials being shipped from the vendor to a receiving location, processed, moved into a warehouse, and then transported to the assembly line, Lean demands that the material be shipped directly from the vendor to the location in the assembly line where it will be used. The Lean term for this technique is called point-of-use-storage (POUS).

• Non-Value-Added-Processing – Some of the more common examples of this are reworking (the product or service should have been done correctly the first time), debarring(parts should have been produced without burrs, with properly designed and maintained tooling), and inspecting (parts should have been produced using statistical process control techniques to eliminate or minimize the amount of inspection required). A technique called Value Stream Mapping is frequently used to help identify non-valued-added steps in the process (for both manufacturers and service organizations).

• Excess Inventory – Related to Overproduction, inventory beyond that needed to meet customer demands negatively impacts cash flow and uses valuable floor space. One of the most important benefits for implementing Lean Principles in manufacturing organizations is the elimination or postponement of plans for expansion of warehouse space.

• Defects – Production defects and service errors waste resources in four ways. First, materials are consumed. Second, the labor used to produce the part (or provide the service) the first time cannot be recovered. Third, labor is required to rework the product (or redo the service). Fourth, labor is required to address any forthcoming customer complaints.

• Excess Motion – Unnecessary motion is caused by poor workflow, poor layout, housekeeping, and inconsistent or undocumented work methods. Value Stream Mapping (see above) is also used to identify this type of waste.

• Underutilized People – This includes underutilization of mental, creative, and physical skills and abilities, where non-Lean environments only recognize underutilization of physical attributes. Some of the more common causes for this waste include–poor workflow, organizational culture, inadequate hiring practices, poor or non-existent training, and high employee turnover.

This TPS system, more than any other aspect of the company, is responsible for having made Toyota the company it is today. Toyota has long been recognized as a leader in the automotive manufacturing and production industry.[2]

Toyota received their inspiration for the system, not from the American automotive industry (at that time the world's largest by far), but from visiting a supermarket. This occurred when a delegation from Toyota (led by Ohno) visited the United States in the 1950s. The delegation first visited several Ford Motor Company automotive plants in Michigan but, despite Ford being the industry leader at that time, found many of the methods in use to be not very effective.

They were mainly appalled by the large amounts of inventory on site, by how the amount of work being performed in various departments within the factory was uneven on most days, and the large amount of rework at the end of the process. However, on a subsequent visit to a Piggly Wiggly, the delegation was inspired by how the supermarket only reordered and restocked goods once they had been bought by customers.

Toyota applied the lesson from Piggly Wiggly by reducing the amount of inventory they would hold only to a level that its employees would need for a small period of time, and then subsequently reorder. This would become the precursor of the now-famous Just-in-Time (JIT) inventory system. While low inventory levels are a key outcome of the Toyota Production System, an important element of the philosophy behind its system is to work intelligently and eliminate waste so that inventory is no longer needed. Many American businesses, having observed Toyota's factories, set out to attack high inventory levels directly without understanding what made these reductions possible. The act of imitating without understanding the underlying concept or motivation may have led to the failure of those projects. The underlying principles, called the Toyota Way, have been outlined by Toyota

7. Conclusions

Fierce competition, fluctuating market demand and rising customer requirements has led to customers becoming more demanding with increased preferences (Zhang and Cheng, 2006). This is as a result of today’s marketplace, characterized by shorter product lifecycles, more competitive product introductions and volatility in demand, which makes life-cycle demand more uncertain and difficult to predict (Christopher and Rutherford, 2004).

In the automotive industry, the 21st century, participating largely in globalization has created significant opportunities, and at the same time, put pressure on manufacturers to enhance quality, improve styling, increase organizational efficiencies and drive innovative features into their products in an effort to attract customers and expand into new markets (BCC, 2005).

These challenges imply that automotive manufacturers need to be flexible and responsive to customer demand in order to succeed. The critical role of supply chain management (SCM) in enhancing the automotive performance cannot be underscored. Authorities and organizations such as (Gunasekaran and Ngai, 2004; Hugo et al., 2004; Wei and Chen, 2008; IBM, 2009) have in one way or the other acknowledged the role of supply chain as source of competitive advantage to the automobile industry.

The industry has undergone significant structural and other changes in the last decade (Michalos et al., 2009). In light of this, the last 20 years has seen SCM practices developed toward more lean process approaches, in order to increase supply chain efficiency (reducing costs and eliminating inefficiencies).

The fiercely competitive global business environment and increasing customer demands have led to the development and continuous evolution of a number of related disciplines including SCM (Sahay et al., 2006). Supply chain management (SCM) can be defined as the design and management of seamless, value-added process across organizational boundaries to meet the real needs of the end customer (Fawcett et al., 2007).

Generally, SCM involves relationships and managing the inflow and outflow of goods, services and information (network) between and within producers, manufacturers and the consumers (Christopher, 2005; Samaranayake, 2005; Gripsrud, 2006).

A supply chain includes all activities, functions and facilities (directly or indirectly) in the flow and transformation of goods and services from the material stage to the end user (Sherer, 2005). It consists of an upstream supplier network and downstream channel (Klemencic, 2006).

Today, many organizations have become part of at least one supply chain. They have to perform equally well in order to achieve better performance. A typical supply chain may include suppliers, manufacturers, distributors, retailers and customers.

The automotive industry is made up of supply management and physical distribution management. The industry supply chain stretches from the producers of raw materials through to the assembly of the most sophisticated electronic and computing technologies (Tang and Qian, 2007). The major component of the supply chain include suppliers (tier 1 - 3), OEMs, distribution centers, dealers, customers (Hugo et al., 2004). Most automotive OEMs create 30 to 35% of value internally and delegate the rest to their supplier (Dietz, 2004).

Manufacturers purchased entire subassemblies, such as doors, power trains, and electronics from suppliers. The desire to work with partners to outsource subassemblies is leading to a radically new infrastructure to support the design, procurement, and logistics processes of the manufacturers (Benko et al., 2004).

Tang and Qian (2007) comprehend that to improve their innovative ability, get cars to market faster and reduce errors, automotive manufacturers need to improve their development and management abilities through advances in computer-aided design (CAD), computer aided process planning (CAPP), computer-assisted manufacturing (CAM), computer-aided engineering (CAE), concurrent engineering (CE), product data management (PDM), business process engineering, etc.

The automotive industry has undergone a transformational evolution over the last two decades (Swieki and Gerth, 2008). Hugo et al. (2004) noted that the traditional method for designing an automotive supply chain requires a fully integrated, lean materials flow pipeline, certain design constructs and activities have to be engineered into the supply chain.

Historically, the industry operated under a “push” model. In this model, marketing and sales takes a best guess at market demand and then feed these forecasts into the design, engineering, financial and manufacturing teams to determine make and/or model production volumes (Howard et al., 2006).

With the boom of the Internet, data has become much more accessible to both manufacturers and consumers of automobiles (GXS, 2005; Tang and Qian, 2007). The industry focused primarily on lean, “Just In-Time” manufacturing processes and their supporting technologies. OEMs and suppliers spent millions of dollars and millions of man-hours re-engineering processes and technologies to support a demand-driven model.

Because the price tag for reengineering and supporting technologies, for example, ERP was prohibitively high, efforts were limited to OEMs and their Tier 1 suppliers. Significant progress was made to “commonize” process and technology within the "four walls," however, these efforts were creating a widening process and technology gap between OEMs, Tier 1s and the rest of the automotive supply chain.

As the Internet became a common fixture in automotive business-to business (B2B), competitive pressures grew exponentially (Tang and Qian, 2007). In mature markets, automotive firms face stiff competition and demanding customers. Mass production (forecast driven) has led to overstocking, extra marketing expenses and low profitability The fierce competition, fluctuating market demand and rising customer requirements is a key challenge in the automotive industry.

Lengthy demand planning cycles and lack of visibility to supplier, material, and production constraints have caused scheduling delays and short term production changes. Customers are more demanding and the sheer varieties of cars create an increasingly complex challenge, different preferences and specific requirements for each car, which includes the range of body-styles, engine sizes, colours, options, and trim levels, etc.

The automotive industry requires flexibility and responsiveness in their supply chains. In order to maintain and improve levels of efficiency, quality and cost effectiveness, automotive component suppliers will have to look at different areas across the board to streamline their operations. The generic supply chain strategies are lean and agile supply chain. While leanness is most appropriate to be used in a stable and predictable environment, agility can achieve more benefits in a volatile and unanticipated environment.

The leanness paradigm pays more attention to the low cost, high quality and is more focused on technology and systems. On the contrary, the agility may put higher emphasis on the flexibility and quick delivery to the customers. An agile manufacturer needs to maintain a certain degree of buffer capacity to cope with the volatile demand and high variety of products and is focused on people and information.

Furthermore, the paper suggests a framework for legal supply chain for the automobile industry. Application of the framework would ensure cost minimization and at the same time respond to customer demand. The industry is faced with global financial crisis. This has led to increased pressure on the automotive competitive performance. Hence, leagile supply chain is the strategy of the millennium that can alleviate the automobile industry from the current challenges and suggesting a framework for leagile supply chain strategy is of utmost importance to the industry.

Lean is becoming the next "quality" or "e Business" practice area. In the 1980s, companies with superior quality were able to more easily enter new markets and command higher prices for their products and services than companies with inferior quality.

In summary, the type of inter-firm relation and the interaction between public and private sectors show the integrative approach of Lean Practitioners, which prioritizes the parties‟ mutual goals over their individual interests. Information exchange, technological transfer and diffusion of practices among firms are strongly emphasized. Such a holistic view created a pattern of close relationship among firms and an environment of cooperation, which involves joint efforts to improve productivity and quality of the entire supply chain network, facilitating technology spill over and information sharing across firms and industrial boundaries.

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