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JIT AND RESOURCES

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Abstract

The objective of the thesis was to identify the process of procurement of resources in implementing Just-in-Time system. The theoretical part was based on published literature, such as books, journals, and theses on the subject of Lean and Just-in-Time that served as a foundation for the empirical part.

The theoretical part of the paper identifies key success factors of the Just-in-Time implementation process such as human resource practices, management style, organizational strategic vision, and organizational culture. The thesis provides the challenges that companies may face when they change their management system towards implementing JIT concept.

This paper analyzed the activities in manufacturing enterprise production and business operation by using JIT methods. The conclusions are more based on a general indication rather than a statistically significant result and certain aspects are critical to successful JIT implementation. However, most of the findings of the literature review were reflected by case study.

This thesis topic could be developed further by choosing a particular company with appropriate organization structure in order to implement JIT concept within every department when the organization seeks to strive for a competitive advantage.

Keywords

Lean, Just-in-Time, procurement, JIT implementation

ABBREVIATIONS

JIT – Just-In-Time

TPS – Toyota Production System

VMS – Value Stream Mapping

WIP – Work In Progress

CONTENTS

1 INTRODUCTION

The procurement of resources is an important part of the entire logistics system, and therefore it is necessary to study the system, concepts and methods of procurement and choose the system that is appropriate to the enterprise and will help to minimize all kinds of costs.

Nowadays, the successful implementation of Just-in-Time (JIT) system and procurement take place in an effective manner. The function of procurement is to provide a firm with component parts and raw materials. Procurement also must ensure that high-quality products are provided on time and at a reasonable price.

The idea behind this thesis came from a personal interest in Lean management. Many companies are aware of the great effects of implementing JIT system, especially with well-known success of Toyota. No matter how powerful it is, using JIT is not avoid challenges. This paper identifies these challenges and gives further development ideas and recommendations.

The Just-in-Time system is a powerful management tool that could determine the success or failure of the manufacturing system. This system manages the flow of materials, components, tools and associated information. The benefits of implementing a JIT system influence all entities involved in Supply Chain Management.

Implementing of JIT concept leads to efficiency, to effectiveness and it is a societal good. For example, Harley Davidson’s success with the implementation of JIT has many operations with the fact that when JIT was put into practice, inventory levels were decreased to 75% and productivity was increased. JIT system identified the inefficiencies in the processes and solved them (Forbes Greatest Business Stories of All Time by Daniel Gross, The Turnaround at Harley-Davidson, 4).

Main Objectives

The objective of the thesis is to identify the process of procurement of resources in implementing JIT system. The study will be conducted on different companies that use JIT techniques such as Toyota, Harley-

Davidson, and Dell. Based on this study, a recommendation will be created on the way of implementing Lean tools.

In order to accomplish this objective, several sub-questions need to be considered such as what the main elements of JIT purchasing, what challenges the company has had when implementing JIT technique and what the options for improvement.

Research Method

The thesis will include the results of the study on the challenges of JIT implementation as well as theoretical research on Lean management. The theoretical part of the thesis is based on several studies on JIT management as well as credible websites on the topic. The empirical part will support the theoretical framework and will be based on an analysis of implementing JIT on different companies. After that it will possible to define further development ideas. This thesis relies on theoretical data gathered from various books and websites, in order to develop a well-formed recommendation.

The result of the study suggests how to implement JIT to optimize operations to achieve cost efficiency and to minimize risks and wastes.

2 LEAN

”Lean manufacturing is the name used for a collection of business performance improvement tools that focus on enhancing quality, cost, delivery and people’s contributions through the application of world-class manufacturing principles, the elimination of waste and continual improvements in workplace safety.” (David Hutchins).

A lean manufacturing strategy reviews the customer’s value and redesigns the production processes to maximize that value (Womack & Jones, 2003). Systems are designed to eliminate wastes and create quality goods first time through (Kennedy & Maskell, 2006 and Shah & Ward, 2003). Lean manufacturing is known as a “pull” strategy that means manufacturing only to customer demand. Firms in this environment reorganize into cells and

value streams in order to focus on the value generated by products across all functions. (Womack & Jones, 2003).

Lean can add value, but many top management still have not made the paradigm shift as to how to implement Lean. Lean is a long-term health program when the managers of the company try to do more with the same or less resources. Many companies focus on identifying and eliminating wastes when they are going to implement Lean successfully. Waste is a non-value-adding activity but it adds costs to the company. There are eight main forms of waste:

1. Overproduction (producing more than customer requires);
2. Waiting (for process, excessive machine time/downtime);
3. Transportation (bad organization, double handling);
4. Non-utilized talent;
5. Extra-processing (doing more than necessary);
6. Inventory (stocks of parts not being worked upon and stored between operations);
7. Motion (excessive walking, searching for parts);
8. Defect or error waste (rework, errors in data entry). (Hobbs, 2011, 3).

According to Bernardo Nicoletti (2012), author of Lean and Digitize, Lean is one of the tools for quality management. Within many business companies, Lean helps to increase market share by attempting to minimize operating costs.

“Lean, also referred to Lean Management, Lean Manufacturing, Lean Production or Lean Enterprise, eliminates any activities that do not add value to products, and arrange to produce faster with higher quality and lower costs”. (Bernardo, 2012).

2.1 History

Since the 1950s, Lean tools and techniques and lean management principles have been developing in manufacturing settings. After becoming prominent in the early 1980s, lean practices have been introduced into service industries. (Sloan et al., 2014).

The term “Lean production” was first used by Krafcik in his 1988 article, "Triumph of the Lean Production System," based on his master's thesis at the MIT Sloan School of Management (Krafcik, 1988, 41-52).

When Henry Ford was developing his mass assembly manufacturing system, he focused on elimination of the waste. Henry Ford cited Franklin saying that JIT manufacturing had a major influence on his own business practices. He created a model of assembly line production using Lean concept. Ford's early success was not sustainable. His accomplishment represented a "special case" rather than a robust lean solution. (Womack & Jones, 2003).

Ford built some methods not for the dynamic conditions, but for a steady-state environment. It was the major challenge that he faced. (Ruffa, 2008). While Ford and General Motors dominated the automobile field, the Toyota Company was founded. In order to prevent destruction after World War II, Toyota made an effort to change manufacturing system and focused on the management of costs. For instance, inventories of unsold cars increased, which led to extra costs. All costs were determined as waste, and Toyota used concept of lean to eliminate the waste. (Hobbs, 2003).

Lean manufacturing, in general, is a management philosophy derived mostly from the Toyota Production System (TPS) and was as Lean only in the 1990s. The scale and continuous learning aspects of TPS have made it a core concept of Lean (Womack, Jones and Roos, 1991). The complete term Lean was announced (Bicheno & Holweg, 2009, 281-282).

Nowadays, the strongest proof of the power of lean enterprise is Toyota. Due to its dominant success in increasing sales and market shares in every global market, the world’s lean exemplar became the largest automaker in the world in terms of overall sales.

As lean thinking continues to spread to every country in the world, managers are also adapting the techniques and lean methods to logistics and distribution, services, retail, healthcare, construction, maintenance, and even government. Moreover, lean tools and principles are only beginning to take root among senior managers and leaders in all sectors nowadays.

2.2 The five lean principles

Womack and Jones developed five Lean principles. Every company that implements Lean uses these principles as continuous improvement, not only once.

1. Value.

Every activity that does not add value is waste. There are seven wastes within improvement process which the company tries to eliminate. Improvement starts when the customer defines the value, time, price and quality. It is important to know the final customer, their competitors, and overall process. (Bernardo, 2012, 59).

2. Value stream.

Identification of added value activities and elimination of waste flow is the main objective of the value stream stage. Value streams are created by gathering products that are similar to each other. The grouping of the products depends on the business strategy, but it could be provided according to demand, process or characteristics. The company reschedules the process in order to make the productive flow run and uses value stream mapping (VSM) by showing materials and information flows. (Bicheno & Holweg, 2009, 12).

3. Flow.

Flow optimization is a main objective of the company, which organizes lean thinking. However, it does not guarantee a reduction in defects. The third lean principle “flow” makes the identified flow continuously through the remaining value-added steps.

4. Pull.

Product is pulled between all steps where continuous flow is possible. It is important to make the product flow pulled by the customers.

5. Perfection.

Profitability is an important objective but only as a by-product. The aim of Lean is perfection, the organization seeks perfection and is not so worried about competitors. (Bernardo, 2012, 13).

All the staff will secure the Lean principles within the company. Difficulties arise when these principles must be applied to ordinary reality, when people have to change mentality and their working habits, when the whole organization must change their working habits or when providers must change their working habits. (Bonfigliolo, 2004, 85).

There are five steps to Lean Management:

1. Management understanding and commitment.

Managers must develop policy statements mentioning its commitment to JIT procurement - production - distribution strategy and stating which product lines are involved and which plants must be included. The management coordinate all functions, think about what resources are available for implementation, define the timetable for implementation, recognize the sub-contractors, which are involved in the implementation process. (Bandyopadhyay, 2004).

2. Adjustment with strategic objectives.

Goal alignment helps engage and retain top performing employees also the company can execute strategy faster. However, Lean Management also requires bottom-up implementation. According to Ritzman et al. (1984, 143-152), the main and useful components required for changeover are kept in the right place to allow for quick changeover.

3. Train the employees to Lean manufacturing.

Training the workforce to make clear understanding of some tacit elements within manufacturing process. The standardization of activities can improve operational effectiveness and efficiency (Billesbach, Harrison and Morgan, 1991, 24-28).

4. Develop managers by Lean thinking.

In order to help overcome difficulties and provide support, development is needed to Lean managers. Development of Lean managers also includes job rotation in order to reduce monotony and improve the efficiency of the staff (Krajewski & Ritzman, 1992).

5. Encourage a team-based continuous improvement.

Development the culture that creates project teams and let them work is a crucial element for a continuous improvement. In order to support the person to succeed in all the aspects this person is engaged in, the company encourage a team-based continuous improvement. This technique can lead to smaller batch sizes and short set-up times. (Bandyopadhyay, 2004).

2.3 Lean enterprise

“Lean enterprise begins with Lean Production, the concept of waste reduction developed from industrial engineering principles and refined by Toyota. It expands upon these principles to engage all support partners and customers along the value stream.” (Basu & Walton, 2011).

Aims of Lean enterprise:

1. Give customer contact personnel the responsibility, authority, knowledge, skills, and tools to provide quickly and efficiently what customers want from them.
2. Analyze the final result and evaluate the entire process again (Womack & Jones, 2003, 276).
3. Create simple processes performed by workers with more complex jobs;
4. Eliminate all actions that do not add value which should be continuous based on customer demand.
5. Reduce organizational limits and borders.
6. Provide a supporting role by management.

3 LEAN TOOLS

Nowadays, in the current area of globalization, every industry is adopting new tools and techniques to seek to strive for a competitive advantage and survive in the market.

The main issue is how to deliver goods quickly at high quality and low costs. One of the decisions for this problem is the application of lean manufacturing principles and tools. These lean tools focus on certain steps

of the manufacturing process to identify and eliminate wastes. While production costs and time are reduced, these tools focus on improving quality.

The main lean tools and techniques of a manufacturing program are 5S, VSM, JIT production, Kanban management and Kaizen.

3.1 5S

The 5S system was developed in Japan. One clear and successful example of the application of the 5S principles is TPS (Monden, 2012).

A workspace organization technique composed of five primary phases: Sort, Set Locations, Sweep, Standardize, and Sustain (Dudbridge, 2011, 62).

There are four main objectives of the 5S system:

- improve safety;
- improve work efficiency;
- improve productivity;
- establish a sense of ownership.

The implementation of 5S involves two phases and several stages for each element of the 5S. It is important that all organization levels have been integrated in the process. The original 5S of five Japanese words are Seiri, Seiton, Seiso, Seiketsu, and Shitsuke that represent each of the five stages that make up the methodology. (Kobayashi, 2005).

The first S of the 5 is for “Sort”. This step is to sort out what is required to be available within workspace and remove all unnecessary tools and parts. Only essential items remain in the production areas. If the item is not used up until the date on a label with red tag, it is discarded. Next, the items are sorted according to the frequency of use. This sorting process keeps the workspace in a logical order and reduces risks.

The second S is “Set Locations” of each item or “Set an order of flow”. It means that every item should be placed in the best way. The work is arranged in such a way that the work flows free of inefficiencies through the

value added tasks. There are two ways to ensure that all workers know where the items are by labelling (matching items in color with their area) or using any type of visual management tools (shadow boards: paintings of tools so as to show their correct location). This stage should be repeated whenever any products, parts, or tools change. (Bicheno & Holweg, 2009, 79).

The third S of the 5 is “Sweep” or “Shine”. This step provides a great deal of advantages to the business by improving reliability. The workforce of the company should control the environment for anything that is out of place and try to correct it immediately. Machines and equipment should obtain regular inspection that provide quicker breakdown recovery. If a dirty equipment breaks down, it will take many hours for finding the error and repairing it. Obvious, it is easier to work on with a clean machine for the engineer fitting the new part. The machine used for cleaning should also be well maintained. Moreover, a clean machine will run more consistently and produce less rejects.

The fourth step is “Standardize”. Visual control of every task is the best way of improving efficiency, reducing mistakes and keeping the quality of the output to the appropriate level.

The last S of the 5 is “Sustain”. Sustain is all about the training of workers into the standard required. The training and development of new people in the organization is essential and is seen as a key in order to sustain the system. Disciplined abidance by rules and procedures must be ensured for the successful implementation of 5S principles.

3.2 Just-in-Time (JIT)

Just-in-Time (JIT) is a lean tool that will realize the aim of maximal profit by eliminating waste and improving productivity in pull mode.

The core of the JIT production mode is to keep inventory at the minimum level. In addition, when the company is building a production system it is an important feature to pursuit a zero inventory. JIT requires providing exact

quantity at appropriate time (only when it need). Parts are made by the customer's order and only when they are immediately required.

There are five key elements of JIT implementation:

- Customer demand (production not in batches).
- Throughput time reduction.
- Inventory reduction.
- Quality improvement.
- Space reduction (workspace is keeping clean).

The downstream production should practice level scheduling so as to create a smooth day-to-day order flow that is free from any changes that are unrelated to the customer demand (Womack & Jones, 2003, 58).

When implementing JIT techniques in a company, it is important to have an agreement and support with the workforce of the company, suppliers, and companies involved within the supply chain (Lai, 2009, 18).

3.3 Kaizen

Kaizen was developed in Japan based on the US-born industrial engineering and quality management ideas but now is widely accepted across the world as a standard approach (Imai, 2012). Kaizen culture is a continuous improvement in the personal, family, social and professional life (Hobbs, 2011).

The Japanese-style Kaizen management approach was identified as one route through which clustering could support broad industrial development built on practical, basic and yet substantial innovations in managing enterprises more efficiently and effectively (Imai, 2012).

Kaizen management approach encourages workers to spot inefficiency problems, such as uneven workflow, waste motion, inefficient workplace layout, and other inefficient practices and arrangements and to find solutions to the problems. Kaizen approach emphasizes cost reduction through the elimination of wasted materials and time. (Hobbs, 2011, 11).

The Kaizen process consists of three stages:

1. Preparing for the formal event (the event which focuses on internal processes within company);
2. Performing the event (it takes for a five days or less);
3. Checking whether the improvements are constant and profitable.

There should be a Kaizen leader to support the Kaizen process. On the first stage, the leader selects the area within a company that needs improvement. Team members assess estimated costs and benefits and set a time for the event. In conclusion, a Kaizen leader and team members evaluate the process and improve it to solve the performance issue, measure results, and show these results to stakeholders (Hobbs, 2011, 12). However, a review of the area needs to be done every month to ensure that the improvement was a success and is continuously improvement.

3.4 Kanban

The Japanese word Kanban means “signboard” (a visual pull system). Kanban was named by Taiichi Ohno, a Vice President of Toyota, when he developed kanban cards to implement JIT production and minimize work in progress (WIP) by means of a simple visual tool.

Kanban is a system that allows for the management of the overall supply chain to strategically to link production demands and the management of supplies. The Kanban system allows quickly to adjust and to control the release of the required quantity of goods and to ensure the timely supply of resources. “The idea behind the Kanban concept is that workstations produce or deliver desired components only when needed, thanks to a visual signal in the form of the reception of a card, box, or empty container.” (Sugimori, Kusunoki, Cho & Uchikawa, 1977).

Kanban systems create cost reduction not only by eliminating waste but also by being more responsive to change, facilitating quality control, and giving importance, trust and support to the employees running the processes (Chalice, 2007).

The production planning and procurement in Kanban system have their options. The kanban cards are scanned by material handlers and then findings are transferred as the requests to the material management

information system. For direct purchases, a requisition is transmitted to suppliers. Finally, material handlers deliver supplies directly into the empty bins, thereby ensuring stock rotation in each unit. “The scanning process (in the form of replenishment-ordering rounds) has been eliminated with the use of RFID-enabled kanban cards, which create an automatic replenishment request once the card is placed on the reader board.” (Bendavid, Boeck, & Philippe, 2010).

Kanban management is another important tool of production management in lean production mode. An operation instruction is transferred through Kanban among working procedures, factories and collaboration enterprises which is provided effective production flow. Every working procedure implements according to the Kanban information to guarantee necessary production at a particular time and achieve the goal of JIT production.

The implementation of Kanban management reduces waste and non-value added activities effectively, shortens product life cycle, improves the production efficiency, and ultimately achieves the goal of just-in-time production.

3.5 Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is the sum of all activities that are needed in the manufacture of products including the value-added and non-value added activities. According to statistics, the value added activities only occupy 5% of all production activities in the manufacturing company, but non-value activities occupy 95%. (Xiangjun Ji, Qi Chen & Yubo Ji, 2005, 28-29).

It is important to identify the non-value added activities in the value stream. The enterprise could eliminate all kinds of hidden waste, reduce costs by continuously improving, and at the same time, shortening the production cycle of products, and realize just-in-time production to achieve customer satisfaction (Fawaz Abdulmalek & Jayant Rajgopal, 2007, 223-236).

VSM is a tool for drawing and designing the material and information flow which adopt product family as the unit, use graphics to draw all kinds of

activities including customers and suppliers, and track production paths. Then the necessity of each activity is analyzed in the VSM from the perspective and view of the customer, the ideal future VSM is drawn and a new implementable plan is made (Wenhua Jiang, 2006). The analysis of VSM can help to monitor and understand the material and information flows, identify the hidden non-value activities, and determine which part needs to be improved, to achieve lower production costs and timely response to market demand (Li & Xu, 2008, 122-126).

4 JIT AND PROCUREMENT

The role of purchasing function to business has become increasingly important. The purchasing function provides a firm with particular component parts and raw materials.

The purchasing organizations use a planning system (manual or electronic) to place an order for the buyers of their components or products and to notify them when it is possible to procure goods (Hobbs, 2011).

There are different types of organizations and manufacturing processes which need other relationship between the customers and the factory processes. Figure 1 and Figure 2 show a difference in such a relationship.

In the mass production push system, no real relationship exists at all. The market forecaster as a customer in Just-in-Time Demand Pull System places demands on the factory months in advance of production. In comparison with JIT system, the customer’s demand tooks place throughout the system, from the factory processes to the suppliers. The cycle of Just-in-Time Demand Pull System is simpler because the entire functions are eliminated (such as material control, production control, warehousing, and stocking). (Goetsch, 2013, 371).

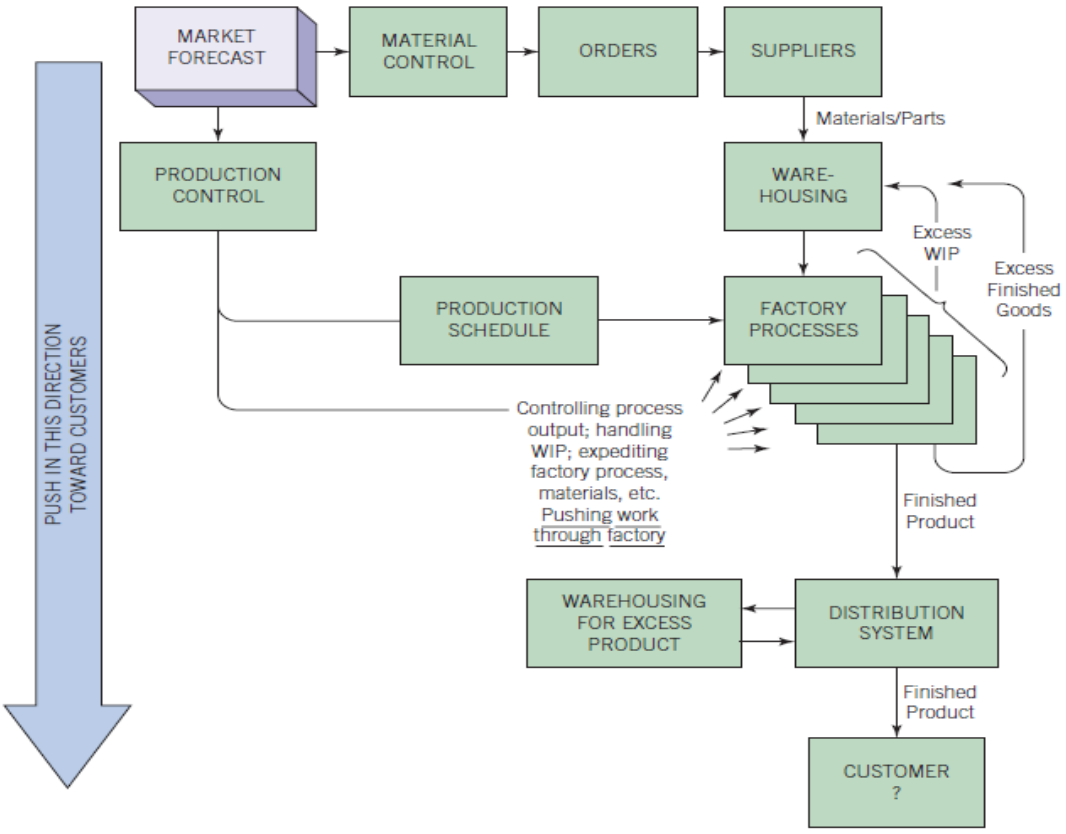

Figure 1. Mass Production Push System (Goetsch, 2013, 371)

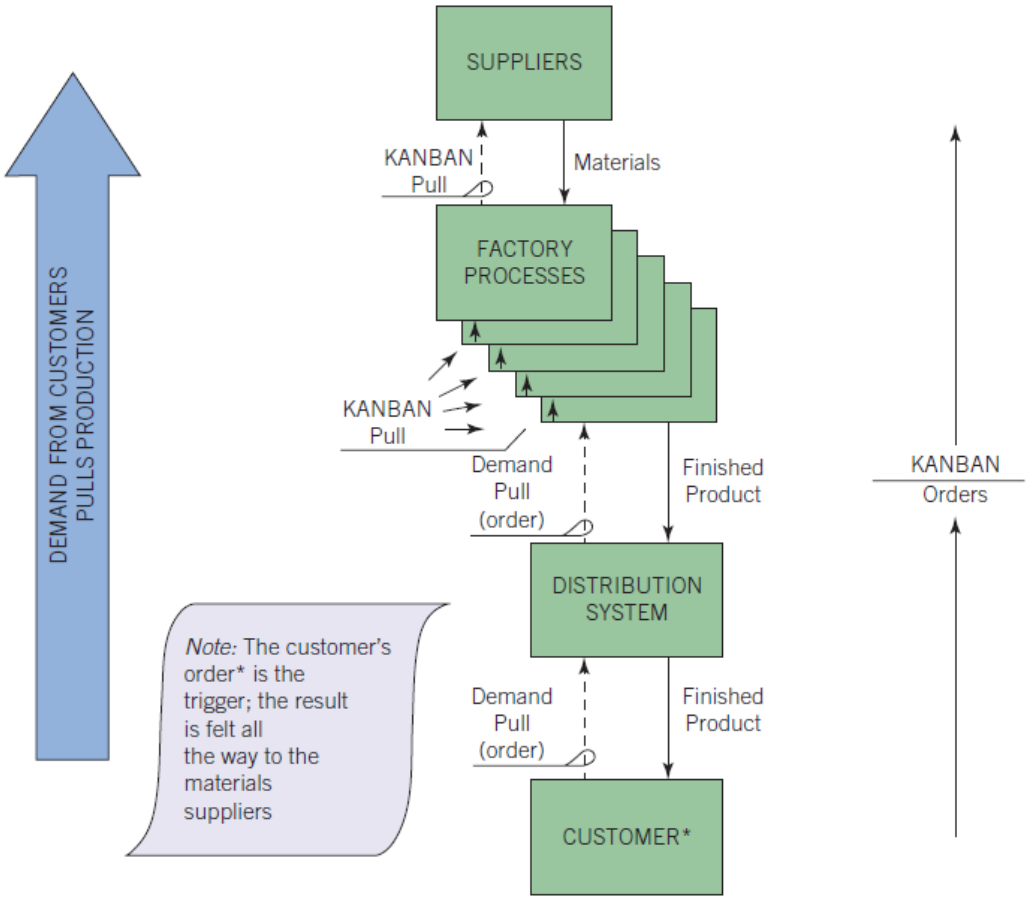

Figure 2. Just-in-Time Demand Pull System (Goetsch, 2013, 372)

In mass production push system, it is difficult to determine how things are going relative to schedules. Components of the product or semi-finished products may be situated in any incomparable locations in the factory at any given time, for example, in the machine shop, on the line, or in storage. JIT is a visual process that makes tracking easy (even without computers). Components and semi-finished products have no place to hide in a JIT factory. In addition to all advantages mentioned above, the simplicity of JIT demand pull system eliminates difficulties because production must stop for a missing part or a manufacturing problem. The methods had to be developed to prevent these consequences. (Goetsch, 2013, 371-372).

4.1 Procurement of resources

Procurement of resources is one of the functional areas that is a potential Lean opportunity. Lean procurement means partnerships and alliances and needs coordination and collaboration. Emphasis on reliability and quality leads to long-term relationship with suppliers. Moreover, suppliers are willing to engage in JIT-partnership sharing technological expertise. (Lysons & Farrington, 2006).

Effective purchasing functions contribute to improving the company's capital turnover ratio. One of the ways to implement it is through a reduction of the networking capital employed by the company. There are many measures that will lead to a lower capital employment. For instance, longer payment terms, reduction of inventories of base materials through JIT agreements with suppliers, and supplier quality improvement. In addition to that, quality improvement of the supplier will lead to less buffer stock required. (Weele, 2010).

The principle of JIT means that all materials and products become available at the time they are needed in the production process in exactly the right quantity (Weele, 2010, 245). The system states the dependability for the main logistic operations – production and procurement.

4.2 Elements of JIT purchasing

JIT purchasing must ensure that high-quality products are provided on time and at a reasonable price. Under the JIT purchasing approach, supplier performance can be measured more accurately compared to traditional purchasing.

One of the most crucial elements of JIT purchasing is small lot sizes. Manufacturing organization makes an effort to reduce order quantities, and corresponding delivery schedules need to be made more frequent. (Lysons & Gillingham, 2003).

Key points of JIT purchasing:

1. Raw materials are delivered in a small size in particular quantity and production department
2. Finished product is delivered as far as possible
3. Stock levels are kept to a minimum in order to reduce inventory costs.

In general, JIT means producing the quantity of units just-in-time (on the time/date required) and delivering the exact quantity demanded at the scheduled time/date by suppliers.

The main objective of JIT approach is to obtain the highest volume of output at the lowest unit cost and to produce and deliver on time. In addition, there are some additional aims which the company is going to reach:

- Reduction of non-value-added activities (wastes);
- Close and long-term relation with suppliers;
- Reduction of the time of manufacturing process;
- Improvement of quality and reliability;
- Reduction of reserve stock (Benton, 2009).

Such factors as stock, volume of raw materials, supplier selection, transportation, and quality that influence the implementation of procurement in JIT approach are described in Table 1.

The main resources to be managed to reach the JIT effectiveness are: materials, workers, machines and tools, energy, methods, and products (Santons, Wysk, Torres, 2014, 4).

Table 1. Characteristics of JIT procurement

Factors	JIT
Stock	All efforts are directed to eliminate stock. Lack of insurance stock.
Volume of raw materials	Volume of raw materials meet customer's requirements, not moreover. Frequent purchases but in small lot size.
Suppliers	Setting continuous long-term relationships. Small supplier base but with close relationship.
Transportation	Objective – enforcing delivery terms. Consumer sets the delivery schedule.
Quality	Parts meet the specifications (zero defects). Quality is the responsibility of suppliers.

The characteristics of JIT procurement show the relationship between the manufacturer and the supplier. In this way, every supplier is informed of the production planning and the related purchasing requirements. Delivery schedules are available online so it is easier for the supplier to forecast the customer's future requirements and to plan production and materials requirements more effectively. It is one of the advantages of working with suppliers in this way. (Lysons & Gillingham, 2003).

Apart from this, another advantage is long-term contracts. The producer sets targets for productivity improvement and cost reduction and renegotiates the conditions with their suppliers at least once a year. Agreements on these issues are documented and communicated to the supplier. After the negotiations, the producer will monitor and measure the future performance of the supplier. Lysons and Farrington (2006) state that through close cooperation with suppliers or by having suppliers located closer to the factory, delivery lead-time can be reduced. In addition, they notice that for successful implementation of JIT, the lead-time must be reduced to the minimum.

The JIT principle for quality is zero defect. It may represent enormous savings to the producer, for instance, the reduction of buffer stock and the number of incoming quality inspection. Moderate stock should be held to ensure that work does not stop if the new supplies fail to be delivered on time. (Geitangi, 2009, 25).

The practices described above are different from traditional purchasing practices. Traditional purchasing theory prescribes multi-sourcing (obtaining

materials from various suppliers) and relation with suppliers as being focused on the short benefits. The main idea states that single sourcing should be prevented.

Table 2. Main differences between the traditional and the JIT approach within purchasing activities (Weele, 2010, 250)

Purchasing activity	Traditional approach	JIT approach
Change of orders	Quantity and delivery time can be changed	Quantity and delivery time fixed and quantities can be corrected within specified deviations
Supplier selection	Many suppliers and the main issue is purchase price	One close supplier that organizes frequent deliveries
Placing the order	Quantity and delivery time are specified order	Annual order and deliveries only when it is needed
Incoming inspection	Inspection of nearly every delivered order	Initial sample inspections, only once is needed
Supplier assessment	Deviation of delivery can be about 10%; quality rating	Deviation of delivery are not accepted; fixed price according to open calculation
Invoicing	Invoicing settled on every order	Payment per month and invoicing are collected
Follow-up of orders	Phone calls solve delivery problems	Few delivery problems due to sound agreement; delivery problems and quality are not tolerated

As can be seen from Table 2, the demands made by JIT on suppliers are considerably high. Traditional buyers should consider single sourcing as an appropriate strategy and they should be willing to arrange longer-term contracts instead of short-term relationship. (Weele, 2010, 249).

When the company select and assess their suppliers, the criteria should be adjusted for comparison. The purchase price, as an easier issue in the negotiations with suppliers, is used for supplier selection. The demands on suppliers are different, and this refers to both flawless product and process quality and delivery reliability.

5 IMPLEMENTING LEAN/JIT

In today's competitive environment, the main objective of every company is long-term survival and continuous improvement of customer satisfaction.

The success of manufacturing system depends upon the company's ability of doing business with shortest possible lead-time, producing high quality product just in time and at a reasonable price (Goetsch, 2013). According to

these objectives, it is difficult to maintain excellent quality and at the same time respect the workforce within organization who do their work in appropriate manner (Malik, 2012).

5.1 Implementation of JIT concept

Implementation of Lean/JIT is an important manufacturing strategy that is vital for every organization and helps to reach the capacity utilization and to eliminate wastes in continuous flow processes (Bicheno & Holweg, 2009). The implementation of the Lean with JIT ensured its survival. After implementing a JIT and transformation manufacturing, the organization will achieve one-piece flow, U-shaped production lines, and productivity sharing (Hobbs, 2011, 6-7).

Implementing JIT purchasing contributes to the purchasing function to improve the quality of incoming parts and supplier delivery performance and at the same time to reduce lead-time and cost of raw materials (Sandeep, 2012). The implementation of JIT concept depends on many factors and needs to be done in interaction with all departments as shown in Figure 3.

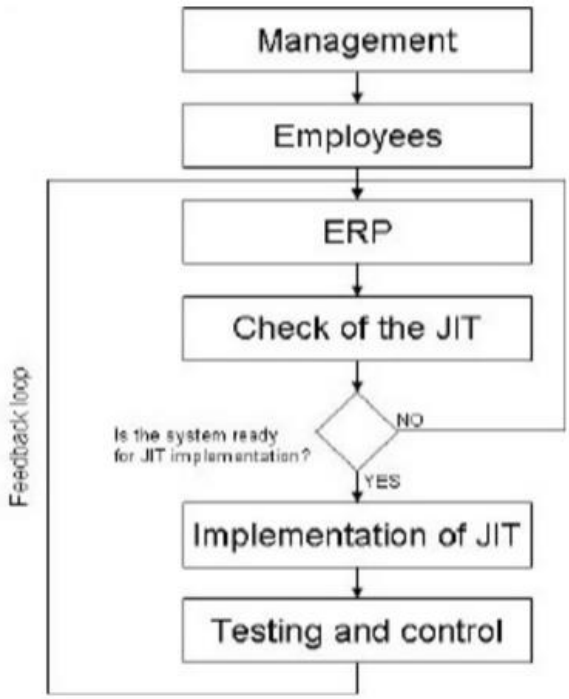

Figure 3. Implementation of JIT Concept (Sandeep, 2012)

The purchasing department takes a lead in developing suppliers (Adagala, 2014). Therefore, purchasing staff need to be experts in lean manufacturing, especially in VSM and Kanban. As not all suppliers respond to lean initiatives, a lean company ends up with fewer suppliers. However, as these may become long-term partners, there will be benefits (Kobayashi, 1995). Simon and Schuster (1994) point bout that even Japanese have difficulties in introducing their suppliers due to legal restrictions against excessively frequent deliveries of parts which resulted in traffic jams. (Ahrens, 2006, 35).

If to take into consideration the purchasing function in JIT production systems, it is important to identify an effective delivery frequency. Different suppliers operate with specific products and organize their delivery according to the characteristics of their goods. ABC pareto-type analysis can be used to differentiate among products and techniques (Ansari and Heckel, 1987, 24-28). In addition, the implementation of JIT production systems helps the suppliers to confront the new delivery out of absorbing stocks (Ha and Kim, 1997, 152-157). In order to implement JIT/Lean transformation, changes should be made in business culture by a strategic improvement:

- Better customer satisfaction;
- Better morale of workforce;
- Better the economic situation;
- Better the financial outcome. (Womack, Jones, Ross, 1990).

In order to support particular strategy to implement JIT within an organization, the selected strategy should be translated into objectives and lean initiatives. For example, (1) by determining the nature of change, (2) defining lean initiatives and (3) establishing lean performance parameters. (Ahrens, 2006, 27-32).

The most important and useful element for strategic improvement and successful implementation of the JIT production strategy is top management commitment (Drew, McCullum & Roggenhofer, 2004). The success of JIT implementation depends on this cycle from top management commitment to employee involvement and back to top management commitment (Bandyopadhyay, 2004, 7). In this way, top management

accept the idea of JIT approach and identify effective factors in the implementation of JIT purchasing:

- Provide regular review of current activities and set objectives and measures.
- Replace an effective system for employee.
- Make changes in information technology and in organizational area.
- Select qualified vendors.
- Integrate various functional area.

Regular review of current activities and tactical planning of buyers for improvement involving top management commitment. The purchasing manager set objectives and measures for each buyer's activity including cost status and volumes of products. (Goetsch, 2013). Definitely, the main objective is to replace an effective system for employee which involved in the purchasing function (Kovacheva, 2010). The significant support from top management is needed in order to achieve this objective. It is important to make changes both in information technology and in organizational area (Bicheno & Holweg, 2009). For instance, engineers can use knowledge-based systems to check supplier's design rules and inform for a new product development and process engineering problems by e-mail at the supplier's site. Qualified selection of vendors can be provided by adoption of vendor rating methods (Billesbach, Harrison and Morgan, 1991). The main section affected by JIT is integrating various functional area as purchasing, sales, financing and warehousing requirements. The main objective of integrated planning is to hence material flow and to improve cooperation and communication in JIT purchasing. (Petroni & Bigliardi, 2005).

JIT purchasing develops supply chain management by optimizing the flow of inventory throughout the whole chain and by overall reductions in channel inventories (Dong et al., 2001; Tan, 2001; Zimmer, 2002).

Based on the relevant issues and reviewing articles about Implementing JIT/Lean, nine necessary changes were determined to redesign the organization. The operational process within the organization should be flexible and dynamic through the JIT system (Chalice, 2007). Table 3

shows how the identification of necessary changes can be used to provide the desired effect and a competitive advantage. A company which has already decided on the major aspects of its manufacturing strategy can match this strategy to the particular capabilities of JIT (Kovacheva, 2010).

Table 3. Necessary changes for effective JIT implementation (Petroni & Bigliardi, 2005)

Desired Effect	Necessary Changes
1. Quality Certification of Supplier	• Ensuring optimum incoming quality • Long-term relationship
2. Reducing vendor lot sized	• Introduction of EDI for planning • Controlling of changing demand
3. Reducing vendor lead-time	• Common access to inventory records • Use of Electronic data interchange (EDI)
4. Reducing set-up time of equipment	• Exploring possibility of standardization of operations and location of components
5. Reducing In-house lot sizes	• MRP information system • Kanban control
6. Group technology process	• Identification of similar manufacturing steps • Grouping of equipment
7. Cross-training of Employees	• Job rotation • Delegation of quality inspection and equipment maintenance
8. Sole sourcing	• Quality should enter evaluation equation of suppliers • Interactive problem-solving approach
9. Preventive Maintenance Scheduling	• Employee participation in constant improvement • Delegation of scheduling and implementing preventive maintenance scheduling

After necessary changes, the companies should find an appropriate strategy for JIT implementation. It emerged that to fulfil a JIT strategy, there are some key elements for successful implementation. Multifaceted employees are needed within manufacturing process in order to obtain higher utilization of workforce and equipment at the same time. In order to increase quality and obtain greater utilization of equipment, top management sets up a preventive maintenance schedule. (Mwacharo, 2013).

Womack and Jones (2003) offer to use policy deployment development of a JIT procedure (Figure 4). This matrix includes selected projects for the current year with main objectives and the targets for improvement. Using the lean policy deployment, the matrix promotes the development of a JIT policy and procedure.

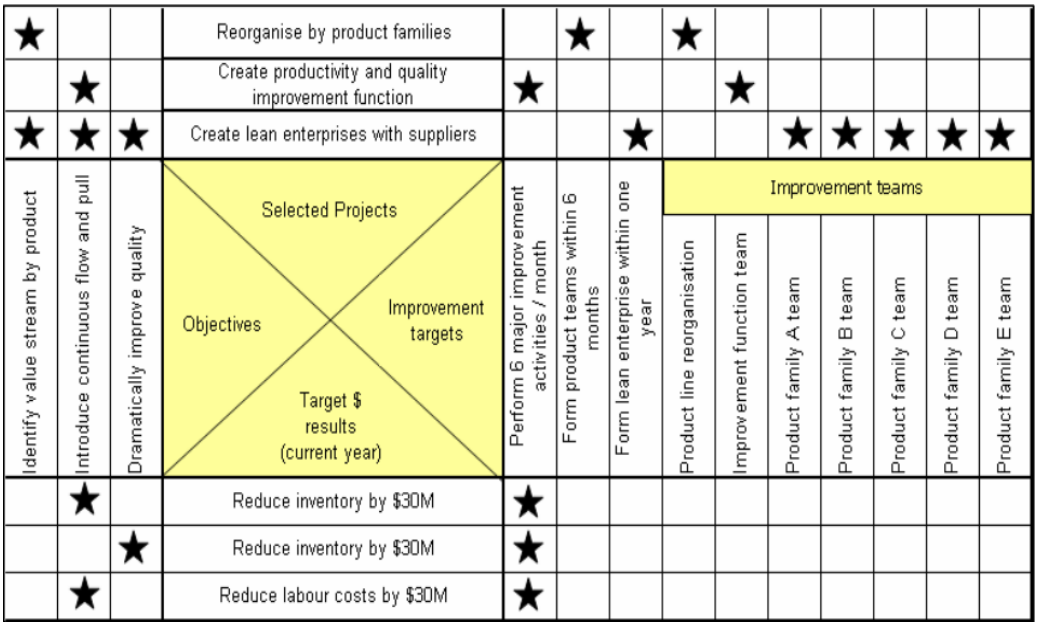

Figure 4. Lean Policy Deployment matrix (Womack, Jones, 2003)

The next step is to test the system after implementing JIT. Finally, the last step is to provide effective communication and control for a successful development of the JIT system (Benton, 2009). There must be continuous control in order to provide the right direction for the flow of items. Also, an essential function is to provide feedback at all levels of the organization and through the whole process (Ahrens, 2006, 32).

Implementation of JIT needs to account all the aspects that were mentioned above. Otherwise, the managers have to develop new methods, new algorithms, and new system of knowledge for effective decision-making.

5.2 The benefits of JIT implementation

1. Reduction of lead-time.

This represents higher levels of customer service and lower safety stock requirements for the company. Lower levels of safety stock contribute to reduced working capital requirements for the company. (Petroni & Bigliardi, 2005).

2. Elimination of wastage from the processes.

During JIT/Lean implementation, the companies improve the quality of materials, semi-finished and finished product (Adagala, 2014). It contributes to eliminating wastage from processes.

3. Reduction of non-value-added activities.

For implementing JIT/Lean, a strategic plan is needed. In this case, the managers must solve any problem related to non-value-added operations. First, the company identifies the non-value-added operations according to their business strategy, management support and involvement of every employee in manufacturing process. Moreover, it is important to remember that the different organizational functional areas are combined. For instance, there should be a connection between accounting and production. (Hobbs, 2003).

4. Reduction of inventory holding costs; minimization of WIP inventory, raw material and the finished goods (Kovacheva, 2010).

All these benefits, which was mentioned above, contribute to reduction of the major expenses for many industries, for example, the costs of production, the cost of purchase and the joint product costs.

Some early attempts to implement JIT in organizations have had disappointing results due to (1) wrong assessment of the production system, (2) different management styles, (3) geographical dispersion of suppliers, (4) cultural differences, (5) supplier power, and (6) poor understanding of some elements of the implementing methods. (Hobbs, 2003).

Employees should understand the significance of the JIT concept, otherwise poor understanding of some elements of the implementing methods can lead to disappointing results. In order to prevent this, there is a need for the development of a continuous JIT training program for employees at all levels. (Benton, 2009).

5.3 The challenges of JIT/Lean

In recent years, every large company has had a common challenge in managing their operations in the world's marketplace. It is evident that a firm has to make as many efforts as possible to become a lean enterprise.

“The journey to lean is not for the timid, and there are no stopping places along the way… Making the transition is highly challenging and many fall by the wayside” (Drew et al., 2004, 8). Slack et al. (2007) defined JIT as a concept that is based on meeting customer’s demand in cooperation with perfect quality and zero waste.

One of the main challenges for all CEO’s of global firms is to keep their firm competitive in the long term (Mefford, 2009, 262-272). In this way, unnecessary production is a great challenge for the manufacturer who is trying to maintain the continuous flow processes in the long term.

The communication problem is another challenge for the company because JIT approach mainly relies on efficient and effective communication (Adagala, 2014, 308). It can lead to lack of cooperation from suppliers.

Another challenge that companies may have in implementing lean is the fact that “lean systems are inherently knowledge-intensive” (Drew et al. 2004, 7). The first factor is lack of understanding in JIT philosophy and the logistical challenges accompanied by its implementation (Adagala, 2014, 308). JIT system must be fully implemented according to lean principles, initiatives and performance parameters in order to meet the competitive challenge in highly competitive markets.

Womack and Jones introduced the concept of Lean Enterprise and suggested the usage of lean management throughout all departments in a company. This includes other functional area of organization such as accounting, distribution, human resource, and marketing. If implementation of JIT is proceeded in just one department that the immediate results may be positive but with time. Since the department affects other departments, the results will reduce. (Bicheno & Holweg 2009, 3).

Implementing Lean/JIT is a significant process as it changes the way of operating, and senior management may be against such radical changes.

For instance, it eliminates the customer's way of inventory accumulation. (Drew et al. 2004, 7). It took a long time for JIT partners or suppliers to fully adopt into drastic changes in demand and supply (Adagala, 2014, 308). The problem for manufacturers arises when customers demand short lead-time (Weele, 2010, 248).

Another challenge that companies may have is the lack of the top management support. Staff participate and incorporate in decision making during the formulation and the implementation of corporate strategic plans. (Adagala, 2014, 308). The manager is able to create rewards to encourage staff for constantly maintaining the company’s lean efforts or being actively involved within lean activities. (Bicheno & Holweg 2009, 44). The real problem for the company is to manage the situation of continuous improvement within their organization in every department separately.

6 CASE STUDY

In recent years, companies have managed to reach profitability goals by opting for cost reduction and quality product at the same time. JIT principle is observed worldwide by successful businesses. Most production management systems are based on the JIT principle to ensure the effective functioning of the enterprise. Multiple testing shows that this principle has a significant economic effect by reducing inventories and improving the quality of products and services.

A comprehensive survey of JIT practices in the United States found that 45% of the firms contacted had implemented JIT programs, and another 22% were planning to implement JIT the following year (Benton, 209).

Nowadays, many European companies benefit from adopting JIT approach. For example, HP, Toyota, Chrysler, General Motors, Westinghouse, RCA, DELL and others. Philips and VDL NedCar were among the first companies to introduce the JIT approach in their European plants in the relationships with their suppliers (Weele, 2010, 250).

6.1 Toyota

The best example of most popular ways to have lower cost and high quality products is Just-in-Time (JIT) according to Japanese manufacturing success in 1980s. The Toyota manufacturing system has been viewed in different ways:

1) as a lean production system because it uses less of every resource compared with the conventional mass production system (Womack, et al., 1990);
2) as a conventional reorder point system with extremely small lot sizes (Zipkin, 1991);
3) as a pull system as opposed to the conventional push system.

The major prerequisite to the creation of this system was the rapid growth of automobile production. Because of it, there was excessive accumulation of materials in warehouses.

Due to the constant increase of inventory costs and adjustments batch of goods, Toyota began the reorganization of their supply chain within the company. In this way, adjustment was made before the next supply of parts arrived, so all the components were supplied for each production line depending on the need. The Japanese manufacturers looked for a way to gain the most efficient use of limited resources and worked on optimal cost or quality relationship (Figure 5).

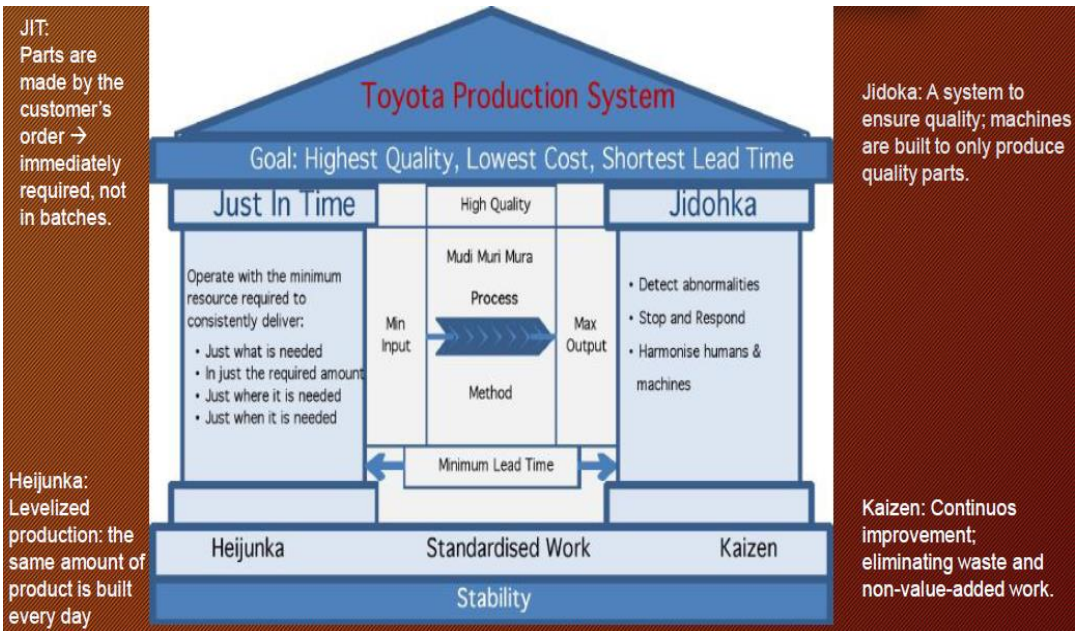

Figure 5. The Toyota Production System (TPS) (Sears, Shook, 2004)

Toyota placed the purchase order and procured as much resources as needed in order to provide accurate calculations for each production department. All this led to a significant reduction in the inventory levels, which in turn led to a reduction of production costs.

For instance, the comparison of the inventory turnover ratios in Toyota and in General Motors shows that at Toyota, an average annual value of inventories was $40-50 per vehicle, while it was $500-600 at General Motors.

According to Monden (1983), the success of TPS was supported by:

- Smoothing of production, standardization of jobs;
- Reduction of setup times;
- Improvement of activities;
- Design of machine layout;
- Automation of processes.

TPS has increased productivity and reduced costs for materials storage using JIT approach. However, the company later introduced Kanban mechanism by which it redesigned the supply chain and made it more efficient. (Japan Management Institute and Lu, 1986).

Unfortunately, while implementing JIT, Toyota met some problems:

1. Traffic problems: the suppliers were blamed for incoordination in the delivery process.
2. Management problems: switches the responsibility from large manufacturing companies to lesser powerful vendors.
3. Environmental problems: attackable in the management of natural catastrophes (earthquakes, storms). For instance, the Great Hanshin Earthquake in Japan, when deliveries were stopped to the facilities of Toyota although the factories were not damaged. (Daniel & Reitsperger, 1996, 95-121).

6.2 Dell

Nowadays, in the field of high technologies, manufacturers more frequently use the customized assembly in which the products are manufactured and equipped to meet demand from the customers. The key criteria here is the lead-time and delivery frequency.

Built to order is one of the main components of the business strategy but not the only one. In addition, a variety of specialized tools are also used. For example, the company has reduced the number of transactions involving human subjects by 50% when it developed automated assembly lines. In general, reduction of transactions, customized order and a variety of specialized tools led to a significant increase in the quality of products.

Dell has reduced production time up to four hours using a supply management system that was created based on the Internet technology. Once the order has been registered, Dell receives all the necessary materials within one or one and a half hour.

Due to JIT system, Dell has increased the volume of production, and has had the opportunity to place additional assembly lines in the area of the former warehouses that are no longer required. Dell requires less space for stock, which means they save money on storage facilities, which in turn will increase their profit margins.

During the first six months of using JIT, the company has saved $15 million, and three years later - approximately $150 million. Dell does not have to tie up capital in stock so the company can invest it in other areas of the business, such as R&D or promotion, to increase sales.

After analyzing the experience of the companies that use JIT system for several years, these general results were achieved:

1. The annual increase in labor productivity by 20-25%.
2. Reduction of the time required for changeovers by 80%.
3. Reduction of lead-time on one product by 30% (from 12 weeks to 4 days).
4. Reduction of WIP plant-wide by 50%.
5. Increase in cash turnover by 10-15%.
6. Increase of factory floor space from 30% to 40%.

6.3 Harley-Davidson

In 1970, Harley-Davidson, the manufacturer of motorcycles, faced strong competition from Japanese companies such as Suzuki, Yamaha, Honda and others. Many companies in automobile industry had not been able to compete and had bankruptcy. Japanese companies deliver their products virtually worldwide, with better quality and cheaper in comparison with their competitors.

In 1978, Harley-Davidson filed a lawsuit and accused the Japanese companies of selling motorcycles at dumping prices. During the trial, it was defined that the costs of the Japanese producers were reduced by 30% lower than the costs of Harley-Davidson.

Therefore, in 1982, under the threat of bankruptcy Harley-Davidson started to implement JIT production system. At the first stage of the JIT implementation, the company was faced with many problems. However, they succeeded in manufacturing high quality motor cycles at low cost. Harley-Davidson achieved:

• Reduction of rework by 68%.

• Inventories of WIP decreased by $22 million.

• Inventory costs have fallen by 75%.

• Increase of productivity by 50%.

With JIT Inventory, manufacturers keep only as many parts on hand as needed for immediate use instead of keeping large pools of components and tools lying around the facility (Forbes Greatest Business Stories of All Time by Daniel Gross, The Turnaround at Harley-Davidson, 4).

Under JIT, factories could turn over inventory twenty to thirty times a year. By contrast, Harley-Davidson only did so four times a year (Daniel Gross et al., 1996).

The adoption of MAN let Harley cut its inventory by 75% and allowed its two assembly plants to operate without stockrooms (Daniel Gross et al., 1996). Harley-Davidson realized savings on storage and inventory costs, thus leaving the company with more cash available to meet debt payments. The reduction of inventory cleared space on the factory floor, thereby eliminating assembly-line bottlenecks.

Under Harley-Davidson's brand of JIT, which they called Materials as Needed (MAN), defective parts could be spotted before they were widely used. Since inventory came in smaller batches, adjustments could be made before the next supply of components arrived. (Daniel Gross et al., 1996).

7 RESULTS AND RECOMMENDATION

The study was done by the comparative analysis of JIT systems in Dell, Toyota and Harley-Davidson. The comparison was carried out in five categories: (1) respond to demand, (2) material requirements planning, (3) order volume, (4) inventory level, (5) the relationship with suppliers. As a result, it was found that:

1. Planning material requirements at each stage of production process is carried out in sequence from the end to the start-up phase.

2. Quantity of products is based on the real demand that allows to quickly adjust the business strategy and production schedules. In this way, there is no surplus of finished products.
3. These enterprises such as Dell, Toyota and Harley-Davidson make purchases in small quantities, so they can quickly react to demand.

In this paper, the advantages and features of the JIT concept, the main elements of JIT purchasing, and the main options for improvement were examined. Moreover, the thesis analyzed the challenges that the company has had in implementing JIT technique.

Taking into account the data of Table 1 and Table 2, JIT implementation brings many significant economic benefits for the enterprise. These benefits can be applied to improve the quality of the finished product, and minimize the surplus stocks as well as the supply of materials which are produced at the manufacturer's premises. It is necessary for every company to reduce the time of the production cycle in order to provide the tendency of a wide range of production and its consumption that promotes the use of the principle of JIT. According to JIT system, the products, materials, resources, and information come at the right time in an amount not exceeding necessity. Instead of delivering a small batch from different suppliers in the exact terms of orders, executed by different suppliers, goods should be combined in a single delivery.

In addition, non-economic benefits are also provided for the company. Usage of the JIT principles has a positive effect on long-term investment policy of the company, which gives preference to equipment related to flexible automation of production, transport, and control processes. For the implementation of JIT, it is necessary to create the closest relationship between the buyer and the supplier in terms of information exchange and coordination plans.

However, an experience of different large enterprises shows that it is necessary to change the way of thinking of the whole staff which is engaged in production and marketing for the effective implementation of the JIT approach. Unavailability of leadership, poor planning, and lack of understanding of the concept itself lead to the creation of considerable

stock and disappointed results. The implementation of JIT system is a quite time-consuming process and is associated with various factors without which the system cannot function correctly. The problem of using JIT included:

1. Remoteness and dependence on suppliers.

2. Low speed of delivery of materials.

3. Large and irregular delivery of resources.

However, a successful implementation of JIT approach leads to greatly increased efficiency and productivity in the short term and significantly reduce losses. Therefore, it is possible to implement ERP system for resource planning process needs, but for production process control it is better to use the JIT system.

Based on the analyzed literature and case study, some recommendations for effective and successful JIT implementation were defined:

1. Train the organization and make sure that everybody thoroughly understands the JIT philosophy.
2. Ensure that the top management support the change with strong leadership.
3. Find a good change agent with great experience (Weele, 2010, 248).
4. Map the value streams, apply standard lean tools and begin as soon as possible with an important and visible activity.
5. Integrate the supporting functions into the lean and build internal customer and supplier relationships.

8 CONCLUSION

Within the terms of limited resources and fluctuations in demand, it is difficult to ensure the stability of the production, to develop products according to the needs, and to maintain quality at the high level. Attempts to correct this situation such as numerous management impacts often lead to inefficient use of scarce resources. In addition, it can lead to negative financial results and uncertain prospects.

The main objective of the thesis was to identify the process of procurement of resources in implementing JIT system. In order to achieve this objective, the three sub-questions were answered – what the main elements of JIT purchasing, what challenges the company has had when implementing JIT technique and what the options for improvement.

Some basic elements affecting JIT purchasing implementation were identified to achieve more benefit of JIT. According to Table 2, the major elements of JIT purchasing include participation of the supplier at an earlier stage during the decision making process that aims at finding solutions to the problems. The next element is a long-term contract between the buyer and the supplier that results in reduction of the lead-time. In general, the buyer and the supplier should possess mutual dependence. In addition to that, locating, choosing and developing mutual relations with the suppliers are also the main elements of JIT purchasing. The number of the suppliers should be limited.

Many companies have the challenges of implementing JIT technique. After a qualified and deep analysis of these challenges, the critical and significant ones were identified. The main challenge that the company faced was in involving those workers who were not motivated or not accepting the change in business processes. Lack of the top management support, lack of cooperation from suppliers, unnecessary production, and the communication problem need to be excluded in order to keep the firm competitive in the long term. Another significant challenge that the company had was in maintaining Lean. Lean management is meant to be a continuing process. Therefore, it is challenging for some companies to sustain it.

Table 3, identified the necessary changes for effective JIT implementation. In order to define the options for improvement, it is useful to pay attention at necessary changes for successful JIT implementation mentioned in Table 3. Therefore, JIT purchasing has already been widely studied in different sectors such as manufacturing, service and administration. Thereby, this gives some other further development ideas and recommendations for future study as follows:

1. Concentrated efforts in research are necessary to understand problems related with JIT purchasing implementation on part of management, workers and suppliers.

2. For designing a complex performance measurement system, a greater research for effective JIT purchasing implementation is needed.

3. More exhaustive study is required while implementing JIT purchasing and identifying bottlenecks of the system. (Singh & Garg, 2011, 29-33).

This paper analyzed the possibility of using JIT, proposed the basis of five lean principles, relevant theories, JIT within purchasing function, and the classification of lean tools and techniques. The classification is based on management principles and organization of production activities aimed at increasing production flexibility and customer satisfaction. The comparison of implementing Lean tools and techniques showed that the fundamental principles of the effective functioning is the principle of JIT production. JIT is the principle of continuous improvement of the production system and the principle of perfect quality. The management of production activities is realized by the complex of management practices.

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