Measuring JIT Performance in Auto-suppliers industry in The United States

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Abstract

The just-in-time (JIT) production system has been used in the United States for decades, often not to its full extent. Japan has also implemented JIT in many of their organizations both at home and in their manufacturing sites abroad. Many American companies that have adopted the JIT system both internally and externally did not receive outstanding results even after many attempts. Many experts point out that JIT has to be modified in order to fit in the American culture. JIT is not just a philosophy but an actual process.

The core JIT philosophy is to achieve the performance of activities based on immediate need or demand. JIT can be applied not just in the manufacturing area, but it also can be broadly used as a process that is designed to assist companies in operating cost, reduce their energy usage, processing times and material. In fact, JIT has now become popular in many industries such as hospitals, education, banks, trade, information technology and many others.

This paper will focus on the JIT performance in automotive supplier industry. In chapter one, the brief history and current situation of automotive industry will be addressed, in chapter two, the previous research and observations will be covered as well as advantages and disadvantages of JIT. The qualitative survey results and survey data were collected via telephone in order to eliminated survey errors (participants can ask question if they do not understand the question). The data was analyzed by SPSS software; the researcher used the following models: Cronbath's Alpha, Factor analysis, Pearson Correlation, Mean, and Crosstab.

Keyword: JIT, Just-in-time, automotive supplier, and JIT performance.

Introduction

Automobile production involves two types of companies: parts manufacturing (suppliers) and vehicles assembling (automakers). Most consumers recognize the automakers, but few will pay attention to the suppliers. This is because most people believe that automakers produce everything for their products. This may have been true in the late nineteenth century or early twentieth century. However, automakers had to let parts makers handle more and more components in order to concentrate on marketing and selling their vehicles. Unsurprisingly, suppliers have more than three and a half times more employees and contribute 60% of the value of a finished vehicle. In fact, parts suppliers took on such an important role that the major factor influencing the competitiveness of carmakers is the strength and constructiveness of their relationships with their suppliers (Klier & Rubinstein, 2006).

Each vehicle contains approximately 15,000 parts. Because automakers decide to have suppliers take care of producing parts, managers of purchasing department have to figure out how to promote long-term relationships and mutual cooperation with suppliers. Their interactions extend from product development to manufacturing or the other option is to rely on shorter-term contracts and competitive bidding, as well as more in-house development and manufacturing, in an attempt to lower final costs (Abernathy 1979; Monteverde and Teece 1982). Many researchers have found interesting cases on how Japanese automakers have been relying on their suppliers to boost up performance. According to Cusumano, in the late 80's auto suppliers (including non-consolidated subsidiaries) accounted for about 70% of manufacturing costs (Cusumano, 1988) as well as over half of the engineering hours required- for new product development (Clark 1989; Fujimoto 1989). In addition, effective supplier management and supplier contributions also have been frequently cited as key factors in Japanese cost and quality advantages over The United States counterparts, not just in auto industry but other industries as well (Nishiguchi 1989). The results indicated that extensively relied on suppliers have more positive impact on business. On the other hand, Japanese automakers transplanted their manufacturing plants into the United States in the 80's; therefore they also faced the challenge of dealing with U. S. based suppliers in quality, prices, and delivery. Furthermore, because of joint ventures or mergers with Japanese automakers the U. S. automakers also improving both cost and quality standard as well as adopting Japanese practices for supplier management (Sabel et al. 1989).

In the United States, Japanese automakers encouraged major Japanese component companies to establish plants as well this was intended to ensure quality of locally available sources and avoid suppliers' shortage. Many local suppliers were contracted to their American counterparts creating a potential problem for the Japanese automakers. For example, General Motors, produce most of components in-house using dependent subsidiaries. These variations cannot be simply ignored; Sadler (1994) states "the degree of "outsourcing"- the proportion of the value of a model purchased from independent component suppliers-averaged about 35-40 percent for the Big Three in North America (Sadler, 1994)."

Just-In-Time

Just-In-Time (JIT) carried an inherent logic, wherein spatial proximity between automakers and supplier was fundamental to its efficiency (Hoffman and Kaplinsky 1988). That is, by adopting JIT an extensive geographic shift in existing patterns of automotive component supply was necessary. This was apparently supported by the selected suppliers out of the three hundred Japanese automotive component plants (Included those joint ventures with American companies) and they established alongside the new Japanese assembly facilities in North America during the 1980s (Sadler, 1994).

JIT manufacturing is a system that produces goods based on demand. It differs from the traditional American manufacturing idea of producing as much supply as possible in expectation of demand. To be exact, JIT will reduce all work-in-progress, and produces only goods that are immediately needed and reduce the inventory as much as possible. Drury (1990) states that JIT attempts to manufacture products from start to finish, the first task in applying JIT production, is to rearrange the factory floor layout away from batch production toward a product layout using flow lines. In addition, each flow line will be like U-shaped. This design will increase workers ability to operate and manage more than one machine, and the ability to help other workers if any trouble occurs in the production line. If any problems are encountered during the production flow, the entire line shuts down, and the problem is resolved immediately. Since parts are produced based on demand, there is a continuous flow of components rather than a bunch of work-in-progress (WIP).

Under this situation, any issue (defective parts) will be eliminated. When only minimal levels of inventories are maintained, any hold up in the production process may cause delays in customers' deliveries. Doing the job right the first time is one of the main emphases of JIT production (Drury, 1990)

First, Japanese automakers had lowered the in-house production ratio while compared to those U.S. automakers. In addition, the Japanese parts suppliers share more parts development and design competency to their buyer (automakers) as compared to their US counterparts. In fact, it increases the Japanese automakers' ability to design and develop cars with less manpower and within a shorter timeframe.

Secondly, the Japanese supplier system had a hierarchical structure, with each major automaker at the top of the hierarchy. Japanese automakers do not directly deal with parts suppliers as frequently as U.S. competitors. Therefore, the management cost with regard to the purchase of parts was relatively lower than U.S. automakers (Konno, 2005).

In order to make JIT more professional, both automakers and parts suppliers should build an electronic information network, connected together, and participate in a JIT-based production system. Furthermore, it is important to share and exchange information with selected suppliers in order to maintain long-term business relationships. This provides benefits that can be enjoyed by both suppliers and assemblers in the way of profits generated through more moderate transaction costs and through a learning effect brought about by the accumulation of production experience (Monden, 1998).

Many studies in economic geography in Europe and America have been indicating that the concept of JIT is a complex phenomenon that includes: (1) changes to a company's internal production system and labor relations; (2) the reorganization of relationships with suppliers and subcontractors; (3) the introduction of a Japanese-style production/management system; and (4) the efficient distribution of parts. In this paper, since it is not possible to cover the entire spectrum of contributing factors, our argument will be limited to the spatial aspects associated with the distribution of automotive parts (Kaneko & Nojiri, 2008).

Building Relationship

Indeed, automakers want to generate the maximum profit from customers, but not suppliers. Taiichi Ohno (2006) stated that, "The achievement of business performance by the parent company through bullying suppliers is totally alien to the spirit of the Toyota Production System."(p.6). The key word in that statement is "parent," which signals a long-term relationship that involves trust and mutual well-being. At the same time, the relationship connotes discipline and the expectation of improvement and growth.

In the 90's, more and more automakers starting demanding their suppliers to reduce the costs, improve the quality, and also wanted them to innovate the components in shorter period of time. While Japanese automakers increase their market share rapidly since 80's, many experts suggest that The United States Big Three should establish supplier keiretsu, and train their supplier to improve and act more efficiency. However, most of them failed, some of them even created supply chains that apparently look like their Japanese counterparts, but they forgot the organizational culture. Therefore, the relationship between U.S. automakers and their suppliers have been stuck at an inferior level (Liker & Choi, 2004).

Liker and Choi (2004), who have studied the American and Japanese automobile industries for more than two decades, found that Toyota and Honda have built great supplier relationships by following six steps. First, they understand how their suppliers work. Second, they turn supplier rivalry into opportunity. Third, they monitor vendors closely. Fourth, they develop those vendors' capabilities. Fifth, they share information intensively but selectively. And sixth, they help their vendors continually improve their processes.

However, on the other hand, some companies are doing quite well with their keiretsu structure. For example, Toyota is increasing its share-holding ratio as well as dispatching executives to its keiretsu suppliers. Nissan also tried to strengthen the framework with their core suppliers by launching "Project Partner Companies System" which is exchanging information. Even though Nissan said they have completely separated with its keiretsu group in the past (Konno, 2005)

Buyer-supplier relationships in the automotive industry in the United States and Japan

The reason of why this paper is focusing on automotive industry is it demonstrates both the traditional and the relational models of the buyer-supplier relationship and a stream of literature

deals with such relationships in the US and Japan, individually and comparatively (Hill, 1995). GM tried to save cost by encouraging intense supplier competition in early 90's. However, it made a serious negative impact; even though GM claimed they have saved about 4 billion. In the meantime, Toyota had developed long-term relationships with suppliers by offering long-term business relationship (Bensaou & Venkatraman, 1995). Suppliers, in return, have made relation specific investments to improve Toyota's productivity (Hill, 1995).

In the contrast, the Big Three have generally maintained non-exclusive and arms length arrangements with suppliers, thus sharing a large number of common suppliers (Womack, 1990). Suppliers in principle benefit from such practices by learning from multiple customers and economies of scale opportunities. Yet, due to the maintenance of multiple sources and thus bargaining power by the US automotive manufacturers, the size and scale of suppliers are restricted. Therefore, Japanese suppliers generate triple revenue than U. S. counterparts annually (Dyer, 1996). The buyer-supplier relationship has been drawing so much attention due to its importance. That is, maintaining buyer-supplier relationship will add value of competitive ability in supply chain management.

Length and Stability of Relationships

Many researchers found that the relationships between buyers and suppliers in the Japanese auto industry tended to be longer term and more stable than in the U. S. industry. Cusumano (1985) states that Japanese automakers making most of their materials and parts by themselves and then began producing automobiles in the 1930s. They have been established suppliers and supplier organizations prior to World War II to help them increase production and then continued to develop close relationships after the war as output levels climbed significantly (Cusumano, 1985). According to Asanuma (1988), Japanese automakers continued to utilize a select group of suppliers in the late 1980s as well as maintain contracts with these firms for particular components until the automaker altered the components through full model changes (usually once every four years in Japan) or minor model changes (generally every two years) (Asanuma, 1988).

Innovating to improve process

The leading Japan-based OEMs were clear efficiency leaders between 1987 and 2002. They minimized the hours required for assembly and also improved quality by, for example nearly reducing end-of-line re-work and creating close advantaged relationships with suppliers that raised quality and efficiency throughout the value chain. The Big Three still get behind significantly on hours per vehicle and have difficulty on adopting these solutions. During the 80's, the Big Three sent people to learn lean production system, taking look-and-learn tours to Japan, and forging strategic alliances with the Japan-based OEMs. In the end, Ford reached best practice assembly hours-per-vehicle in 1987, according to analysis, Chrysler achieve the goal in 1992 and GM in 1997 (Baily et al, 2005).

Therefore, implementing JIT purchasing systems will not only reducing inventory costs, but also shorter lead times, and improved productivity for buying organizations (Tracey, Tan, Vonderembse, and Bardi, 1995). A buyer's inventory costs may be reduced because costs are transferred to suppliers after implementation of JIT (Romero, 1991), so suppliers' inventory costs are less likely to decrease (Dong, 1998).

Based on the suppliers' performance, here are the research questions: (1) Is there a significant and direct influence among supply chain integration, JIT purchasing and JIT manufacturing; (2) Do supply chain integration, JIT purchasing and JIT manufacturing have significant and direct benefits for suppliers' logistics performance; and (3) What are the explanatory powers and influences of supply chain integration, in comparison with JIT purchasing and JIT manufacturing, for suppliers' logistics performance.

The hypotheses of the study

H1: Supply chain integration directly influences JIT purchasing.
H2: Supply chain integration directly influences JIT manufacturing.
H3: Supply chain integration directly influences logistics performance.
H4: JIT purchasing directly influences JIT manufacturing.
H5: JIT purchasing directly influences logistics performance.
H6: JIT manufacturing directly influences logistics performance.

Literature Review

In this chapter, the previous research literature on JIT adoption and activities will be summarized, as well as its impact on firm performance and the buyer-supplier relationship, supply

chain management and integration, and other related issues. Particularly, the fundamental activities in JIT operations, the environmental conditions that may motivate JIT implementation, the impact of JIT on buyers as well as suppliers, and Toyota Production System combination and its implications on JIT performance are discussed and reviewed.

JIT strategies are generally separated into two categories: JIT manufacturing and JIT purchasing. In JIT manufacturing category, many researchers and scholars have accomplished to a significant degree within a comparatively isolated internal, operational environment with few behavioral interactions between different parties involved in JIT activities. However, JIT purchasing has much to do with supply chain management. Therefore, more research has been conducted. Three main courses relating to JIT purchasing and supply chain management are: 1) marketing oriented: JIT and the buyer-supplier relationship within a behavioral and/or organizational framework; 2) operations management oriented: likely to consider operational processes and relationships with a focus on experimental issues at the operational level; 3) business logistics research: involving the first two in terms of methodology (Dong, 1998). The following literature reviews are summarized form the theories and peer-reviewed articles focusing JIT research areas.

According to Ballou (1992), JIT refers largely to a philosophy "where the entire supply channel is synchronized to respond to the requirements of operations or customers" (p. 528). Many authors distinguish between JIT manufacturing and JIT purchasing. The JIT promotes the reduction of waste by cutting down production processes, shorten the set up times, controlling material flows, and emphasizing preventive maintenance are seen as ways by which excess inventories can be reduced or eliminated, and resources utilized more efficiently (Kannan & Tan, 2005).

Taiichi Ohno, the creator of Toyota production system, described JIT production by saying, "All we are doing at the time line from the moment the customer gives us an order to the point when we collect the cash, and we are reducing that time line by removing the non-value-added wastes (Liker, 2004)." In fact, Toyota engineers identified several different types of waste and categorized them into seven forms as following: Waste of overproduction, Waste of inventory, Waste of repair/defects, Waste of motion (unnecessary movement), Waste of processing, Waste of waiting, and Waste of transport (Imai, 1997; Taylor and Brunt, 2001; Liker, 2004).

Since numerous economists suggested the JIT may create a quandary; although it could eliminate inventories and contributes to reduce the costs associated with inventories, it also contributes to getting rid of benefits that are associated with inventories. It is not obvious how come an unrelenting drive toward a zero inventory policy (ZIP) should be efficacious. Consider Zangwill's (1992) characterization of JIT: In most manufacture approaches, inventory is important, as well as a fair amount is required for effective operation. This indeed is not the same for the Japanese production hypothesis, which focuses on different views and requires zero inventories. Inventory is a reflectivity of waste, this hypothesis proclaims, and the more in the stock, the more the underlying waste (p.15). Whenever quality is bad, additional parts must be on hand to replace defective parts. This additional inventory is uneconomical and, if quality were better, then this could be eliminated. Inventory is frequently controlled to supply parts in case a machine collapses, or worker does not attend, or parts fail to arrive on time. The inventory is controlled, thus, to cover for underlying wastes or inefficiencies, as all this theory claims, should be wiped out (Zangwill, 1992).

The integration of JIT was not design for the U.S. initially. There were many barriers such as undependable demand (possible out of stock), supply (efforts on re-product and prolong waiting time), labor relations (worker analphabetism and unions), inflation (decreasing value in inventory and weaken financial intensity), and even management lose it effectiveness. The elements above can be categorized as followings:

1. Reducing Cost
2. Quality and Supply
3. Labor relations / Management initiatives (TQM)

Reducing Cost

Reducing Cost is a comprehensive field of reducing inventory, quality control, and employees' salaries. Fully understanding of the where capital and waste were in order to make these operations work. Reducing inventory is to cut down the quantity of inventory on hand to certain levels, which meet the minimum safety level for unexpected demands. According to

Aghazadeh (2001), there are many methods to calculate applicable to inventories for instances: economic order quantity, product order quantity, and quantity discount models that can reduce the amount of cost that is involved in the inventories themselves resulting in capital savings (p.34).

The US auto industry tried to adopt many Japanese production methods with tons of effort, but the outcomes did not reflect the effort. In Japan, the suppliers take their respective tasks and procedures to perform and will not go over those limits, as it were. On the other hand, in the U.S. it has been an issue of both companies and suppliers making parts for the same purpose, therefore making wasteful allocation of resources, and waste. This has been reduced by implementing a new system of hierarchical supply.

Supply and Quality

Kanban and quality control are the top methods used in Japan nowadays. Because manufacturers cut down their inventory, tighter demands are aimed on the suppliers. This became a controversy of planning and scheduling of the manufacturer, in addition to quality, location, and cost. The planning and scheduling is a core concept, as manufacturer applies material requirements planning (MRP) and additional substance to stabilize production. Essentially, they must work with suppliers to establish the transition flows smoothly, thus, the parts can arrive in the right places and right times. The Kanban, formulated by the Japanese, is a system to authorize producing, and purchasing the required replacement. Naturally, this allows minimum lead times. Nevertheless, JIT is all about minimization.

Many global organizations have attempted to use vertical integration as a strategy. This process requires organizations to acquire new divisions that supply different needed parts for the assembly of the product. They can separate their individual needs and produce and then assemble those required parts in large-scale quantity, hence cutting down their own costs much more. According to Rubenstien (1992), Ford and GM established facilities and made their own parts at large amount of individual items to attain lower product costs. The portions of self-attained parts supplied in house were significant: GM has 75%, Ford has 50%, and Chrysler has 40%. This effected the auto industry dramatically, especially in Detroit, the world largest automotive producing city, has lost 30% of its labor division (p.168). This made a huge change and pushed the suppliers and automakers to start working together to communicate and coordinate the needs, lead times and production criteria. The suppliers began to build plants near assembly plants to reduce transportation cost and time. GM was the first U.S. automaker to weigh the cost benefit advantages to outsourcing and spending less money by purchasing from outside.

Labor Relations and Management Initiatives (TQM)

According to Aghazadeh (2003), TQM is an important role in JIT as encourage workers to help in the development of cost savings measures to get job done, and many other areas of reduction. TQM can be applied in team initiatives were: collecting data, retraining labor, communication. Here are the basic worker focused concepts:

1. Visualize the procedure in less steps if possible
2. Remember that inventory is a moving item not a stable one
3. Emphasis should be placed on the synchronization of each procedure
4. Simplify, unite, eliminate unnecessary activities
5. Wastes are over (under) output, unneeded steps and excessive inventory and motion (p.37)

These basic steps can attribute to JIT success. Routine employees properly in the workshop can save labor cost without delaying the production flow. JIT is a tool for senior management to implement TQM. Assign an upper-level team to command and supervise effectiveness and administer adherence (motivators and punishments) policies.

Just-in-time purchasing

According to Gonzalez-Benito et al., JIT purchasing practices have initially been divided into two groups: operational and complementary practices. Operational practices also called the logistic practices, because it has the characteristics of JIT purchasing fundamentally affecting the physical flow of materials from the supplier to the purchaser. Complementary practices, on the other hand, since they contribute to the efficient working of the operational practices, and further divided into three subgroups: relational, involvement and quality practices. The subgroup of relational practices intends to set up cooperative relationships with a reduced supply base. Therefore, it encompasses practices such as long-term contracts, single sourcing, cost-based

negotiation and benefits sharing, which characterize an evolution of governance structures from competition to cooperation and entail an intensive flow of information between both parties (Gonzalez-Benito *et al*., 2000)

The subgroup of involvement practices includes those practices fostering supplier participation in the relationship. Early supplier involvement in product development and supplier development are hence included. Finally, the subgroup of quality practices fundamentally comprises quality certification and quality and reliability based selection. Although these practices are traditionally developed in cooperative environments since they require intensive information exchange and aim at eliminating systematic inspection of receptions, they are, in some way, a set of safeguards that the company establishes to protect against supplier incompetence.

JIT purchasing has been differentiated with the traditional ideas of manufacturing, purchasing, and materials management. The fundamental concept of JIT purchasing is to make sure that production is as close as possible to a continuous process, from receipt of raw materials/components through the shipment of finished goods (Gunasekaran, 1999). JIT purchasing has the following characters: less suppliers, local suppliers, rapid deliveries with small quantities, secure contract agreements, and close relationships between buyers and suppliers (Schonberger and Gilbert, 1983). In addition, Tracey et al. added perfect quality, and effective, efficient transportation and material handling systems (Tracey et al., 1995).

The benefits of JIT purchasing for buyers are reduction of the costs for carrying parts inventory, transportation, redraft, and accelerating the transition, less suppliers to deal with, fast detection of defects, inspection reduced, quick response to engineering modification, and so on (Schonberger and Ansari, 1984). According to Dong et al, JIT purchasing strategy is aimed at a synchronized and timely product flow from supplier to buyer. Therefore, the basic elements of a JIT purchasing strategy include: (1) reduction in order sizes; (2) reduction in order lead times; (3) quality control measures, including supplier quality certification and preventive maintenance programs; and (4) supplier selection and evaluation (Dong et al., 2001). It also requires a high level of teamwork between automaker and part supplier. Automaker does not assume to hold stocks of parts to allow for the insufficiency of the supplier, but instead expects to receive parts as quick as possible when they are needed. The supplier, on the other hand, needs to be taken into the confidence of the automaker, particularly in terms of the visibility of the forward order book and developments in product design.

Just-in-time Manufacturing

JIT manufacturing engages the producing goods depend on demand. It opposes the traditional American manufacturing ideal which was of producing as much inventory as possible in expectation of demand. According to Drury, JIT tries to assembly products from start to finish, in order to applying JIT production, first is to reorganize the factory floor layout from lot production toward a product layout using flow lines. In addition, each flow line will typically be U-shaped. This layout allows workers able to operate more than one machine, as well as increase ability to help other workers if any problem occurred in the production line. In case of problem occurred during the producing process, the entire production line will be shutting down, and the problem will be identified and solved immediately. Because most of parts are produced based on demand, it uses continuous flow of components rather than traditional batches of work-in-progress (WIP). That is, under this environment, faulty parts must be removed. Only minimal levels of inventories will be maintained, any delay in the production process may cause hold up in customers' deliveries. Doing the job right at the first time is one of the main emphases of JIT production (Drury, 1990).

Hofer and Schendel state that there are three levels of strategy: 1. Corporate Strategy: makes the businesses that corporation should be in, 2. Business Strategy: labels the ways to compete in a given business, and 3. Functional Strategy: defines how each function contributes to the competitive advantage of the business (Hofer & Schendel, 1978). Manufacturing strategy is part of functional strategy, and it contributes to the competitive advantage of the business. Why? Because manufacturing strategy is the process companies use to build the resources and the capabilities to create competitive advantage, and to align their competitive priorities with the marketing function (Schroeder and Flynn, 2001). Furthermore, Bates et al. described manufacturing strategy as a design for the manufacturing function that supports the achievement, development and elimination of manufacturing capabilities far into the future (Bates et al., 1995).

Robinson and Timmerman's discovered a supplier rating system based on ten performance factors that was developed by a company based on their study. The ten factors were: price, cost of quality, sales agreement, match product specification, pass the product expectations, quality assurance, delivery assurance, lead time, administrative precision, and after sales support. Weights were determined for each of these ten factors, and the company's suppliers will be rated based on their performance (Robinson and Timmerman, 1987). The company promoted a supplier day which gave awards to its top performing suppliers. The suppliers' reaction to the company was quite positive. They considered the company as being on top of things, and it was an encouragement for them to improve their quality and service consistent to the company. Meanwhile the company became more responsive to the type of service required from their suppliers with a modified rating system. Although the system was not perfect, it was a nice system that any company may apply when evaluating supplier performance.

The JIT production embodies everyone's participation and contribution to ensure operation runs smoothly. Cooperation and coordination amid employees, procedures, and functions are of determinant importance for JIT success. Besides that, supply chain management is the key point in JIT environment and if failed in supplier management and customers will inevitably obstruct JIT production. This means that extra responsibilities will be carried by workers and managers. These new responsibilities are quality control and preventive maintenance, multi-functional employees, suggestions for nonstop improvements and involvement in small-scale groups for problem resolution. Technology became a significant role in JIT environment to guarantee that agendas are met all of the time and set up times are cut down to the lowest possible. Advanced technology will enhance the competitiveness of the firm and new products development. According to Ahmad et al, the effectively of JIT production is likely to represent higher in an organization with a clear manufacturing strategy (Ahmad et al., 2003).

Based on a comprehensive survey of JIT literature, White and Ruch (1990) blended the literature and identified ten management practices typically associated with JIT manufacturing systems and viable for execution in U.S. manufacturers. They are: quality circles, total quality control, focused factory, total productive maintenance, reduced setup times, group technology, uniform workload, multifunction employees, Kanban, and just-in-time purchasing (White & Ruch, 1990). White and Ruch anticipated that the individual JIT management practices be introduced into U. S. manufacturers as separate programs for improving performance; however, the researchers suggested that the greatest gains achieved by organizations implementing JIT may be the synergistic benefits derived from the JIT management practices operating as an integrated system.

According to Lorefice, the three basic elements of JIT manufacturing are: 1. People Involvement, 2. Plants, 3. System. People Involvement: we must maintain support from all people involved in production. This will reduce time, conflicts between management, and also minimize implementation issues. Overall, we try to have all employees' involvement. Stockholders and owners of the company are able to give input. Labor organizations are beneficial if they are aware of all information of JIT. Management support is helpful if support from all level of management. In addition, governmental support is needed.

Plants: there are certain requirements needed to obtain while implement JIT. Here are the requirements: Plant Layout: mainly focused on maximizing working flexibility; Demand pull production: manufacture once the order is received. This allows company manages more appropriately in the quantity and time; Kanban: a card or a tag in Japanese, shows information of inventory status and process on the card; Self-inspection: carried out by the workers that catch the defects; Continuous improvement: every participating member should adopt this concept constantly.

System: Both the technology and process that combines the different processes and activities together. There are two major types, which are Material Requirement Planning (MRP) and Manufacturing Requirement Planning (MRP II). MRP is a manufacturing approach that controlled by computer. MRP involves the production plan and the master production schedule. The production plan is the management and planning of resources. Master production schedule engages in what products should be produced in what time. MRP II is involved in operation includes the management or planning of financial resources. All three factors form the elements of JIT (Lorefice, 1998). Researchers have found numerous benefits incurred by implementing JIT production. Hay (1988) states JIT not only offer companies on outstanding gains in quality of

manufactured goods, but also help them to reduce reaction time to market nearly 90 percent.Manufacturing procedures are delegated for preceding and subsequent processes in order to make the kanban system work, the production kanban is a card that authorize production line to operate, and the withdrawal kanban is a card that authorize the good to be moved.

Toyota practiced kanban at its U.S. joint-venture facility in California (Became fully owned in 2009). The JIT execution began in the assembly area and came along with the manufacturing sector to selected suppliers over a two-year period. The system applies material requirement provision as overall production planning and kanban for workshop floor control. A single kanban system will be applied, when kanban represents the authority to produce and move. The system integrates many adaptations, such as use of paper tickets as kanban, multiple operation kanban, use of hooks/boards as kanban and staging areas. The workers participated in quality circle activities during paid overtime. According to Khanna, the benefits by this system accounted are: reducing in Raw Materials (RM) inventory (21%), Work In Process (WIP) (45%), reducing in storage cost (30%), reducing in forklift trucks (30%), reducing in presses (30%), reducing in labor (20%) and growth in output volume (40%) (Khanna, 2007).

JIT works great in those companies with slow but steady mode. Fast carrying out could make workers feel frustration and disappointment on the workplace that conflict to accomplish what their higher authorities comprehend to be comparatively easy. For example, reducing WIP inventories increases inventory turnovers which will lead to reduction in inventory investment and improve cash flow. Keep this in mind; it took almost 20 years for Toyota to adapt these techniques and still improving.

By applying kanban system can make JIT faster and easier. It aids to keep track of the number of products that has been produced and number of products that need to be producing soon in near future, which is the important intention of JIT manufacturing. Once the kanban system is applied, everything must be done with authorization. Thus, this technique offers a clear idea of how many raw materials require to be bought, and how many finished goods have been shipped and WIP inventories.

Just-in-Time Performance

According to Flynn et al., JIT performance can be measured by inventory turnover, cycle time, lead time, delivery performance, and other measures (Flynn et al., 1995). Yasin et al. (1997) recommended fourteen variables to measure JIT performance are: the size of reduction of inventory due to JIT; the level of reduction of rejects of finished goods due to JIT; the degree of improvement in on-time receipts from suppliers due to JIT; the extent of lead time reduction due to JIT, and the level of improvement of relationship with suppliers due to JIT.

Many researchers believe that total quality management (TQM) practice and JIT practice have certain level of relevant, associations, and connect to each other. These practices are called infrastructure practices, and separated into five dimensions: 1) information feedback, 2) plant environment, 3) management support, 4) supplier relationship, and 5) workforce management. Hall states that “information feedback offers a workforce with process and performance information to support in decentralized management of the production process and variance minimization (Hall, 1987)”. Toyoda and Toyoda point out that it is important to make the plant environment clean and organized will shorten switch between products and an methodical approach to problem resolving (Toyoda & Toyoda, 1988). Management support involves strategic communication (Hall, 1987), development of a company culture, or the "social energy that drives-or fails to drive-the organization" (Hitt et al., 1991), and rewarding JIT and TQM efforts (Ebrahimpour & Lee, 1988). Garvin suggests that infrastructure activities will contribute positive impact supplier relationship as they are focusing on quality and time measures rather than on cost criteria when they select suppliers (Garvin, 1983), establish long-term relationships with mutually supportive (Ansari & Modarress,1986), and have meetings frequently between purchasers and suppliers to exchange technical, economic, and managerial information and services (Schonberger & Ansari, 1984). Workforce management engages investments in the training and development, selection, and retention of employees. In addition to transforming a company's product, employees add tangible value through their problem solving ability, coordinate the work of departments, and practice judgment in unique situations (Snell & Dean, 1992). Therefore, investments in labor force management will increase the organization’s human capital, which has economic value to the firm (Hitt et al., 1991; Snell & Dean, 1992).

There are only a couple of experimental analyses that relate JIT plant adoption to underlying incentives. Banker et al. (1993) demonstrated that the feedback of manufacturing performance results to line workers is positively related to the execution of JIT at the plant level, which indicates that motivators prompt activities. Nevertheless, this research paper did not look into plant performance results, and no information regarding whether incentive-driven actions affect performance. In Young and Selto's (1993) subject study of a JIT section of a single manufacturing firm, they were hoping to have employee to revaluate the JIT implementation/performance and incentives. Unluckily, the manager did not allow employees to respond to any survey questions regarding incentives. In addition, they discovered that personnel evaluations and compensation were not related to workers' performance or to JIT implementation or performance.

In Chenhall and Langfield- Smitha's study (2003) of a single manufacturing firm, outcome on the affect of incentive alterations, examples are: a reward system, and JIT/ total quality management (TQM) adoption on performance results. Merely citation was made to the actions generated by the incentive changes and JIT/ TQM adoption. They have found that, although reward system and JIT/TQM adoption contributed to enhanced productiveness during the first 10 years, additional organizational changes in succeeding years, examples are team-based structures and value added management (VAM), were relatively disappointed. They attributed the failure of reduction of trust between workers and management generated by the mechanical control of reward system and the intrusiveness of VAM monitoring.

Logistic Performance

In terms of the diversity of JIT from a distribution-centered perspective, Van Egeraat and Jacobson (2005) state the following: In JIT, transportation costs and the costs for ordering and assembling parts will also increase if shipments are made more frequently. One measure to counter this is to adjust and reduce individual orders to match assembly schedules, thereby preventing any increases in ordering/assembly costs. Another measure is to reduce the distance needed for goods and services. However, the following reasons can be given for doing business with a supplier who is located far away from assemble plant; differences in labor costs in the area where the supplier is located; parts being produced in an intensive manner, and economies of scale to be pursued. The growth of technical capabilities in the region, or historical circumstances; continued inertia of location; parts mass produced with cheap labor costs may be supplied from a distance; concentrated production of high value-added parts also being performed at the distant place. It has also been observed that when suppliers have extended in scale and begin to deliver to a number of assemblers, they tend to locate away from their customers.

Measurement of logistics performance in production includes reduction of costs in inventory, transportation, and materials handling (Tracey et al., 1995), since logistics costs relate to the costs of inventory, transportation, and purchasing. The level of JIT manufacturing can reduce logistics costs, while the degree of supply chain integration and JIT purchasing reduces logistics costs only indirectly for suppliers (Dong et al., 2001).

Automaker and Suppliers relationship

Heide states that U.S. manufacturers have undertaken strategic realignments in the area of purchasing, and these strategic realignments result in purchasing efforts to establish stronger relationships with suppliers (Heide, 1995). According to Williamson (1985) and Heide (1995), developing stronger relationships is partly in response to the presence of uncertainty and transaction-specific assets. Zaheer and Venkatraman suggested that ‘‘higher degrees of quasi-integration imply a stable, long-term relationship between the buyer and supplier” (p.23). (Zaheer & Venkatraman, 1995). In addition, this type of purchasing strategy provides the buyer with more control over the transaction costs associated with the exchange relationship.

Landeros introduces a model for developing and maintaining buyer–supplier relationships. The model consists of four stages: 1) buyer’s expectations, 2) seller’s perceptions, 3) mutual understanding and commitment, 4) Performance activity. According to Landeros, understanding and managing conflicts in the relationship is the key to maintaining a cooperative buyer–supplier relationship. As a relationship function, purchasing is the role to interact with the firm’s suppliers. Therefore, it is hypothesized that strategic purchasing has a positive impact on buyer–supplier relationships.

Nishiguchi has found that one of the most important reasons for the competitiveness of Japanese manufacturers was the nature of Japanese subcontracting, which related to problem solving over opposed bargaining between buyers and suppliers. Nishiguchi (1994) concluded that Japanese companies have improved their performance by creating arrangements with their suppliers based on continuous improvement. Major contractors will receive benefit from better performance of the subcontractors, while subcontractors benefit from rules allowing for the fair distribution of benefits among supply chain members. Supply chain synchronization should obviously boost the usage and performance of JIT. The importance of a properly established and retain buyer–supplier relationship for a successful JIT strategy has been addressed in many studies. However, synchronization does not necessarily involve that the supplier's performance will improve with JIT.

Buyers may sense the inventory cost reductions once JIT is implemented while supplier inventory costs are unlikely to diminish (Dong, 1998). A buyer's inventory costs may be reduced only because costs are transferred to suppliers after JIT is implemented (Romero, 1991; Fandel and Reese, 1991; Zipkin, 1991). The unfavorable position that suppliers often are in (in relation to their customers) does not imply that they are always worse-off with JIT. In his theoretical work, Dong (1998) found that suppliers benefit from JIT if they have high carrying costs and low order costs and, therefore, prefer the small lot sizes associated with JIT.

The foundation of JIT adopted by large manufacturers is the selection, certification, fast response, and quality-orientation. It consistently focuses on cutting down inventories leads to delivery schedules made by weekly or even daily bases instead of the conventional monthly bases. Lately, many large customers (i.e.: automakers) are expecting their minor suppliers to deliver goods on the docks at exact hours of day. This is very important, without parts delivered on time the entire plant shuts down without inventory they cannot produce. During a plant tour in Hyundai automobile plant in Alabama, because of one supplier (instrument panel) delayed the shipment, the whole plant was shut down. Therefore, on time delivery is as important as quality control. Many small-scale manufacturers resist JIT because they have to take those costs shift from customers (i.e.: automakers). Together with the supplier's contribution to JIT manufacturing philosophy is the bit-by-bit reduction as serving the large JIT firms.

In the long-run, successful customer relationships for the small manufacturer will achieve their goals at reducing setup time, and offering a faster response to the customer's needs. By creating partnership the small manufactures will gain its output volumes in addition to narrow the production integrate. Greater production volumes will contribute to a stronger relationship between the supplier and small manufacturers. The materials, tools and sub-contracted suppliers to the small manufacturer also supply larger customers who most likely have established JIT-based requirements for their supplies. Therefore, these suppliers may be able to provide the small manufacturer with the same quality and delivery as their larger customers.

The advantages and disadvantages of JIT

The advantages of JIT inventory system are: 1) eliminates waste by concentrating on delivery the correct part at the right time. 2) Minimizes storage usage and reduces the cost of storage warehouse expense. Limited the stock space used for production lines will save money for the company. 3) Provides faster response time to take orders from customers. 4) Can reduce the lot sizes. 4) Reduce cost in wages, and save money on transporting goods to warehouses. 5) Decreases the time necessary for lead, setup, and production.

The disadvantages of JIT are: 1) the manufactures have to increase their quality control in order to reduce defective rate due to less inventory for replacement. 2) Shipping overseas became impossible and could not be controlled by the company (that's why auto makers encourage their first tier suppliers to establish their plant close by). 3) When ordering fewer quantities, the production line may become idle, which cost money. 4) On the other hand, if ordering a large quantity, then they have to pay extra shipping and wages for overtime in an effort to meet the demand. 5) Manufacturers often pay more as they require trained workers.

METHODOLOGIES

Introduction

The target industry of this study is automotive suppliers industry. The reason of choosing automotive suppliers because of it contains complex components and many foreign automakers and suppliers have operating plants in the U.S. for a long time. Of course, we should remember that The United States is number one consumer in the global market. Furthermore, the automotive

industry is comparatively advanced in applying lean methods. Cusumano and Takeishi (1991) state that many researchers lately found out that supplier relationship with U.S. automakers are experiencing major modifications with some patterns of Japanese supply-chain management (p.36)

The foundation for the research methodology is demonstrated in this chapter. The research hypotheses are going to be tested. In the first section, the sampling method will be explained. The survey sampling targets on senior manager from major first-tier and second-tier suppliers of the automotive industry. In addition, in-depth interview with some senior managers will be done as part of qualitative research. In the second section, the research methodology will be presented. This research applies an observational, cross-sectional survey design. A two-step approach to structural equation modeling will assess the nomological fit. The research instrument is described next, including the appropriateness of tile items to measuring the construct. The structural models, equations, and power analysis discussion are then provided. In the final section, the data collection method is explained. An overview of the research methodology is shown in Figure 3.1.

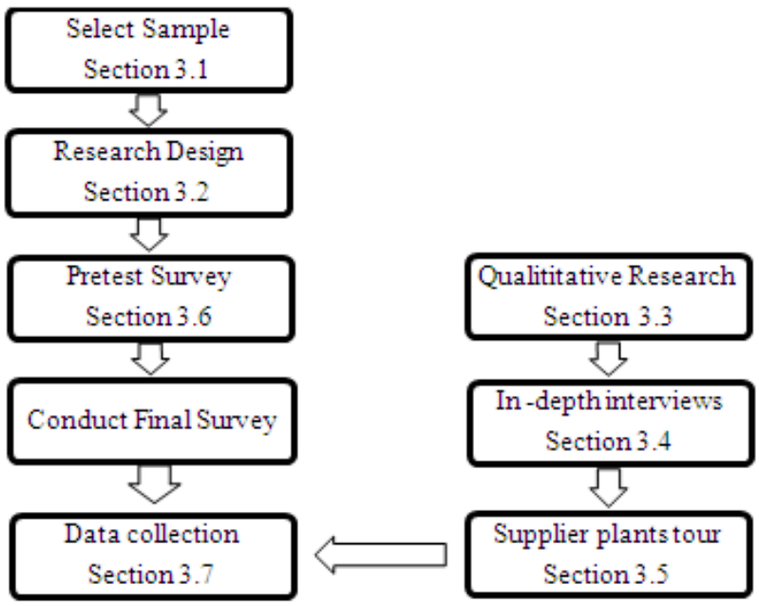

Figure 4. Research methodology

Research Question

The research questions will be repeated here for the reader's convenience:

(1) Is there a significant and direct influence among supply chain integration, JIT purchasing and JIT manufacturing?

(2) Do supply chain integration, JIT purchasing and JIT manufacturing have significant and direct benefits for suppliers' logistics performance?

(3) What are the explanatory powers and influences of supply chain integration, in comparison with JIT purchasing and JIT manufacturing, for suppliers' logistics performance?

Research Design

Interview question guidelines were used to maintain focus and draw information and data related to the research study. Appendices 1 and 2 are the questionnaires that were used for the interviews. Questionnaires were sent to the interviewees two weeks prior to the interviews. All interviews were tape recorded. The research study is to find out the how JIT performance affect the suppliers, as well as the interaction with their customers (mainly automakers).

Survey analysis of multiple choice questionnaires appeared to be inefficient. The qualitative nature of the study and significant data cannot be fully described by answering multiple-choice questionnaire responses; therefore in-depth interviews were obtained. Furthermore, the implementation and function can be described by the interviewee's point of view. It was important for the researcher to understand why JIT system became a major role in manufacture industry.

Because of the nature of the data, quantitative analyses to test the statistical significance of performance only received about 40 percent feedback. On the other hand, in-depth interviews can generate effect, rationale, and choices among purpose, objectives, and decisions could be discovered as more suitable. The difficult task was anticipated to be the analysis and interpretation

of data for significant patterns. Therefore, in-depth interviews of senior managers can be the most appropriate method of collecting the required information.

Recognize the qualitative data first. There are three types of qualitative data can be collected: 1) in-depth, open-ended, and interviews, 2) direct observation, and 3) written document (Patton, 2002). After collect all the data, I need to evaluate them, due to raw information. Sometimes, I probably received incomplete responses, error answered, and dishonesty answers, and then analyzed data (descriptive and inferential). Descriptive data analysis is more like using inductive approach, "allow research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies (Thomas, 2003)." Inferential data analysis is like comparing and makes a comment of what might happen in near future (forecast).

Both preferred research methods will be applied in the study. First two methods in-depth interviews and observation will be qualitative research method, and the third one will be survey questionnaires. The questionnaire will ask participants how they evaluate the influence of factors on dependent variables, and the sample will be 200 participants.

The scale for survey questions will be given a numerical value from 1 (strongly disagree) to 7 (strongly agree). After collecting all data from survey questionnaires, the Structural Modeling Equation (SME) from Amos will be applied as analysis work. Here is the research plan:

Table 3: Research Plan

Respondents	In-depth interviews	Plant Observation	Survey questionnaires
Senior Managers in automotive suppliers	6		200
automotive supplier plant		3	
Total	6	5	200

Select Sample

In this study, the definition of U.S. first-tier and second-tier automotive suppliers that manufacture individual parts and preassembled components and subsystems for U.S. automobile manufacturers and Japanese transplants located in the United States. The following Suppliers will be exclude such as raw materials, chemicals, semiconductors, indirect materials, dies and tooling, engineering services and consulting . The automotive supplier lists in "2008 ELM Guide to U.S. Automotive Sourcing" will be used as sampling in the study. Most of suppliers in the study are located in the Mideast region of the United States. The sales criterion will be used to eliminate samples to first-tier and second-tier automotive suppliers that are directly involved by their automotive buyers' purchasing policies and practices.

In this dissertation, a mixed method approach which includes both qualitative approach and quantitative approach will be applied. The qualitative research employed field interviews and observation. The researcher will conduct field interviews in 2010 with the senior managers of first-tier and second-tier automotive suppliers. In addition, survey will be collected for analyses in October by phone, mail, and email. The data was then reduced, organized, and interpreted. The research questions were addressed to the senior managers within the companies. Presented in this research are the experiences, perceptions, beliefs, and rationalizations of the interviewees. Bias data may exist.

Qualitative Research Design

The study with qualitative research design depends on the intention of the study, the political background, the interests of the researchers, and the finances available (Patton, 2002). In phenomenological research, the purpose of the study is usually examining participants' viewpoint. Then research has to use their knowledge and instructive conversation to obtain the data from participants.

Coherence and utility are issues to be considered in qualitative research methods. Because there are no statistical tests of significance such as exist in quantitative methods, questions such as "does the study hang together as a whole" and "are the conclusions and comments of the researcher supported by a number of sources" need to be answered to support the coherency of the study. An important consideration is also the usefulness of the study. Eisner (1997) views qualitative studies as guides whose interpretation and narratives reveal aspects of a setting or situation I would otherwise have likely missed.

Qualitative research is not a top-down, subject-object relationship in which the researcher finds the truth about a subject, but is instead a systemic process, the product of the "interaction of two postulated entities, the objective and the subjective (Eisner, 1997)." Therein, lays this research approach's richness as well as its potential issues.

In qualitative research part, in-depth interview method will be applied. "The purpose of qualitative interviewing is to describe and understand experience, not to test hypotheses, find statistical differences between groups, or describe what proportion of a population holds a certain belief (Oishi, 2003). Therefore, the qualitative interview will help me to create hypotheses and ideas on the research question.

In-depth Interview

Quantitative methods focus on dealing with numbers or anything that can be measured. The common forms of quantitative method are counting and measuring. The results of the quantitative research are presented in graph and tables. Quantitative research helps researcher formulate the research problem and research hypotheses to be tested. The quantitative research emphasizes on causes and facts of behavior (Bogdan & Biklen, 1998). Data can be transformed to numbers that can be quantified and summarized, the mathematical process is the norm for analyzing the numeric data, and the result is presented in statistical terminologies (Charies, 1995).

Based on the research question, in-depth interviewing with managers in automotive suppliers is a necessary process. Like other qualitative methods, in-depth interview has advantages and disadvantages. In this case, the most challenge will be persuading them (managers) to give me the opportunity to do so. I will address both advantages and disadvantages below:

Validity

Validity can be defined as the degree to which a test measures what it is supposed to measure. According to Mason and Bramble (1989), there are three basic approaches to the validity of tests and measures, 1) content validity, 2) construct validity, and 3) criterion-related validity. As a researcher, I want to ensure that all the information acquired is related to the purpose of the study, and information has highest reliability and validity.

Content validity will be used in this research topic. "In order to establish the content validity of a measuring instrument, the researcher must identify the overall content to be represented. Items must then be randomly chosen from this content that will accurately represent the information in all areas (Key, 1997)." Therefore, the research will be able to find a group of items that can be measured.

Reliability

Reliability is defined as the extent to which the measures can yield same results on other replication studies (Hair *et al.,* 1998). There are four ways to measure reliability. First, the retest method and alternative form methods require two repeated measuring with the same group of people. Second, the survey targets are senior managers; the limitation of the resources does not allow us to survey the same group of senior managers twice. The third method, split-halves method, has the critical limitation that the reliability results depend on how to subdivide the total set of observations into two groups. The reliability results can be significantly different if the ways to split the observations are different. Therefore, the internal consistency method is used to measure the construct reliability in this study (Zhou, 2003).

Plant Tour and Observation

In order to compare with the quantitative data, exploratory plant tours and in-depth interviews are needed. The interviews will be conducted on a convenience of suppliers located in Tennessee, Alabama and Georgia that available to give a brief tour. The questionnaires will be sent to senior managers of the plants and asking them to fill out the questionnaires in one week advance, thus review and discussion with the respondents can be done. Liker and Yu (2000) state that the plant tours make it possible to identify the most knowledgeable respondents and to develop items for the questionnaires in simple, concrete terms in the language of the respondents (p.81).

Survey Design

A survey method is adopted as part of the purpose of this study. Collection of primary data allows researchers to obtain information to directly reflect the variables to be investigated. Survey for automotive suppliers will be developed and pre-tested. The survey design procedure followed Dillman (1978) and Churchill (1979) guideline. The primary instruments is modified on Dr. Dong (1998), which include (1) the extent of JIT adoption; (2) uncertainty (demand and operational); (3) supplier involvement and cooperation; (4) supply chain integration; (5) firm logistics performance.

JIT performance has both cost and inventory system performance, and major operational measures. The scales adopted Tracey, et al. (1995), which was performance measured by cost increases, inventory related outcomes, and operational performance. Tracy et al., state that cost increases include total logistics cost increases and incoming transportation cost increases; inventory related outcomes include raw materials/component parts inventory reduction, WIP inventory reduction, on-time delivery to production, lower levels of stock; operational performance includes on-time delivery from suppliers, reduction in damages in transit, more promptly available information, and incoming shipment size reduction. The items were measured using Likert scale. In the final performance scales, cost and inventory system performance will be focused. Operational performance is based on cycle time performance and quality performance.

Pretest Survey

After survey draft has been completed I will ask that it be reviewed and comment on by committee members to ensure that the questions are easy to understand and correctly phrased. The survey was first reviewed by professors at Argosy University; their suggestions were taken and the survey was corrected prior to the final survey being distributed. In the final survey, a supplier was asked to identify only one buyer who is purchasing parts/components.

This pre-test identified areas for possible misunderstandings and provided validity of the questionnaire. This pilot test process helped increase the face and content validity before conducting the actual research study.

After the pre-test with subjects, an internal consistency reliability coefficient (Cronbach's Alpha) of each item was calculated using the SPSS statistical processing package. To determine the internal consistency of each question, the study looked at all of the items simultaneously, using coefficient alphas. The coefficient alpha, or Cronbach's, measured the degree to which instrument questions were homogeneous and reflected the same underlying construct. An acceptable level of internal consistency would be reflected in an alpha value of no greater than 5 in this study (Nachmias & Nachmias, 2000).

Data Collection and Review

The survey activities comprised of two mailings of questionnaires. The first mailing contains an introductory letter as to invite them to be part of this research. If they have question or do not wish to participate, there is an email address and a phone number for them to call. The second mailing contains a questionnaire, and general instructions for filling out the questionnaire, a self-addressed envelope, and a definition sheet of the Ten JIT practices to be applied. There will be Argosy University letterhead printed on the introduction letter, purpose of the study, and promise to ensure confidentiality of individual responses. Identification of respondents located in respondent classification section. After one week of the first mailing, a second mailing will be sent. The mailing consisted of 200 questionnaires and yielded 43 responses; for an overall response rate of 21.5 percent.

The filled out questionnaires will be reviewed to discover and exclude responses those uncompleted of any of the key variables measured. Responses from organizations with primary focus on providing services (contain more than 25 percent of their annual sales in service segment). Why? Because JIT assessment is focus on operational by JIT management practices, responses from manufacturers with no JIT practices will also be omitted from the study.

Data Analysis Method

The research model describes the performance directly and indirectly influenced by the environment, resource, and competitive strategy. These paths are relationships with causal process; therefore, adopting structural equation model is a required test. The data analysis will be done by SPSS 17 (Statistical Package for the Social Science Version 17), and EXCEL working on Windows 7 operation system.

All applicable analyses apply the 95% confidence interval criteria. All of the questionnaires were measured based on seven-point Likert scale, and stored in EXCEL database then compiled into SPSS database. An internal consistency reliability coefficient (Cronbach's Alpha) of each item was calculated using the SPSS statistical processing package. This study tested the relationship among the main variables of the hypothesized model. Factor analysis analyzes the correlations among a number of variables by defining a set of constructs or dimensions in a data matrix.

Research Hypotheses

In this research, the hypotheses seek to understand whether or not these six major criteria are major criteria to automotive suppliers. Hypotheses and respective testing methods of this study are stated as follows:

Table 3: Proposed Hypotheses and Statistical Testing Methods

Hypotheses	Questionnaires	Statistical Testing Method
H1: Supply chain integration directly influences JIT purchasing.	# 25, 28, 31, 32, 33	SPSS
H2: Supply chain integration directly influences JIT manufacturing.	#10, 11, 12, 15, 16, 18, 21, 36, 44	SPSS
H3: Supply chain integration directly influences logistics performance.	#10,21,23,26,39	SPSS
H4: JIT purchasing directly influences JIT manufacturing.	#10, 11, 12, 15, 16, 18, 21, 36, 44	SPSS
H5: JIT purchasing directly influences logistics performance.	#8, 9, 14, 17, 24, 26, 41, 42	SPSS
H6: JIT manufacturing directly influences logistics performance.	#8, 9, 14, 17, 24, 26, 41, 42	SPSS

Non-Response Bias

It is important to minimize the non-response bias. This research utilized multiple contacts with the respondents and followed Dillman (2002) to maximize response rate. After the responses are received, the responses of those who returned early are compared with those who returned late to determine if there are any statistical differences (Lessler and Kalsbeek, 1992).

The Findings

In this chapter, test results of each hypothesis will be discourse into following categories: the sample response rates, frequency distributions, descriptive statistics, and a summary of the findings. The findings described herein are the results of the data collection and statistical tests conducted in accordance with the procedures outlined in Chapter Three. In-depth interviews will be also provided as current reality situation.

Review of the Purpose

The primary purpose of this study was to explore the relationship between supply chain integration, JIT purchasing, JIT manufacturing, and their influence on logistics performance. Specifically, this research tries to answer the question of how strong of the influence between supply chain integration to JIT components. The sample population consists of individual's responses from the various automotive suppliers in the United States. The sample was based on 43 complete survey respondents.

Forty-three usable surveys were collected. Firms varied in size from 10 to 4,600 employees (median = 150), and had annual sales of between $1 million and $12 billion (median = $20 million). All participants have been implementing JIT from 2 to 28 years (median = 10) and their sale are made on JIT basis from 40 percent to 100 percent (median = 90).

Factor analysis

Factor analysis was carried out to reduce the JIT purchasing, JIT manufacturing, and logistics performance scales to a smaller number of motivating factors. Hair et al. state that "principal Components Analysis was used to identify factors with eigenvalues of at least one (Hair et al., 1992)", and Varimax rotation was used to obtain more clearly interpretable factor loadings. In the interests of convergent and discriminate validity, only items that had a factor loading of at least 0.50 can be used. The JIT scale yielded three factors, purchasing, JIT manufacturing, and logistics performance (Table 4.1). All the scale items had factor loading higher than 0.50, However, for more precise reason, the researcher drop the item with factor loading lower than 0.55. Thus, Q20 was dropped.

Table 4.1 Factor analysis

Factor	Scale Item	Factor Loading
JIT Purchasing	~~Q20. This customer provides Training/education programs~~	~~0.529~~
	Q25. Transportation cost reduction	0.788
	Q28. Quality assurance program	0.657
	Q31. Supplier certification	0.846
	Q32. Formal supplier evaluation and selection program	0.751
	Q33. Supplier rating systems	0.738
JIT Manufacturing	Q10. Quality inspection process	0.822
	Q11. Product and/or service quality	0.860
	Q12. Production processes	0.719
	Q15. Involvement with this customer's product/system design	0.666
	Q16. Multifunctional teams with this customer	0.780
	Q18. Sharing information with this customer	0.575
	Q20. This customer provides Training/education programs	0.758
	Q21. Direct investment from this customer	0.647
	Q36. Production costs	0.667
	Q44. Quality of products/services	0.816
Logistics Performance	Q8. Lead times for outbound deliveries	0.758
	Q9. Outbound transportation process	0.817
	Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	0.719
	Q17. Manages this customer's inventory system	0.839
	Q24. Order size reduction	0.709
	Q26. Order lead time reduction	0.774
	Q41. Outbound delivery lead times	0.672
	Q42. Order setup times	0.672

Results of Hypothesis Testing

	Ho1	Ha1	Ho2	Ha2	Ho3	Ha3	Ho4	Ha4	Ho5	Ha5	Ho6	Ha6
Accept		ˇ		ˇ		ˇ		ˇ		ˇ		ˇ

Hypothesis One

Ho1: Supply chain integration does not directly influence JIT purchasing.
Ha1: Supply chain integration directly influences JIT purchasing.

Survey items in this hypothesis evaluated the Supply chain integration and JIT purchasing. Questions 25, 28, 31, 32, 33 address logistics agreement, JIT operation, and JIT programs. All respondents (n=43) completed these survey items. As table 4.2 shown the Cronbath's Alpha is 0.671, which is reliable for the test.

Table 4.3 Reliability Statistics For H1

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.671	.714	7

Table 4.4 Means For H1

	Mean	Std. Deviation	N
Q1. Please describe the supply chain integration in your firm	5.81	.794	43
Q25. Transportation cost reduction	5.00	1.718	43
Q28. Quality assurance program	6.53	.767	43
Q31. Supplier certification	6.44	.934	43
Q32. Formal supplier evaluation and selection program	6.33	1.107	43
Q33. Supplier rating systems	6.21	1.226	43

The means in this group (table 4.4) are equal or greater than 5.00 (the average numbers are equal or greater than 5.00). Q25 (5.00) represents that transportation cost reduction is improved a little bit. Q28 (6.53) represents that quality assurance program is improved moderate in most of companies. Q31 (6.44) represents that supplier certification are necessary required in most of companies. Q32 (6.33) represents that formal supplier evaluation and selection is necessary required in most of companies. Q33 (6.21) represents that supplier rating systems are very important for most of companies.

Table 4.5 Crosstab: SCI vs. JIT Purchasing factors

	Q1. Supply chain integration
Q25. Transportation cost reduction	62.8%
Q28. Quality assurance program	93.1%
Q31. Supplier certification	90.7%
Q32. Formal supplier evaluation and selection program	88.4%
Q33. Supplier rating systems	93.0%

In Q25, 62.8% of respondents said more than above to extent a lot (scale 5-7) on transportation cost reduction who indicated influence the supply chain integration as compared to 37.2 % of respondents who indicated not influence the supply chain integration. In Q28, 93.1% of respondents said more than above to extent a lot on quality assurance program who indicated influence the supply chain integration as compared to 6.9 % of respondents who indicated not influence the supply chain integration. In Q31, 90.7% of respondents said more than above to extent a lot on supplier certification who indicated influence the supply chain integration as compared to 9.3 % of respondents who indicated not influence the supply chain integration. In Q32, 88.4% of respondents said more than above to extent a lot on formal supplier evaluation and selection program indicated influence the supply chain integration as compared to 11.6 % of respondents who indicated not influence the supply chain integration. In Q33, 93.0% of respondents said more than above to extent a lot on supplier rating systems indicated influence the supply chain integration as compared to 7 % of respondents who indicated not influence the supply chain integration.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.5) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q31 and Q32 in this research was 0.710 which represents a strong relationship. Also, Q31 and Q33 in this research was 0.791 which represents a strong relationship. Q28 and Q31 in this research was 0.660 which represents a

moderate relationship. Q28 and Q32 in this research was 0.575 which represents a moderate relationship. Q32 and Q33 in this research was 0.651 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho1 is rejected, and Hypothesis Ha1 is accepted.

Table 4.6 Pearson Correlations For H1

		Q1.	Q25.	Q28.	Q31.	Q32.	Q33.
Q1. Please describe the supply chain integration in your firm	Pearson Correlation	1	-.105	-.106	-.111	-.065	-.204
	Sig. (1-tailed)		.252	.249	.239	.340	.095
Q25. Transportation cost reduction	Pearson Correlation	-.105	1	.000	.119	.163	.068
	Sig. (1-tailed)	.252		.500	.224	.149	.333
Q28. Quality assurance program	Pearson Correlation	-.106	.000	1	.660	.575	.511
	Sig. (1-tailed)	.249	.500		.000	.000	.000
Q31. Supplier certification	Pearson Correlation	-.111	.119	.660	1	.710	.791
	Sig. (1-tailed)	.239	.224	.000		.000	.000
Q32. Formal supplier evaluation and selection program	Pearson Correlation	-.065	.163	.575	.710	1	.651
	Sig. (1-tailed)	.340	.149	.000	.000		.000
Q33. Supplier rating systems	Pearson Correlation	-.204	.068	.511	.791	.651	1
	Sig. (1-tailed)	.095	.333	.000	.000	.000	

Finding one: from in-depth-interview

In the Q25 transportation cost reduction, most of tier-1 automotive suppliers receive this benefit, however, tier-2 or smaller suppliers have to pay outbound transportation expense. One of the logistic managers explained, says, “From what I know, direct tier-1 suppliers do not have to pay transportation fee, because those transportation trucks are operate by their customers. On the other hand, we are not just supply to one customer, but also providing aftermarket products. You can save money on transportation, but you lose the rest of market.”

All of the managers interviewed during this project expressed a strong belief that quality assurance, supplier certification formal supplier evaluation and selection program and supplier rating systems are very important. Five out of six managers agreed “there are several steps you can take to avoid unnecessary purchasing defect products and waste time to return and delay the process. You can evaluate your suppliers and give them certifications, and then purchasing raw material or products from them, so you do not have to spend much time to inspect the incoming material. In addition, use supplier rating system can identify which supplier performs better and which supplier is underperformed. We usually rate them as following: 1) do they deliver on time, 2) do they deliver exact the amount we request, 3) the quality of delivery (any damage during

transportation), 4) the quality of material, and 5) customer support. Furthermore, they usually evaluate their suppliers annually or even semi-annually. One of the managers says their supplier rating systems are done by Nissan, so they have less worry about suppliers' issue.

In the Q28 quality assurance program, Four out of six managers state that internally, before product launches, we have 1) product failure mode analysis, 2) estimate of how serious these items will be in this production process, 3) poka yoke (mistake-proofing), and 4) eliminate the problem from beginning (learned for pervious lessons).

In the Q31 supplier certification, all interviewed managers agreed that "we require our suppliers to obtain quality certifications, and continuing improve their quality. Their product must pass our inspection." If the suppliers have either ISO2001 and/or TS6949 (management process), we will only visit and inspect them once per three years. We try to handle all the potential problem process and we do have inspection process in the end, especially in final inspection process before shipping. We use poka yoke to minimize the defect rate.

In Q32 formal supplier evaluation and selection program, four out of six managers state that we have formal process for supplier's quality, production process, and capacity to ensure they are in the great status. In Q33, all the managers state that the supplier rating system is based on quality, delivery, and price. However, the quality is more important than the other two.

Hypothesis Two

Ho2: Supply chain integration does not directly influence JIT manufacturing.
Ha2: Supply chain integration directly influences JIT manufacturing.

Survey items in this hypothesis evaluated the Supply chain integration and JIT manufacturing. Questions 10, 11, 12, 15, 16, 18, 21, 36, 44 address logistics agreement, JIT operation, and JIT programs. All respondents (n=43) completed these survey items. As table 4.7 shown the Cronbath's Alpha is 0.753, which is reliable for the test.

Table 4.7 Reliability Statistics For H2

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.753	.761	11

Table 4.8 Means For H2

	Mean	Std. Deviation	N
Q1. Please describe the supply chain integration in your firm	5.81	.794	43
Q10. Quality inspection process	6.26	.928	43
Q11. Product and/or service quality	6.49	.703	43
Q12. Production processes	6.35	.752	43
Q15. Involvement with this customer's product/system design	5.35	1.617	43
Q16. Multifunctional teams with this customer	4.95	1.676	43
Q18. Sharing information with this customer	5.77	1.250	43
Q21. Direct investment from this customer	3.44	2.292	43
Q36. Production costs	3.93	1.142	43

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items		
Q44. Quality of products/services		5.81	1.200	43

The means in Q10, Q11, Q12, Q15, Q18, Q44 are equal or greater than 5.00 (the average numbers are equal or greater than 5.00), except Q16 (4.95 which is very close to 5), Q21 (3.44 which is below 4), and Q36 (3.93 which is below 4). Q10 (6.26) represents that quality inspection process is very important in most of companies. Q11 (6.49) represents that product and/or service quality is very important in most of companies. Q12 (6.35) represents that production processes are very important. Q15 (5.35) represents that involvement with this customer's product/system design is required in some of companies. Q16 (4.95) represents that multifunctional teams with this customer are moderate required in some of companies. Q18 (5.77) represents that sharing information with this customer is very important in most of companies. Q21 (3.44) represents that direct investment from this customer is only available for some companies. Q36 (3.93) represents that production costs are increased a little bit in most of companies. Q44 (5.81) represents that quality of products/services have been improve very much in most of companies.

Table 4.9 Crosstab: JIT Purchasing vs. JIT Manufacturing factors

	Q2. JIT purchasing
Q10. Quality inspection process	86.0%
Q11. Product and/or service quality	88.3%
Q12. Production processes	88.3%
Q15. Involvement with this customer's product/system design	74.4%
Q16. Multifunctional teams with this customer	65.2%
Q18. Sharing information with this customer	74.3%
Q21. Direct investment from this customer	32.6%
Q36. Production costs	76.7%
Q44. Quality of products/services	74.3%

In Q10, 88.3 % of respondents said more than above to extent a lot (scale 5-7) on quality inspection process who indicated influence the JIT Purchasing as compared to 11.7 % of respondents who indicated not influence the JIT Purchasing. In Q11, 93.0% of respondents said more than above to extent a lot on product and/or service quality who indicated influence the JIT Purchasing as compared to 7.0 % of respondents who indicated not influence the JIT Purchasing. In Q12, 92.9% of respondents said more than above to extent a lot on production processes who indicated influence the JIT Purchasing as compared to 7.1 % of respondents who indicated not influence the JIT Purchasing. In Q15, 74.5% of respondents said more than above to extent a lot on involvement with this customer's product/system design who indicated influence the JIT Purchasing as compared to 25.5 % of respondents who indicated not influence the JIT Purchasing. In Q16, 65.2% of respondents said more than above to extent a lot on multifunctional teams with this customer indicated influence the JIT Purchasing as compared to 34.8 % of respondents who indicated not influence the JIT Purchasing.

In Q18, 76.7% of respondents said more than above average on sharing information with this customer indicated influence the JIT Purchasing as compared to 23.3 % of respondents who indicated not influence the JIT Purchasing. In Q21, 35.0% of respondents said more than above to extent a lot on direct investment from this customer who indicated influence the JIT Purchasing as compared to 65.0 % of respondents who indicated not influence the JIT Purchasing. In Q36, 76.7% of respondents said more than above to extent a lot on production costs who indicated influence the JIT Purchasing as compared to 23.3 % of respondents who indicated not influence the JIT Purchasing. In Q44, 74.4% of respondents said more than above to extent a lot on quality of products/services who indicated influence the JIT Purchasing as compared to 25.6 % of respondents who indicated not influence the JIT Purchasing.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.10) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q10 and Q11 in this research was 0.789 which represents a strong relationship. Also, Q10 and Q12 in this research were 0.619 which represents a moderate relationship. Q11 and Q12 in this research were 0.661 which represents a strong relationship. Q16 and Q21 in this research were 0.626 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho2 is rejected and Hypothesis Ha2 is accepted.

Table 4.10 Pearson Correlations For H2

		Q1	Q10	Q11	Q12	Q15	Q16	Q18	Q21	Q36	Q44
Q1. Please describe the supply chain integration in your firm	Pearson Correlation	1	.131	-.132	.031	.181	-.007	-.164	.242	.090	-.062
	Sig. (1-tailed)		.202	.200	.421	.122	.483	.146	.059	.282	.346
	N	43	43	43	43	43	43	43	43	43	43
Q10. Quality inspection process	Pearson Correlation	.131	1	.789**	.619**	.145	.130	.114	.113	.264*	.086
	Sig. (1-tailed)	.202		.000	.000	.176	.202	.233	.234	.043	.291
	N	43	43	43	43	43	43	43	43	43	43
Q11. Product and/or service quality	Pearson Correlation	-.132	.789**	1	.661**	.035	.020	.051	-.078	.192	.195
	Sig. (1-tailed)	.200	.000		.000	.412	.450	.373	.309	.109	.105
	N	43	43	43	43	43	43	43	43	43	43
Q12. Production processes	Pearson Correlation	.031	.619**	.661**	1	.093	.032	-.038	.060	.195	.179
	Sig. (1-tailed)	.421	.000	.000		.276	.419	.404	.350	.105	.125
	N	43	43	43	43	43	43	43	43	43	43
Q15. Involvement with this customer's product/system design	Pearson Correlation	.181	.145	.035	.093	1	.287*	.065	.227	-.141	-.064
	Sig. (1-tailed)	.122	.176	.412	.276		.031	.340	.071	.183	.342
	N	43	43	43	43	43	43	43	43	43	43
Q16. Multifunctional teams with this customer	Pearson Correlation	-.007	.130	.020	.032	.287*	1	.472**	.626**	.210	-.111
	Sig. (1-tailed)	.483	.202	.450	.419	.031		.001	.000	.088	.239
	N	43	43	43	43	43	43	43	43	43	43
Q18. Sharing information with this customer	Pearson Correlation	-.164	.114	.051	-.038	.065	.472**	1	.303*	.222	-.030
	Sig. (1-tailed)	.146	.233	.373	.404	.340	.001		.024	.076	.425
	N	43	43	43	43	43	43	43	43	43	43
Q21. Direct investment from this customer	Pearson Correlation	.242	.113	-.078	.060	.227	.626**	.303*	1	.103	-.013
	Sig. (1-tailed)	.059	.234	.309	.350	.071	.000	.024		.255	.468
	N	43	43	43	43	43	43	43	43	43	43
Q36. Production costs	Pearson Correlation	.090	.264*	.192	.195	-.141	.210	.222	.103	1	.164
	Sig. (1-tailed)	.282	.043	.109	.105	.183	.088	.076	.255		.147
	N	43	43	43	43	43	43	43	43	43	43
Q44. Quality of products/services	Pearson Correlation	-.062	.086	.195	.179	-.064	-.111	-.030	-.013	.164	1
	Sig. (1-tailed)	.346	.291	.105	.125	.342	.239	.425	.468	.147	
	N	43	43	43	43	43	43	43	43	43	43

Finding two: from in-depth-interview

In Q15 involvement with this customer's product/system design, four out of six senior managers state that on the early item in the front end, we have quite bit of input of design including suggesting all materials into design for product improvement. In Q16 multifunctional teams with this customer, the automakers have several key suppliers of major components and accessories that collaborate on R&D, procurement and supply chain processes. Three out of six senior managers state that they have multifunction team members who cooperate with their customers in product design, manufacturing, and logistic departments. “Our multifunctional team will ensure that the product is durable and the material applied will make the product stronger and last longer. In addition, they have to ensure better quality of service, while maintaining the flexibility of customization depends on particular customer requirements.”

In Q21 direct investment from the customer, three out of six senior manager state that they receive direct investment because they have been working with them for long period of time and always have working on certain product/system design. On the other hand, the other three manager state they only receive tooling to produce specific products from their customer. Once the product discontinued, they have to return the special tools. In Q36 production costs, four out of six manager state “the material costs have big portion in production costs, and there is no sign of decreasing, especially import from overseas.” “However, we were unable to increase our product prices; therefore, we have to reduce energy, and water usage. In addition, we negotiate the transportation fee with our suppliers.”

Hypothesis Three

Ho3: Supply chain integration does not directly influence logistics performance.
Ha3: Supply chain integration directly influences logistics performance.

Survey items in this hypothesis evaluated the supply chain integration and logistics performance. Questions 8, 9, 14, 17, 24, 26, 41, 42 address logistics agreement, JIT operation, and JIT programs. All respondents (n=43) completed these survey items. As table 4.11 shown the Cronbath’s Alpha is 0.658, which is reliable for the test.

Table 4.11 Reliability Statistics For H3

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.658	.673	9

Table 4.12 Means For H3

	Mean	Std. Deviation	N
Q1. Please describe the supply chain integration in your firm	5.81	.794	43
Q8. Lead times for outbound deliveries	5.74	1.115	43
Q9. Outbound transportation process	5.56	1.031	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	6.23	1.043	43
Q17. Manages this customer’s inventory system	3.12	2.195	43
Q24. Order size reduction	5.05	1.479	43
Q26. Order lead time reduction	5.44	1.517	43
Q41. Outbound delivery lead times	4.30	1.124	43
Q42. Order setup times	4.44	1.333	43

The means in Q8, Q9, Q14, Q24, Q26, Q44 are equal or greater than 5.00 (the average numbers are equal or greater than 5.00), except Q17 (3.12 which is below 4), Q41 (4.30 which is below 4), and Q42 (4.44 which is below 4). Q8 (5.74) represents that lead times for outbound deliveries is stable in most companies. Q9 (5.56) represents that outbound transportation process is important in most of companies. Q14 (6.23) represents that Electronic Data Interchange (EDI) connections or web-based inventory system are very important in most of companies. Q17 (3.12) represents that manages this customer's inventory system is available for some companies. Q24 (5.05) represents that order size reduction has been improved in many of companies. Q26 (5.44) represents that order lead time reduction has been improved in many companies. Q41 (4.30) represents that outbound delivery lead times have been decreased in many companies. Q42 (4.44) represents that order setup times have been decreased in many companies.

Table 4.13 Crosstab: SCI vs. Logistics Performance factors

	Q1. Supply chain integration
Q8. Lead times for outbound deliveries	76.8%
Q9. Outbound transportation process	81.4%
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	88.4%
Q17. Manages this customer's inventory system	27.9%
Q24. Order size reduction	72.2%
Q26. Order lead time reduction	74.5%
Q41. Outbound delivery lead times *	79.1%
Q42. Order setup times*	81.3%

In Q8, 76.8 % of respondents said more than above to extent a lot (scale 5-7) on lead times for outbound deliveries who indicated influence the supply chain integration as compared to 23.2% of respondents who indicated not influence the supply chain integration. In Q9, 81.4% of respondents said more than above to extent a lot on outbound transportation process who indicated influence the supply chain integration as compared to 18.6 % of respondents who indicated not influence the supply chain integration. In Q14, 88.4% of respondents said more than above to extent a lot on Electronic Data Interchange (EDI) connections or web-based inventory system who indicated influence the supply chain integration as compared to 11.6 % of respondents who indicated not influence the supply chain integration. In Q17, 27.9% of respondents said more than above to extent a lot on manages this customer's inventory system who indicated influence the supply chain integration as compared to 72.1 % of respondents who indicated not influence the supply chain integration.

In Q24, 72.2% of respondents said more than above to extent a lot on order size reduction with this customer indicated influence the supply chain integration as compared to 27.8 % of respondents who indicated not influence the supply chain integration. In Q26, 74.5% of respondents said more than above to extent a lot on order lead time reduction indicated influence the supply chain integration as compared to 25.5% of respondents who indicated not influence the supply chain integration. In Q41, 79.1 % of respondents said unchanged to decrease a lot on outbound delivery lead times who indicated influence the supply chain integration as compared to 20.9 % of respondents who indicated not influence the supply chain integration. In Q42, 81.3% of respondents said unchanged to decrease a lot on order setup times who indicated influence the supply chain integration as compared to 18.7 % of respondents who indicated not influence the supply chain integration.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.14) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q8 and Q9 in this research was 0.604 which represents a strong relationship. Also, Q14 and Q26 in this research was 0.551 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho3 is rejected and Hypothesis Ha3 is accepted.

Table 4.14 Person Correlations For H3

		Q1	Q8	Q9	Q14	Q17	Q24	Q26	Q41	Q42
Q1. Please describe the supply chain integration in your firm	Pearson Correlation	1	-.001	.072	.140	-.015	-.317*	-.108	-.149	.102
	Sig. (1-tailed)		.497	.324	.186	.463	.019	.245	.170	.258
	N	43	43	43	43	43	43	43	43	43
Q8. Lead times for outbound deliveries	Pearson Correlation	-.001	1	.604**	-.009	.071	.123	.139	.006	-.034
	Sig. (1-tailed)	.497		.000	.477	.326	.216	.187	.484	.414
	N	43	43	43	43	43	43	43	43	43
Q9. Outbound transportation process	Pearson Correlation	.072	.604**	1	-.124	.086	.123	.189	-.005	.042
	Sig. (1-tailed)	.324	.000		.215	.291	.216	.113	.487	.396
	N	43	43	43	43	43	43	43	43	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	Pearson Correlation	.140	-.009	-.124	1	.154	.085	.551**	.345*	.147
	Sig. (1-tailed)	.186	.477	.215		.162	.293	.000	.012	.173
	N	43	43	43	43	43	43	43	43	43
Q17. Manages this customer's inventory system	Pearson Correlation	-.015	.071	.086	.154	1	.013	.192	-.092	-.002
	Sig. (1-tailed)	.463	.326	.291	.162		.467	.109	.279	.496
	N	43	43	43	43	43	43	43	43	43
Q24. Order size reduction	Pearson Correlation	-.317*	.123	.123	.085	.013	1	.394**	.077	-.107
	Sig. (1-tailed)	.019	.216	.216	.293	.467		.004	.311	.247
	N	43	43	43	43	43	43	43	43	43
Q26. Order lead time reduction	Pearson Correlation	-.108	.139	.189	.551**	.192	.394**	1	.213	.054
	Sig. (1-tailed)	.245	.187	.113	.000	.109	.004		.085	.365
	N	43	43	43	43	43	43	43	43	43
Q41. Outbound delivery lead times	Pearson Correlation	-.149	.006	-.005	.345*	-.092	.077	.213	1	.306*
	Sig. (1-tailed)	.170	.484	.487	.012	.279	.311	.085		.023
	N	43	43	43	43	43	43	43	43	43
Q42. Order setup times	Pearson Correlation	.102	-.034	.042	.147	-.002	-.107	.054	.306*	1
	Sig. (1-tailed)	.258	.414	.396	.173	.496	.247	.365	.023	
	N	43	43	43	43	43	43	43	43	43

Finding three: from in-depth-interview

In the Q9 outbound transportation process, five out of six of managers said that we do not ship consistent quantity of parts, because the containers we received from our customers may be less than what we shipped. It always have 6 hours time lag. It takes time to unload parts and we all try to make it one to one system, the reality isn't just like that. Our customers may have down time. In the Q26 order lead time reduction, four out of six managers state "if the customer's demand is stable; their order will be stable, too. That is, even one of our customers who is located farer than other two closer (250 mile difference), but with a stable order history, the order lead time will take much less than other two."

In the Q14 Electronic Data Interchange (EDI) connections or web-based inventory system, all the managers state that they have been using EDI very extensively to our customers and suppliers. Mostly we call "stockholders", they can access through our ERP systems, and we send

sipping confirmation to EDI as well. In the web-based inventory system, we do have a close network for registered customer to check their available inventories.

In the Q26 order lead time reduction, five out six managers state that most of their customers want their order arrive as quickly as possible; however, we only can do our best to achieve this goal. We have distribution centers that able to take order this afternoon and guarantee arrive tomorrow to our customer. Most of automotive suppliers have stocking contracts, because they do not want their customers' plant shut down because of they under estimate the quantity of parts.

Hypothesis Four

Ho4: JIT purchasing does not directly influence JIT manufacturing.
Ha4: JIT purchasing directly influences JIT manufacturing.

Survey items in this hypothesis evaluated the JIT purchasing and JIT manufacturing. Questions 10, 11, 12, 15, 16, 18, 21, 36, 44 address logistics agreement, JIT operation, and JIT performance. All respondents (n=43) completed these survey items. As table 4.15 shown the Cronbath's Alpha is 0.617, which is reliable for the test.

Table 4.15 Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.617	.622	11

Table 4.16 Means For H4

	Mean	Std. Deviation	N
Q2. Please describe the JIT purchasing in your firm	5.44	.854	43
Q10. Quality inspection process	6.26	.928	43
Q11. Product and/or service quality	6.49	.703	43
Q12. Production processes	6.35	.752	43
Q15. Involvement with this customer's product/system design	5.35	1.617	43
Q16. Multifunctional teams with this customer	4.95	1.676	43
Q18. Sharing information with this customer	5.77	1.250	43
Q21. Direct investment from this customer	3.44	2.292	43
Q36. Production costs	3.93	1.142	43
Q44. Quality of products/services	5.81	1.200	43

The means in Q10, Q11, Q12, Q15, Q18, Q44 are equal or greater than 5.00 (the average numbers are equal or greater than 5.00), except Q16 (4.95 which is very close to 5), Q21 (3.44 which is below 4), and Q36 (3.93 which is below 4). Q10 (6.26) represents that quality inspection process is very important in most of companies. Q11 (6.49) represents that product and/or service quality is very important in most of companies. Q12 (6.35) represents that production processes are very important. Q15 (5.35) represents that involvement with this customer's product/system design is required in some of companies. Q16 (4.95) represents that multifunctional teams with this customer are moderate required in some of companies. Q18 (5.77) represents that sharing information with this customer is very important in most of companies. Q21 (3.44) represents

that direct investment from this customer is only available for some companies. Q36 (3.93) represents that production costs are increased a little bit in most of companies. Q44 (5.81) represents that quality of products/services have been improve very much in most of companies.

Table 4.17 Crosstab: JIT Purchasing vs. JIT Manufacturing factors

	Q2. JIT purchasing
Q10. Quality inspection process	86.0%
Q11. Product and/or service quality	88.3%
Q12. Production processes	88.3%
Q15. Involvement with this customer's product/system design	74.4%
Q16. Multifunctional teams with this customer	65.2%
Q18. Sharing information with this customer	74.3%
Q21. Direct investment from this customer	32.6%
Q36. Production costs	76.7%
Q44. Quality of products/services	74.3%

In Q10, 86.0 % of respondents said more than above to extent a lot (scale 5-7) on quality inspection process who indicated influence the JIT Purchasing as compared to 14.0% of respondents who indicated not influence the JIT Purchasing. In Q11, 88.3% of respondents said more than above to extent a lot on product and/or service quality who indicated influence the JIT Purchasing as compared to 11.7 % of respondents who indicated not influence the JIT Purchasing. In Q12, 88.3% of respondents said more than above to extent a lot on production processes who indicated influence the JIT Purchasing as compared to 11.7 % of respondents who indicated not influence the JIT Purchasing. In Q15, 74.7% of respondents said more than above to extent a lot on involvement with this customer's product/system design who indicated influence the JIT Purchasing as compared to 25.3 % of respondents who indicated not influence the JIT Purchasing. In Q16, 65.2% of respondents said more than above to extent a lot on multifunctional teams with this customer indicated influence the JIT Purchasing as compared to 34.8 % of respondents who indicated not influence the JIT Purchasing.

In Q18, 74.3% of respondents said more than above to extent a lot on sharing information with this customer indicated influence the JIT Purchasing as compared to 25.7 % of respondents who indicated not influence the JIT Purchasing. In Q21, 32.6% of respondents said more than above to extent a lot on direct investment from this customer who indicated influence the JIT Purchasing as compared to 67.4 % of respondents who indicated not influence the JIT Purchasing. In Q36, 25.6% of respondents said more than above to extent a lot on production costs who indicated influence the JIT Purchasing as compared to 74.4 % of respondents who indicated not influence the JIT Purchasing. In Q44, 74.3% of respondents said more than above to extent a lot on quality of products/services who indicated influence the JIT Purchasing as compared to 25.7 % of respondents who indicated not influence the JIT Purchasing.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.18) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q10 and Q11 in this research was 0.789 which represents a strong relationship. Also, Q10 and Q12 in this research was 0.619 which represents a moderate relationship. Q11 and Q12 in this research was 0.661 which represents a strong relationship. Q16 and Q21 in this research was 0.626 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho4 is rejected and Hypothesis Ha4 is accepted.

Table 4.18 Pearson Correlations For H4

		Q2	Q10	Q11	Q12	Q15	Q16	Q18	Q21	Q36	Q44
Q2. Please describe the JIT purchasing in your firm	Pearson Correlation	1	-.026	-.051	-.060	-.132	-.185	-.191	-.212	.081	.315*
	Sig. (1-tailed)		.435	.373	.350	.200	.117	.109	.086	.302	.020

	N	43	43	43	43	43	43	43	43	43	43
Q10. Quality inspection process	Pearson Correlation	-.026	1	.789**	.619**	.145	.130	.114	.113	.264*	.086
	Sig. (1-tailed)	.435		.000	.000	.176	.202	.233	.234	.043	.291
	N	43	43	43	43	43	43	43	43	43	43
Q11. Product and/or service quality	Pearson Correlation	-.051	.789**	1	.661**	.035	.020	.051	-.078	.192	.195
	Sig. (1-tailed)	.373	.000		.000	.412	.450	.373	.309	.109	.105
	N	43	43	43	43	43	43	43	43	43	43
Q12. Production processes	Pearson Correlation	-.060	.619**	.661**	1	.093	.032	-.038	.060	.195	.179
	Sig. (1-tailed)	.350	.000	.000		.276	.419	.404	.350	.105	.125
	N	43	43	43	43	43	43	43	43	43	43
Q15. Involvement with this customer's product/system design	Pearson Correlation	-.132	.145	.035	.093	1	.287*	.065	.227	-.141	-.064
	Sig. (1-tailed)	.200	.176	.412	.276		.031	.340	.071	.183	.342
	N	43	43	43	43	43	43	43	43	43	43
Q16. Multifunctional teams with this customer	Pearson Correlation	-.185	.130	.020	.032	.287*	1	.472**	.626**	.210	-.111
	Sig. (1-tailed)	.117	.202	.450	.419	.031		.001	.000	.088	.239
	N	43	43	43	43	43	43	43	43	43	43
Q18. Sharing information with this customer	Pearson Correlation	-.191	.114	.051	-.038	.065	.472**	1	.303*	.222	-.030
	Sig. (1-tailed)	.109	.233	.373	.404	.340	.001		.024	.076	.425
	N	43	43	43	43	43	43	43	43	43	43
Q21. Direct investment from this customer	Pearson Correlation	-.212	.113	-.078	.060	.227	.626**	.303*	1	.103	-.013
	Sig. (1-tailed)	.086	.234	.309	.350	.071	.000	.024		.255	.468
	N	43	43	43	43	43	43	43	43	43	43
Q36. Production costs	Pearson Correlation	.081	.264*	.192	.195	-.141	.210	.222	.103	1	.164
	Sig. (1-tailed)	.302	.043	.109	.105	.183	.088	.076	.255		.147
	N	43	43	43	43	43	43	43	43	43	43
Q44. Quality of products/services	Pearson Correlation	.315*	.086	.195	.179	-.064	-.111	-.030	-.013	.164	1
	Sig. (1-tailed)	.020	.291	.105	.125	.342	.239	.425	.468	.147	
	N	43	43	43	43	43	43	43	43	43	43

Finding four: from in-depth-interview

In Q16 multifunctional teams were addressed one manager explained, only when the model renewed, the multifunctional team will be associate with that changes. Generally speaking, the multifunctional team within our organization and multifunctional team within customer's organization, and then they are contact point for the information flow between both of two teams such as joint meeting.

In the Q18 sharing information with this customer, four out of six manager state that we have to share information with our customer either good or bad. Sharing information to our customers and let them know what are the situations are, such as our internal production processes, and external conditions like material costs, labor issues, union issue, and CSR.

In the Q36 production costs, three out of six managers state that we use lot of automation, and automation tends to keep a lower cost and stable cost. The production systems used are designed to increase productivity and reduce the man power. Thus, while material costs increase,

we are able to at least balance the production costs according to one manager. One manager pointed out that they place the order in Japan, and it will take one and half months to put together and take two weeks to ship from California to Taxes, so we have to carry extra. Because of currency exchange rate, the cost of material increased. Sales volume is high but the sale prices decreased. In the Q44 quality of products/service, all the managers state that quality of products is better and better every year.

Hypothesis Five

Ho5: JIT purchasing does not directly influence logistics performance.
Ha5: JIT purchasing directly influences logistics performance.

Survey items in this hypothesis evaluated the JIT purchasing and logistics performance. Questions 8, 9, 14, 17, 24, 26, 41, 42 address logistics agreement, JIT operation, and JIT programs. All respondents (n=43) completed these survey items. As table 4.19 demonstrates the Cronbath's Alpha is 0.746, which is reliable for the test.

Table 4.19 Reliability Statistics For H5

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.746	.753	9

Table 4. 20 Means For H5

	Mean	Std. Deviation	N
Q2. Please describe the JIT purchasing in your firm	5.44	.854	43
Q8. Lead times for outbound deliveries	5.74	1.115	43
Q9. Outbound transportation process	5.56	1.031	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	6.23	1.043	43
Q17. Manages this customer's inventory system	3.12	2.195	43
Q24. Order size reduction	5.05	1.479	43
Q26. Order lead time reduction	5.44	1.517	43
Q41. Outbound delivery lead times	4.30	1.124	43
Q42. Order setup times	4.44	1.333	43

The means in Q8, Q9, Q14, Q24, Q26, Q44 are equal or greater than 5.00 (the average numbers are equal or greater than 5.00), except Q17 (3.12 which is below 4), Q41 (4.30 which is below 4), and Q42 (4.44 which is below 4). Q8 (5.74) represents that lead times for outbound deliveries is stable in most companies. Q9 (5.56) represents that outbound transportation process is important. Q14 (6.23) represents that Electronic Data Interchange (EDI) connections or web-based inventory system are very important in most of companies. Q17 (3.12) represents that manages this customer's inventory system is available for some companies. Q24 (5.05) represents that order size reduction has been improved in many of companies. Q26 (5.44) represents that order lead time reduction has been improved in many companies. Q41 (4.30) represents that outbound delivery

lead times have been decreased in many companies. Q42 (4.44) represents that order setup times have been decreased in many companies.

Table 4.21 Crosstab: JIT Purchasing vs. Logistics Performance factors

	Q2. JIT purchasing
Q8. Lead times for outbound deliveries	69.7%
Q9. Outbound transportation process	74.3%
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	83.7%
Q17. Manages this customer's inventory system	30.2%
Q24. Order size reduction	69.8%
Q26. Order lead time reduction	72.1%
Q41. Outbound delivery lead times *	78.8%
Q42. Order setup times*	81.3%

In Q8, 69.7 % of respondents said more than above to extent a lot (scale 5-7) on lead times for outbound deliveries who indicated influence the JIT Purchasing as compared to 30.3% of respondents who indicated not influence the JIT Purchasing. In Q9, 74.3% of respondents said more than above to extent a lot on outbound transportation process who indicated influence the JIT Purchasing as compared to 25.7% of respondents who indicated not influence the JIT Purchasing. In Q14, 83.7% of respondents said more than above to extent a lot on Electronic Data Interchange (EDI) connections or web-based inventory system who indicated influence the JIT Purchasing as compared to 16.3% of respondents who indicated not influence the JIT Purchasing. In Q17, 30.2% of respondents said more than above to extent a lot on manages this customer's inventory system who indicated influence the JIT Purchasing as compared to 69.8 % of respondents who indicated not influence the JIT Purchasing.

In Q24, 69.8% of respondents said more than above to extent a lot on order size reduction with this customer indicated influence the JIT Purchasing as compared to 30.2% of respondents who indicated not influence the JIT Purchasing. In Q26, 72.1% of respondents said more than above to extent a lot on order lead time reduction indicated influence the JIT Purchasing as compared to 27.9% of respondents who indicated not influence the JIT Purchasing. In Q41, 78.8% of respondents said unchanged to decrease a lot (scale 4-7) on outbound delivery lead times who indicated influence the JIT Purchasing as compared to 21.2% of respondents who indicated not influence the JIT Purchasing. In Q42, 81.3% of respondents said unchanged to decrease a lot on order setup times who indicated influence the JIT Purchasing as compared to 18.7 % of respondents who indicated not influence the JIT Purchasing.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.14) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q8 and Q9 in this research was 0.604 which represents a strong relationship. Also, Q14 and Q26 in this research was 0.551 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho5 is rejected and Hypothesis Ha5 is accepted.

Table 4.22 Pearson Correlations For H5

		Q2	Q8	Q9	Q14	Q17	Q24	Q26	Q41	Q42
Q2. Please describe the JIT purchasing in your firm	Pearson Correlation	1	-.254	-.206	.016	-.155	.059	-.154	-.093	.285*
	Sig. (1-tailed)		.050	.093	.461	.160	.354	.161	.277	.032
	N	43	43	43	43	43	43	43	43	43
Q8. Lead times for outbound deliveries	Pearson Correlation	-.254	1	.604**	-.009	.071	.123	.139	.006	-.034
	Sig. (1-tailed)	.050		.000	.477	.326	.216	.187	.484	.414
	N	43	43	43	43	43	43	43	43	43

Q9. Outbound transportation process	Pearson Correlation	-.206	.604**	1	-.124	.086	.123	.189	-.005	.042
	Sig. (1-tailed)	.093	.000		.215	.291	.216	.113	.487	.396
	N	43	43	43	43	43	43	43	43	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	Pearson Correlation	.016	-.009	-.124	1	.154	.085	.551**	.345*	.147
	Sig. (1-tailed)	.461	.477	.215		.162	.293	.000	.012	.173
	N	43	43	43	43	43	43	43	43	43
Q17. Manages this customer's inventory system	Pearson Correlation	-.155	.071	.086	.154	1	.013	.192	-.092	-.002
	Sig. (1-tailed)	.160	.326	.291	.162		.467	.109	.279	.496
	N	43	43	43	43	43	43	43	43	43
Q24. Order size reduction	Pearson Correlation	.059	.123	.123	.085	.013	1	.394**	.077	-.107
	Sig. (1-tailed)	.354	.216	.216	.293	.467		.004	.311	.247
	N	43	43	43	43	43	43	43	43	43
Q26. Order lead time reduction	Pearson Correlation	-.154	.139	.189	.551**	.192	.394**	1	.213	.054
	Sig. (1-tailed)	.161	.187	.113	.000	.109	.004		.085	.365
	N	43	43	43	43	43	43	43	43	43
Q41. Outbound delivery lead times	Pearson Correlation	-.093	.006	-.005	.345*	-.092	.077	.213	1	.306*
	Sig. (1-tailed)	.277	.484	.487	.012	.279	.311	.085		.023
	N	43	43	43	43	43	43	43	43	43
Q42. Order setup times	Pearson Correlation	.285*	-.034	.042	.147	-.002	-.107	.054	.306*	1
	Sig. (1-tailed)	.032	.414	.396	.173	.496	.247	.365	.023	
	N	43	43	43	43	43	43	43	43	43

Finding five: from in-depth-interview

In Q9 outbound transportation process, three out six managers state that their customers take care of outbound transportation process, thus they no problem with it. On the other hand, the other three managers explained that some of our customers have distribution network and transportation network and they pick up the products on schedule basis. In some cases, we ship directly from our distribution centers to their solely using third party carriers.

In Q42 order set up time, three out of six managers state that while production running, the order set up time will increase a bit. However, the other three manager point put that they have been using automation for more than a decade, most of the orders are controlled by automation system, and thus their order setup time has not change very much.

Hypothesis Six

Ho6: JIT manufacturing does not directly influence logistics performance.
Ha6: JIT manufacturing directly influences logistics performance.

Survey items in this hypothesis evaluated the JIT manufacturing and logistics performance. Questions 8, 9, 14, 17, 24, 26, 41, 42 address logistics agreement, JIT operation, and JIT programs. All respondents (n=43) completed these survey items. As table 4.23 shown the Cronbath's Alpha is 0.752, which is reliable for the test.

Table 4.23 Reliability Statistics For H6

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.752	.784	9

Table 4.24 Means For H6

	Mean	Std. Deviation	N
Q3. Please describe the JIT manufacturing in your firm	6.05	1.133	43
Q8. Lead times for outbound deliveries	5.74	1.115	43
Q9. Outbound transportation process	5.56	1.031	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	6.23	1.043	43
Q17. Manages this customer's inventory system	3.12	2.195	43
Q24. Order size reduction	5.05	1.479	43
Q26. Order lead time reduction	5.44	1.517	43
Q41. Outbound delivery lead times	4.30	1.124	43
Q42. Order setup times	4.44	1.333	43

The means in Q8, Q9, Q14, Q24, Q26, Q44 are equal or greater than 5.00 (the average numbers are equal or greater than 5.00), except Q17 (3.12 which is below 4), Q41 (4.30 which is below 4), and Q42 (4.44 which is below 4). Q8 (5.74) represents that lead times for outbound deliveries is stable in most companies. Q9 (5.56) represents that outbound transportation process is important in most of companies. Q14 (6.23) represents that Electronic Data Interchange (EDI) connections or web-based inventory system are very important in most of companies. Q17 (3.12) represents that manages this customer's inventory system is available for some companies. Q24 (5.05) represents that order size reduction has been improved in many of companies. Q26 (5.44) represents that order lead time reduction has been improved in many companies. Q41 (4.30) represents that outbound delivery lead times have been decreased in many companies. Q42 (4.44) represents that order setup times have been decreased in many companies.

Table 4.25 Crosstab: JIT Manufacturing vs. Logistics Performance factors

	Q3. JIT manufacturing
Q8. Lead times for outbound deliveries	72.1%
Q9. Outbound transportation process	81.4%
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	90.7%
Q17. Manages this customer's inventory system	27.9%
Q24. Order size reduction	74.5%
Q26. Order lead time reduction	76.8%
Q41. Outbound delivery lead times *	86.0%
Q42. Order setup times*	83.7%

In Q8, 72.1% of respondents said more than above to extent a lot (scale 5-7) on lead times for outbound deliveries who indicated influence the JIT manufacturing as compared to 27.9% of respondents who indicated not influence the JIT manufacturing. In Q9, 81.4% of respondents said more than above to extent a lot on outbound transportation process who indicated influence the JIT manufacturing as compared to 18.6% of respondents who indicated not influence the JIT manufacturing. In Q14, 90.7% of respondents said more than above to extent a lot on Electronic Data Interchange (EDI) connections or web-based inventory system who indicated influence the JIT manufacturing as compared to 9.3% of respondents who indicated not influence the JIT manufacturing. In Q17, 27.9% of respondents said more than above to extent a lot on manages this

customer's inventory system who indicated influence the JIT manufacturing as compared to 72.1% of respondents who indicated not influence the JIT manufacturing.

In Q24, 74.5% of respondents said more than above to extent a lot on order size reduction with this customer indicated influence the JIT manufacturing as compared to 25.5% of respondents who indicated not influence the JIT manufacturing. In Q26, 76.8% of respondents said more than above to extent a lot on order lead time reduction indicated influence the JIT manufacturing as compared to 73.2% of respondents who indicated not influence the JIT manufacturing. In Q41, 86.0% of respondents said unchanged to decrease a lot (scale 4-7) on outbound delivery lead times who indicated influence the JIT manufacturing as compared to 14.0% of respondents who indicated not influence the JIT manufacturing. In Q42, 83.7% of respondents said unchanged to decrease a lot (scale 4-7) on order setup times who indicated influence the JIT manufacturing as compared to 16.3 % of respondents who indicated not influence the JIT manufacturing.

Correlation Analysis

The Pearson correlation coefficient was used to check the correlation of each set of paired dimensions. In the Pearson Correlations table (table 4.14) shown that all the p values are greater than 0.05. The result showed that the Pearson Correlation coefficients of the following paired dimensions were larger than 0.55: The correlation between Q8 and Q9 in this research was 0.604 which represents a strong relationship. Also, Q14 and Q26 in this research was 0.551 which represents a moderate relationship. However, the P>0.05 thus the Hypothesis Ho6 is rejected and Hypothesis Ha6 is accepted.

Table 4.26 Pearson Correlations For H6

		Q3	Q8	Q9	Q14	Q17	Q24	Q26	Q41	Q42
Q3. Please describe the JIT manufacturing in your firm	Pearson Correlation	1	-.028	-.186	.011	-.136	.013	-.040	-.049	.270*
	Sig. (1-tailed)		.429	.116	.473	.192	.467	.400	.378	.040
	N	43	43	43	43	43	43	43	43	43
Q8. Lead times for outbound deliveries	Pearson Correlation	-.028	1	.604**	-.009	.071	.123	.139	.006	-.034
	Sig. (1-tailed)	.429		.000	.477	.326	.216	.187	.484	.414
	N	43	43	43	43	43	43	43	43	43
Q9. Outbound transportation process	Pearson Correlation	-.186	.604**	1	-.124	.086	.123	.189	-.005	.042
	Sig. (1-tailed)	.116	.000		.215	.291	.216	.113	.487	.396
	N	43	43	43	43	43	43	43	43	43
Q14. Electronic Data Interchange (EDI) connections or web-based inventory system	Pearson Correlation	.011	-.009	-.124	1	.154	.085	.551**	.345*	.147
	Sig. (1-tailed)	.473	.477	.215		.162	.293	.000	.012	.173
	N	43	43	43	43	43	43	43	43	43
Q17. Manages this customer's inventory system	Pearson Correlation	-.136	.071	.086	.154	1	.013	.192	-.092	-.002
	Sig. (1-tailed)	.192	.326	.291	.162		.467	.109	.279	.496
	N	43	43	43	43	43	43	43	43	43
Q24. Order size reduction	Pearson Correlation	.013	.123	.123	.085	.013	1	.394**	.077	-.107
	Sig. (1-tailed)	.467	.216	.216	.293	.467		.004	.311	.247
	N	43	43	43	43	43	43	43	43	43
Q26. Order lead time reduction	Pearson Correlation	-.040	.139	.189	.551**	.192	.394**	1	.213	.054
	Sig. (1-tailed)	.400	.187	.113	.000	.109	.004		.085	.365
	N	43	43	43	43	43	43	43	43	43

Q41. Outbound delivery lead times	Pearson Correlation	-.049	.006	-.005	.345*	-.092	.077	.213	1	.306*
	Sig. (1-tailed)	.378	.484	.487	.012	.279	.311	.085		.023
	N	43	43	43	43	43	43	43	43	43
Q42. Order setup times	Pearson Correlation	.270*	-.034	.042	.147	-.002	-.107	.054	.306*	1
	Sig. (1-tailed)	.040	.414	.396	.173	.496	.247	.365	.023	
	N	43	43	43	43	43	43	43	43	43

Finding six: from in-depth-interview

In Q8 lead times for outbound deliveries, two of six managers said that they have involvement with customers located in Mexico and Canada. They often have longer lead time due to having to cross borders. One manager states that they have issues with the truckers' in Canada, they have had hard time finding Canadian trucking company to deliver their products.

In Q24 order size reduction, all the managers state that most of the customers do not want to stock up their inventory, thus they prefer order a small quantity but order more frequently to maintain their low inventory level. Some customers even have zero-inventory policy and do not have warehouse, so their order is very precisely.

Conclusion

As we all know if the company wants to be successful, it must help their suppliers by sharing knowledge. However, in the survey result, the portions of companies providing training/education programs are not as much as expected. Most of the managers stated that the training/education events only occurred when their customers are introducing new vehicles. In most cases, Japanese vehicles remodel every 3-4 years, and German vehicles remodel every 5-7 years, American vehicles have most wide range which is between 3-7 years depending on the type of vehicles. One of manager said "most of our products, or should I said camshaft and other major engine components have not change for decades. Most of the engine assembly is still in house; therefore, we only have minimum training from our major customer. Three out of six of the senior managers interviewed explained that they have been doing stamping and welding for more than three decades and only receive training from automakers when the job required special skill. However, we do offer training and education package to our employees."

It is very important to ensure that suppliers are in good shape. The common rating system are based on 1) do they deliver on time, 2) do they deliver exact the amount we request, 3) the quality of delivery (any damage during transportation), 4) the quality of material, and 5)customer support. If the raw material supplier has the problem to keep up the standard, most of automotive suppliers will help them figure out what the problem is and come up useful solution instead of terminate the business relationship.

The survey was collect in early October and early November 2010 and the results do not show quite as impressive due to lack of auto sales. Many well-known mega automotive suppliers filed chapter 11 in 2009, and some of them shut down unprofitable plants in order to survive in this slump market. Yes, the auto sales have been picking up in late 2009 and early 2010, but those figures are still far behind the number in 2006 and even 2007.

Many automakers have not been utilizing long-term forecasting they are typically looking short-term-- annually or semi-annually since economic crisis. Many suppliers pointed out their customers' sales are not stable because of the economic recession; therefore, they have to focus on our distribution network with our customers. Their customers have to figure out and forecasting accurately (update weekly) based on economy and sales history in order to maintain JIT.

During the interviews, one of the manager stated the only 60% of suppliers in GM use JIT while compare Toyota's 100%. Many of them said not all of their suppliers are JIT basis, for example, about 60% of Delphi's suppliers use JIT.

Many suppliers successfully adopted automation technology, and automation tends to keep a lower cost and stable cost. The production system used here is designed to increase productivity and reduce the man power. They keep most of automated assembling jobs in the United States, and move hands on jobs into Mexico.

One of the most important SCI is suppliers' locations close to the customers' plants. American automakers are heavily relying on long distance transportation. On the other hand,

Japanese automakers encourage their suppliers to establish their manufacturing plants close by locations in the United States. Indeed, not all of Japanese suppliers are capable on this. Thus, Japanese automakers work with local auto suppliers by joint ventures, mergers, and cooperative agreements.

Many automakers have suffered because of the recall activities which has damaged their reputation for a short period of time in 2010. In fact, most of the recall activities were in 2007 and because the company wanted to save money which resulted in some people dying. Millions and millions of vehicles have been recalled and these companies have been utilizing JIT for long time. There must be a missing link. Suppliers try to survive in the economic recession and because they are unable to increase the sale price, plus the union problems, and sales volume decrease-- What can they do? Lower the material usage, lower the quality standard, lay off skilled workers and replaced them with less costly part time labor. The above factors will save them some money in the short-term, but they have to pay it back multiple times in the long-term. Have they learned the lesson, as a researcher, I have no idea.

Some of suppliers state that their market share has been decreased due to many automotive suppliers outsourcing their manufacturing to partners in China. By having them produce the products than ship to the United States it reduces overhead cost. It is much cheaper to produce in China and distribute here but offers great risk. Many managers state "China imports have affected our market share, because their sales prices are much less than ours, and that is a challenge for us. But we have basically stayed with some of our core business products which we are very good at."

In fact, according to Masaki Imai, "Chinese products are not superior, but they can produce at a far more competitive price. Superior has many connotations, in terms of design, efficiency, etc. I certainly wouldn't call China superior (Imai, 2009)." He also states that in order to produce high quality product, high quality conscious employees are required.

How to maintain JIT status during the economy downturn? It is even more important to maintain JIT when we face the economic recession. Many managers agreed that now is a period of time when you don't have the money to invest in inventory; you need to match the flow of incoming material with outgoing material, reduce overall investment, maintain process efficient in the first place, and flexible in the second place." "The flexibility in JIT allows you to have flexible number of operators depend on production volume." So, how do they react? They say that we maintain JIT by first, inform our suppliers that the demand decreased and we no longer need that much raw material. Second, we shut down the plants that are not profitable. We have several products manufactured in Asia, and it longer time to impact the inventory.

So, how did the Japanese transplants or Japanese affiliated companies do a better job in lean supply chains in the United States? 1) because they are more willing to work with their suppliers in developing lean capabilities 2) They evaluate and forecast the demand accurately to avoid their suppliers need to hold inventory (result shown that Japanese automakers have much higher inventory turnover rate) (Liker & Wu, p.84), 3) They follow their discipline and make sure their suppliers do too. 4) They encourage their suppliers to transport small quantity, mix items in the same container. One senior manager says "once you learn the principle then it's a problem solving exercise to make it works on the floor."

Limitation

This research has three limitations. First, all participants only have one time to response within a particular time frame. They probably cannot response truthfully especially in such an unpredictable business environment. Second, due to the economic recession the sample was relatively small, thus should increase next time in order to get more accurate data. Third, the research, conducted via surveying and in-depth interviews should not be over-generalized to other industry.

Future Research

Future research should focus on Japanese automakers' auto suppliers or American automakers' suppliers and do a comparative analysis. More significant findings could be determined in a closer examination of the differences between the countries and systems. The future research could also identify the cultural impacts and trends to predict performance.

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