

Just in Time Production System: A Case Study

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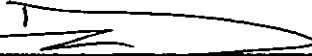
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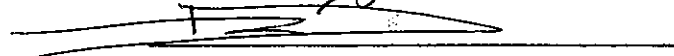
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ABSTRACT

The main purpose of this thesis is to examine the just in time (JIT) purchasing and production system which is used by companies so as to increase the competition in spreading market conditions and investigate the necessary equipments that must be existed in the management in order to apply this system. This study also allows us to find out the benefits of the system and compare the JIT and traditional systems to each other.

The study used descriptive and experimental case study techniques to test the applicability of the JIT production and purchasing system in Dağlı detergent company (Dağlı Trading Ltd) which operates in North Cyprus. In order to collect data and information to apply the case study techniques, interview and direct observation methods were used by the researcher. This study also investigated whether or not the implementation of the JIT production system is feasible in the detergent company.

The findings obtained show that the company keeps unnecessary inventory stocks, workers are not qualified, raw material and finishing job quality control system are not efficient enough. The findings also indicate that there is no maintenance for machines and the piled-up of inventories bring extra cost for the company. These findings reveal that the implementation of JIT production system is currently not feasible in the company under inspection.

Keywords: Just-in-time production system, Minimum stock, Minimum cost, Detergent company, North Cyprus.

ÖZ

Bu çalışmanın amacı, genişleyen piyasa şartlarında, şirketlerin rekabet gücünü artırmak için üretimde kullandıkları tam zamanında üretim sisteminin uygulanabilirliği için işletmede olması gerek araçları, sistemin kattığı yararları incelemektir. Bu çalışma aynı zamanda sistemin kattığı yararları incelemekte ve geleneksel üretim sistemi ile tam zamanında üretim sistemini karşılaştırmaktadır.

Bu çalışmada tam zamanlı satın alma ve üretim sisteminin uygulanabilirliği Kuzey Kıbrısta deterjan üretimi yapan Dağlı Trading Ltd. de test edilirken, tasviri olay çalışması ve deneye dayalı olay çalışması kullanılmıştır. Olay çalışması uygulamasının doğru ve kesin uygulanabilmesi için araştırmacı karşılıklı görüşme ve direkt gözlem yöntemleriyle bilgi toplanmıştır. Bu çalışma tam zamanlı üretim sisteminin deterjan fabrikasına uygunluğunu araştırarak ve fabrikaya uygulanabilirliğini veya uygulanamayabilirliğini gözden geçirecektir.

Bulduğumuz sonuçlar gösteriyor ki, bu şirket gereksiz envanter tutmakta, işçileri yeterli kvalifikasyonlara sahip değil, ham madde ve bitmiş ürün kalite kontrol sisteminin verimliliği yeterli değil. Bulgular işaret ediyor ki, makine bakımının yapılmaması ve stoklarda meydana gelen yığılma şirkete ekstra bir maliyet yüklüyor. Bu bulgular şirkette tam zamanlı üretim sisteminin uygulanabilirliğinin mümkün olmadığını ortaya çıkarıyor

Anahtar kelimeler: Tam zamanlı üretim sistemi, En az stok, En az maliyet, Deterjan şirketi, Kuzey Kıbrıs.

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Chapter 1

INTRODUCTION

1.1 Brief introduction

After the World War 2, Japanese companies found a new system for minimizing resources and maximizing productivity. Name of this system was Just in Time (JIT) production system. Japanese companies were always careful in order not to waste resources, including space as well as time and labour. JIT system generally means, low stock levels of raw materials, components, work in progress and finished goods. It requires that only necessary units be provided in necessary quantities to be used at necessary times. JIT production system has been used as a response to increasing competition.

In developing global markets, competition has been continuously intensifying. Companies spend effort to find a way to increase market share in such a challenging competitive environment. In that respect, customer satisfaction has become exceedingly important. Just-in-time (JIT) production system philosophy produces only needed quantity of products when they are necessary. The term just in time (JIT) is used to refer to an operations system in which materials are moved through the system and services are delivered with precise timing so that they are delivered at each step of the process just as they are needed. This system is named JIT production system (Stevenson, 2007). Muhlemann et al. (1992) state that JIT has been equated with an inventory control system which requires an organization's suppliers to provide raw material in small quantities very frequently. JIT production system has

been used as a response to increasing competition. Taiichi Ohno (1988) initiated the basic idea of JIT production system, then Toyota Company first used JIT production system to produce different types of cars. The other Japanese companies followed Toyota Car Company to utilize the benefit of the system (Yükçü, 2000). The JIT production system then became widespread in many companies in Japan in the late 1970s, and began to be known abroad (Yui, 1997).

According to Mackelprang and Nair (2009), global manufacturing has witnessed fierce competitive environment since 1970s. This challenging environment forced firms to identify additional sources of competitive advantage. For many firms, JIT manufacturing practices have provided a competitive boost and enabled them to meet the demands of global competition. A comprehensive adoption of JIT practices can be quite expensive, nevertheless, many firms see implementing JIT practices as a worthwhile investment that will generate significant returns via cost savings. The allure of JIT is due to its perceived ability to help firms reduce their costs while improving other operational metrics by eliminating non-value added activities. However, despite widespread global adoption of JIT practices, skeptics have questioned the successful application of JIT practices outside of Japanese culture (Heiko, 1989).

Mosavi et al. (2010) state that today, most companies are spending great effort to boost work force productivity, remove any waste from system, improve product quality with a competitive price, and respond to customers' demands quicker and more effectively to penetrate into the global market. Among the various modern production managements systems, the just-in-time production system has attracted many managers' attentions. (Mohaghar and Morovati, 2005) the JIT production

system is a general management philosophy, before being a production control method. This philosophy is based on a system of beliefs and views which is mixed with a series of values and procedures (Rahmani, 2006). In most developed researches, main attention has been focused on engineering side of the JIT production system, different parameters considered to implement this production system accurately. Other modern systems' effects have even been tried to be surveyed simultaneously with this production system. However, human factor has received less attention in developing this production system.

With each passing day, JIT system is gained ground and is well known throughout the world. According to Russell and Taylor III (1998) the flexibility to move workers between jobs as the need arises is well suited to the dynamics of new markets, product diversity, and new technologies. When a company impliment JIT system, some modifications come into existence at company's organization and work environment. If a company use JIT system, it has strong relationship with supplier so as to provide minimum inventory.

1.2 Scope and Objectives of This Research

The aim of the study is to present whether or not a JIT system can be implemented in a detergent factory called Dağlı Trading which is located in North Cyprus. The study also provides an idea for the managers of the case company with an opportunity to comprehend whether or not the implementation of a JIT production system is possible in the firm.

1.3 Methodology of the Research

Descriptive and experimental case study techniques were conducted to test applicability of a JIT production system. The information and data for the case study is provided by interview and direct observation methods.

1.4 Findings of the Study

The findings of this thesis can be summarised as such: They show that the company keeps unnecessary inventory stocks, workers are not qualified, raw material and finishing job quality control system are not efficient enough. The findings also indicate that there is no maintenance for machines and the piled-up of inventories bring extra cost for the company.

1.5 Structure of the Study

Chapter 1 is introductory part. Chapter 2 explains the review of literature of the concept of the Just in time production system. Chapter 3 contains an overview of the research techniques conducted and data collected in the study. Chapter 4 presents the case study's applications and results. In Chapter 5, concluding remarks are presented. Chapter 6 gives some recommendations and suggestions for further studies.

Chapter 2

LITERATURE REVIEW

2.1 Background

JIT means keeping work flow moving all the time starting from the receipt of raw-materials until the completion and delivery of the finished goods to the final customer. JIT production system also entails eliminating inventories, reducing level of distances, eliminating defects and scrap, and making maximum use of precious space. Every firm should adopt the same philosophy when implementing JIT production system (Shafer, Meredith, 1998). JIT philosophy has been applied to many industries as well as businesses and very fruitful consequences have been obtained. Schroeder (2004) state that the first and most successful application of JIT system was at the Toyota Motor Company in Japan. In addition to this, Kawasaki U.S.A. in Nebraska started implementation of JIT in 1980. Implementation of JIT has also been achieved in many other U.S. companies. These companies include Ford, General Electric, General Motors, Eaton, Motorola, Black & Decker, Briggs and Stratton, Hewlett-Packard, IBM, John Deere, Bendix, Mercury Marine, Omark, Rockwell, Westinghouse, Tennant, 3M, and Honeywell. Nowadays, some companies still use the JIT system as such Harley Davidson in USA, Toyota Motor Company in Japan, General Motors in USA, Ford Motor Company in USA, Manufacturing Magic in USA, Hawthorne Management Consulting in USA, and Strategy Manufacturing Inc. in Canada. Voss and Robinson (1993) wrote an article about the 'Application of JIT manufacturing techniques in the United Kingdom', and Gunasekaran (1999)

conducted a research concerning JIT purchasing. Gunasekaran (1999) point out that JIT purchasing methods are successful not only in Japan, but also in many countries like, South Korea, Taiwan, USA, UK, Germany, France, and Hong Kong. In addition, Akintoye (1995) applied JIT system for building material management, and Suh et al. (2005) applied this system for drug and gene delivery system.

According to Nishi et al. (2000), JIT production system has been regarded as a promising production system ensuring on-time product delivery, low inventory, and short product lead time. However, in the daily manufacturing environments of most of the plants producing wide range of products, there are some inevitable changes caused by unexpected events such as equipment failure, and product inferiority or sudden order of special products. Therefore, it is essential to develop rescheduling methods which can frequently and quickly modify a schedule so as to cope with those disturbances.

Below, Figure 1 portrays the River and Rocks model of JIT. The depth of the river is the inventory and work in progress in the factory. Under a conventional manufacturing system, the inventory allows all of the other concerns to be hidden at the cost of time and money. JIT removes the inventory and this exposes some of the rocks. Action must be taken to lower or remove the rocks or serious problems will result. (http://www.tangram.co.uk/TI-Glazing-Manstrat_03.html)

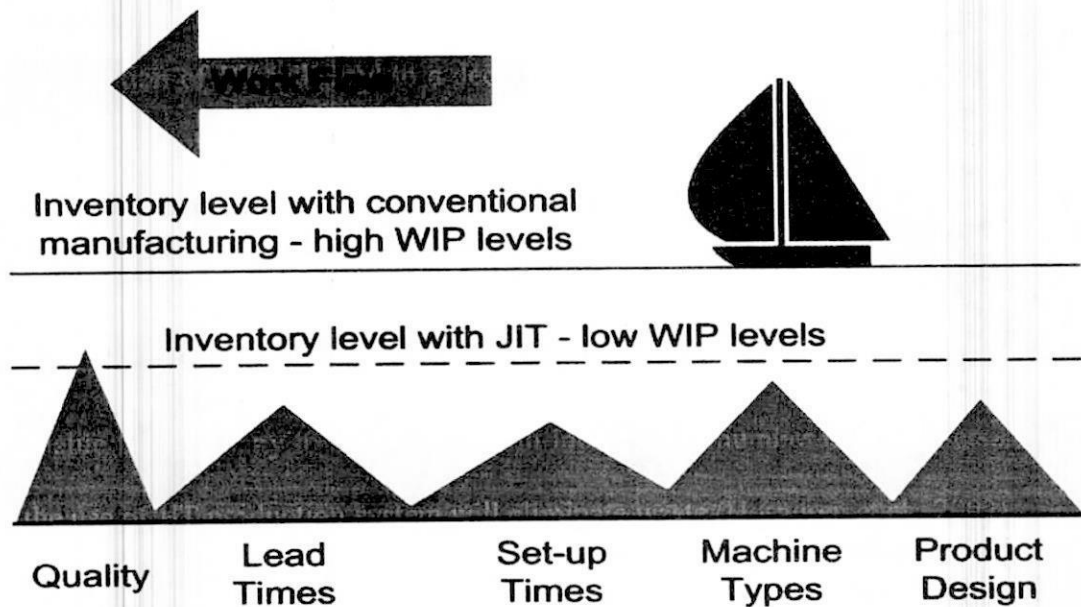


Figure 1: River and rock models of JIT
 Source: http://www.tangram.co.uk/TT-Glazing-Manstrat_03.html

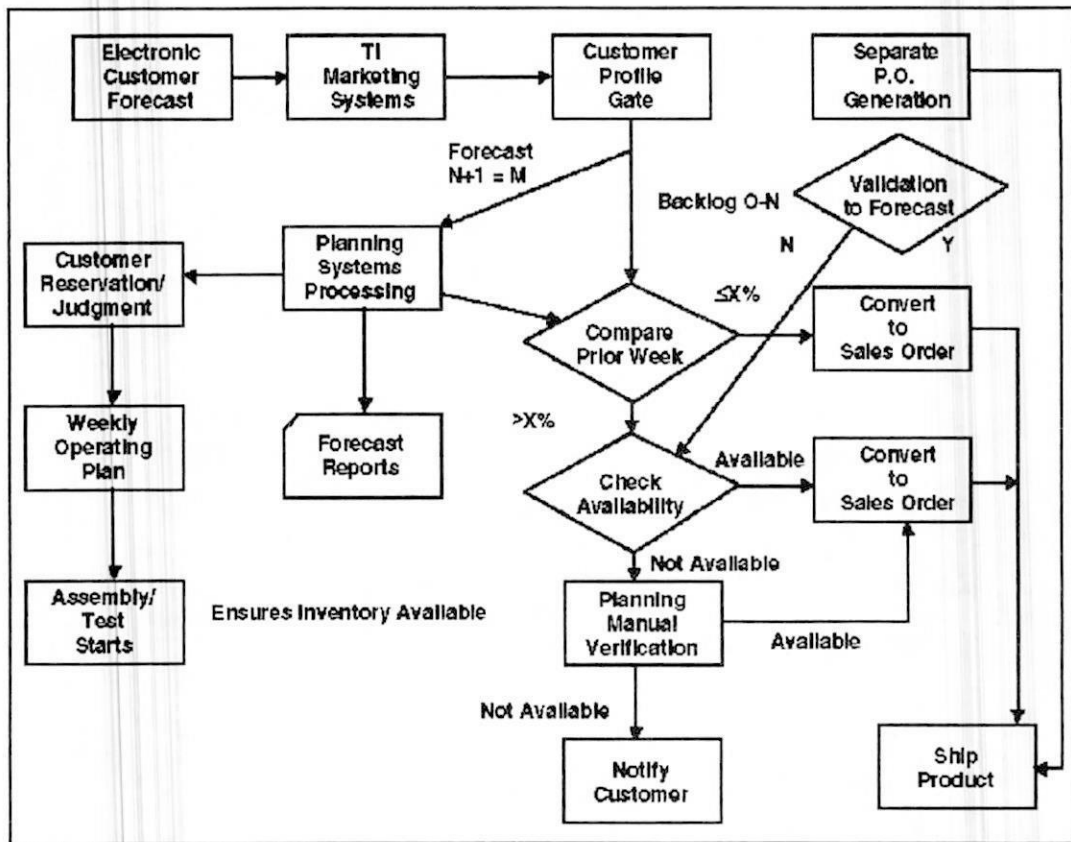
Application of JIT will lead to a decrease in inventories, waste reduction, employee involvement and customer satisfaction (Bailes and Kleinsorge, 1992). Aim of JIT system is to minimize inventory (zero inventory), eliminate unnecessary work in process, and eliminate waste. If a company is successful in implementing the JIT system, it can decrease the cost of a product. Therefore, employing the system will enable the company to save money and increase the number of customers. In short, the use of JIT production system will eliminate waste (Horngren et al., 2002).

2.2 Necessary Tools for JIT Implementation

Russell and Taylor III (1998) state that the JIT production system is the result of the mandate to eliminate waste. It is composed of the following elements:

1. Flexible resources
2. Cellular Layout
3. Pull production system
4. Kanban production control

5. Small lot production
6. Quick setup
7. Uniform production level
8. Quality at the source
9. Total productive maintenance
10. Supplier network



JIT PROCESS FLOW

Figure 2: JIT process flow

Source: http://www.bmpcoe.org/bestpractices/internal/tisem/grf_tisem_02.html

2.2.1 Flexible Resources

In for the JIT production system to be successfully implemented, there is a need for multi-skilled workers and flexible machineries. In this case, workers can replace one another and a machine can be used whenever the other machineries are out of

state that cells group dissimilar machines together to process a family of parts with similar shapes or processing requirements. The layout of machines within the cell resembles a small assembly line and is usually U-shaped. Cycle time directly affected production time.

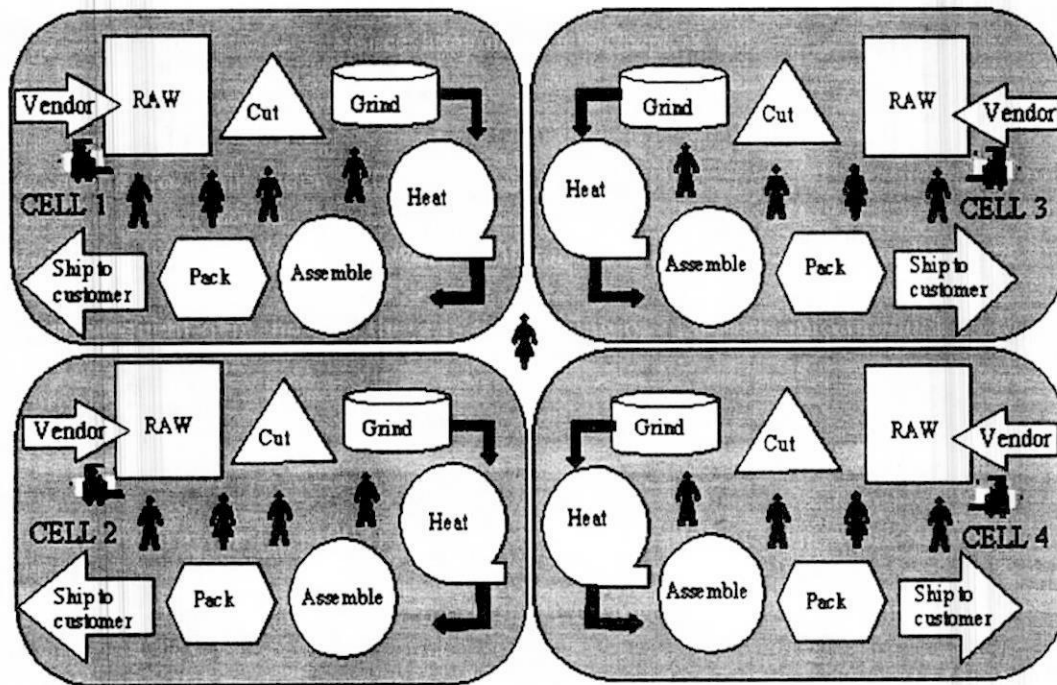


Figure 4: JIT cellular factory layout
Source: <http://maaw.info/Chapter8.htm>

2.2.3 Pull Production System

According to Schroeder (2004), in a pull system, material is pulled through production by the subsequent work centers. Materials are provided only when there is a subsequent demand and there is no pushing of materials into production to meet future demands.

Russell and Taylor III (1998) argue that, with the pull system, workers go back to previous stations and take only those parts or materials they need and can process immediately. When their output has been taken, workers at the previous station know that it is time to start producing more, and they replenish the exact quantity that the

subsequent station just took away. If their output is not taken, workers at the previous station simply stop production. In this case, no excess quantity of output is produced. This system forces operations to work in coordination with one another.

If a company uses a pull system, it does not need extra inventory. However, in order to be able to achieve that, it must establish strong relationship its suppliers and there should be a strong and an effective communication between the company and its internal and external environment. Developing a pull system is not an easy job for the company, but once it is successfully implemented, it can yield significant reductions in inventory-related costs.

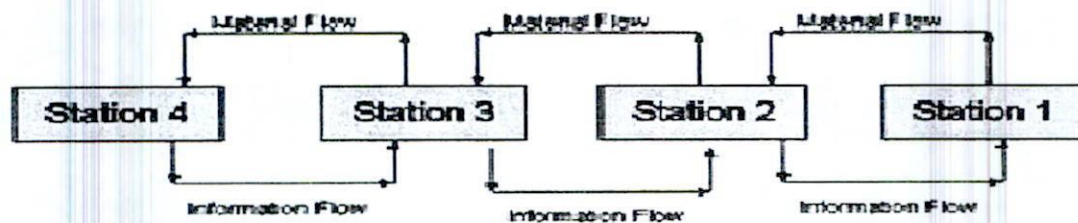


Figure 5: Pull system

Source: http://engineeringinformatika.blogspot.com/2007_08_01_archive.html

2.2.4 Kanban Production Control System

According to Stevenson (2007), a manual system is used for controlling the movement of parts and materials that responds to signals of the need for the delivery of the parts of raw materials.

Kanban system is like pull system, but in the kanban system, communication is made with card or signal. When workers need some more part, they must use kanban card and no part or lot can be moved or worked on without one of these cards.

Junior and Filgo (2010) state that, kanban is a subsystem of the JIT. This system was created to control inventory levels, the production and supply of components, and in some cases, control raw material inventories. According to Graves et al. (1995), kanban is defined as a Material Flow Control Mechanism (MFC) and it controls the proper quantity and proper time of the production of necessary products. It has been used worldwide with the meaning of card because it utilizes cards for delivery and/or production of parts, items, or raw materials. However, if the interpretation of the kanban system is so restricted, it can be said that most of the companies use a system like this since the shop floor materials are controlled by using some kind cards. For example, production order, schedule sheets, material list, or product structure. There are number of works in which the term kanban is used indiscriminately, meaning both 'card' and 'the system' itself.

The figure 6 shown below demonstrate basic kanban system:

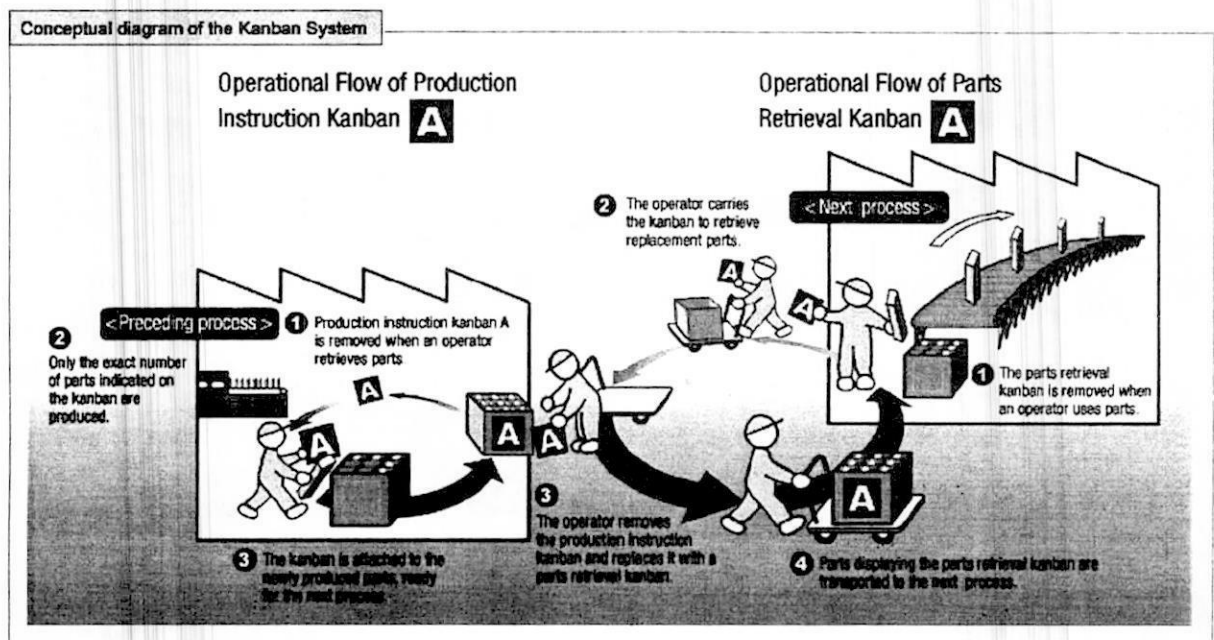


Figure 6: Kanban system

Source: <http://www.save9.com/sector-expertise/lean-database-development/>

2.2.5 Small Lot Production

Production is directly related to the order. Generally, any company desires to produce large lot of production. This is due to the fact that, if a company produces a large quantity of product at one time, it can buy a large quantity of raw material as safety stock. However, if it cannot sell all the units produced, it starts to incur extra inventory-related costs. Russell and Taylor III (1998) state that small lot production requires less space and capital investment than systems that incur large inventories. By producing small amounts at a time, processes can be physically moved closer together and transportation between stations can be simplified. In small lot production, quality problems are easier to detect and workers show less tendency to let poor quality pass. Lower inventory levels make processes more dependent on each other. This is beneficial because it reveals errors and bottlenecks more quickly and gives workers an opportunity to solve them.

2.2.6 Quick Setups

According to Stevenson (2007), setting-up equipments and machineries must be simple and standardized. Multipurpose equipment or attachments can help to reduce setup time. Moreover, group technology may be used to reduce setup cost and time by capitalizing on similarities in recurring operations.

If a company reduces setup time, it can reduce costs and save time. Operators should be able to setup the machinery in a very short time so that there is no wasted time while switching from one lot to another. In other words, manufacturing facilities must be able to produce different kinds of products without wasting time. Otherwise, if too much time is spent on setting up the machinery, there will be delay in offering the product on time. Therefore, JIT production system must be based on advanced

computer-controlled machines that are able to produce several product types without requiring a set-up.

2.2.7 Uniform Production Levels

Standard work is one of the most comprehensive and powerful tools found in JIT (DeLuzio, 1993). Standardization is achieved when all the tasks necessary to perform the production process are made uniform. In other words, if the same tasks are performed every time a process is carried out, the production process is standardized. Once the procedure is standardized, there will be no variation in the process. Therefore, a work procedure must define every detail as clearly as possible. Otherwise, each operator will perform the task in a way he likes. Also, if the work procedure is made clear, the worker will make high-quality parts with less variation (DeLuzio, 1993). If a company uses uniform production level, workers can finish product in shorter time because when workers perform their duties, they follow a standard process. Besides, if the procedure is standardized, the worker does not face any confusion because there is a known and fixed way of performing the job.

Russell and Taylor III (1998) point out that, JIT system attempts to maintain uniform production levels by smoothing the production requirements on the final assembly line. Changes in final assembly often have dramatic effects on component production upstream. When this happens in a kanban system, kanbans for certain parts will circulate very quickly at some times and very slowly at others. Adjustments of plus or minus 10 percent in monthly demand can be absorbed by the kanban system, but wider demand fluctuations cannot be handled without substantially increasing inventory levels or scheduling large amounts of overtime (Huang et al., 1983)

2.2.8 Quality at the Source

According to Bailes and Kleinsorge, (1992), for a JIT system to work well, quality has to be extremely high. There is no extra inventory to buffer against defective units. Production poor quality items and then having to rework or reject them is a waste that should be eliminated. In a JIT system companies do not have to control buying product and they can trust quality of product and don't keep extra inventory for some error or waste. In a JIT environment, everybody focuses on continuous improvement so as to prevent problems from taking place, and shutting down the production line that may then cause delay in offering the product on time. In other words, everybody should be responsible for the quality of the tasks for which he or she is responsible. One division should provide the coming division with defect-free work-in-process so that there will be no rework and wasted time through the production process. According to a study conducted in some UK and Japanese companies, firms that adapted Total Quality Management and JIT simultaneously gained noticeable synergy (Yui, 1997).

Stevenson (2007) notes that, JIT systems sometimes minimize defects through the use of autonomation. Also referred to as jidoka, it involves the automatic detection of defects during production. It can be used with machines or manual operations. It consists of two mechanisms: one for detecting defects when they occur and another for stopping production to correct the cause of the defects. Thus, the halting of production forces immediate attention to the problem, after which an investigation of the problem is conducted and corrective action is taken to resolve the problem.

2.2.9 Total Productive Maintenance

Russell and Taylor (1998) state that machines cannot operate continuously without some attention. Maintenance activities can be performed when a machine breaks down to restore the machine to its original operating condition, or at different times during regular operation of the machine in an attempt to prevent a breakdown from occurring. The first type of activity is referred to as breakdown maintenance; the second is called preventive maintenance.

Breakdown maintenance is much expensive than preventive maintenance and sometimes stops production. Russell and Taylor III (1998) also argue that most companies do not find it cost effective to rely solely on breakdown maintenance. The most important aim of preventive maintenance is improved quality.

2.2.10 Supplier Networks

Bailes and Kleinsorge, (1992) suggest that, the companies implementing JIT production systems select small number of suppliers and develop strong and long-term working relationship with them. In a JIT system, suppliers are most important factor for the companies striving to successfully implement JIT production system. Because, in a JIT system, if suppliers provide high-quality raw materials on a timely basis, the company can perform its production without any disruption and delay.

According to Russell and Taylor III (1998), the following is a list of trends in supplier policies since the advent of JIT: 1. Locate near to the customer, 2. Use small, side-loaded trucks and ship mixed loads, 3. Consider establishing small warehouses near to the customer or consolidating warehouses with other suppliers, 4. Use standardized containers and make deliveries according to a precise delivery

schedule, 5. Become a certified supplier and accept payment at regular intervals rather than upon delivery.

2.3 Benefits of Using JIT

Many changes brought by the JIT production system require alterations in the existing information systems and traditional system practices (Bailes and Kleinsorge, 1992).

There are four primary types of benefits;

2.3.1 Cost saving

The application of a JIT production system will change the cost structure of a firm as well as cost allocation procedures and recording system. In addition, performance measurements and reporting systems must be changed in a JIT environment. The following paragraphs describe how JIT concept may affectively be used in cost management.

2.3.1.1 Reducing Inspection and Ordering Costs

As discussed above, the use of a JIT system requires dealing with few dependable suppliers by establishing long-lasting and reliable relationships. This is due to the fact that, high quality in production requires close relationships with vendors to ensure that the firm receives defect-free raw materials (Martin et al., 1992). Working with dependable and reliable suppliers ensures the acquisition of high-quality raw materials and eliminates the need for inspection because company can make sure that raw materials that particular supplier is providing are defect-free raw materials. In addition, as company deals with the same supplier, there is no need for a search for the best supplier, detailed paperwork, and the ordering process every time. That is why, cost of purchasing and ordering is minimized. According to a study conducted

and similar storage costs attributed to them. Last but not the least, company that employs a JIT system will also save some resources tied up holding excessive inventories (Tanış, 1992).

2.3.1.5 Minimizing Rework Activity

As explained above, in a JIT environment there is no need to have large inventories to buffer the plant from disruptions caused by poor quality because of effective quality control programs in use. This means when an operator discovers a defective product, he pauses the process and only few parts are at risk of being scrapped. However, in case of having a large amount of work-in-process inventory, and parts from the previous operations that are determined as being defective, many more parts must be scrapped. As a result, a great amount of loss is likely to occur. On the other hand, when an operator reduces the number of defective units, he is able to reduce product costs since this reduction decreases the number of inspectors and employees doing rework. Also an increase in productivity is gained. It has been claimed (Hayes, 1981) "a 2% reduction in defects is usually accompanied by a 10% increase in productivity." Therefore, it can be said that rework costs and cost of lack of productivity are minimized in a JIT setting.

2.3.2 Revenue increase

Offering high quality products and better service to the customers result in increase in revenue. Short lead time and faster move also result in higher sales. Moreover, decreasing cost of organization and eliminating unnecessary operations also result in increase revenue.

2.3.3 Investment Savings

Investment is saved through three primary effects. First, less space is needed for the same capacity. Second, inventory is reduced to the point that turns run about 50 to

100 a year. Third, the volume of work produced in the same facility is significantly increased, frequently by as much as 100 percent. (Shafer, Meredith, 1998).

2.3.4 Workforce Improvements

The employees working in the companies that implement JIT production system are much more satisfied with their work. They prefer the teamwork that JIT demands, and they like the fact that fewer problems arise. They are also better trained for the flexibility and skills needed for implementing JIT production system and they enjoy the growth they experience in their jobs. All this translates into better and more productive work. (Shafer, Meredith, 1998)

2.4 Comparison of Traditional and JIT Production Systems

There are different aspects that differentiate Traditional and JIT production systems from each other. Table 1 shows characteristics of JIT and Traditional systems. These characteristics range from philosophy and culture to standart operating procedures.

Table 1: Comparison of traditional systems and JIT

CHARACTERISTIC	TRADITIONAL	JIT
Priorities	Accept all orders Many options	Limited market Few option Low cost, high quality
Engineering	Customized outputs Design from scratch	Standardized output Incremental design Simplify, design for manufacturing
Capacity	Highly utilized Inflexible	Moderately utilized Flexible
Transformation system	Job shop	Flow shops, cellular manufacturing
Layout	Large space Material handling equipment	Small space Close, manual transfer
Workforce	Narrow skills Specialized Individualized Competitive attitude Change by edict Easy pace Status: symbols, pay, privilege	Broad skills Flexible Work team Cooperative attitude Change by consensus Hard pace No status differential
Scheduling	Long setups Long runs	Quick changeovers Mixed model runs
Inventories	Large WIP buffers Stores, cribs, stockrooms	Small WIP buffers Floor stock
Suppliers	Many Competitive Deliveries to central receiving area Independent	Few or single source Cooperative , network Deliveries directly to assembly line Shared forecasts
planning and controlling	Planning oriented Complex Computerized	Control oriented Simple Visual
Quality	Via inspection Critical points Acceptance sampling	At the source Continuous Statistical process control
Maintenance	Corrective By experts Run equipment fast Run one shift	Preventive By operator Run equipment slowly Run 24 hours

Source: (Shafer, Meredith, 1998)

As can be seen from the table above, JIT system is different from traditional system from different perspectives. JIT works with zero inventory, eliminates unnecessary work in process, and the basic aim of JIT system is to eliminate the waste and minimize inventory-related costs. In addition, JIT system produces small lot sizes, it is flexible, and production depends on demand. JIT system priorities are limited market, low cost, and high quality. JIT system entails engineering standardized output, incremental design and simplifications for manufacturing. JIT's transportation system is including flow shops and cellular manufacturing systems. In the JIT system, company uses close area and small space for eliminating unnecessary operations and manual transfer. In the JIT system, workers study with work team, and no status differentiate workers from one another. The JIT system is based on mixed model runs and quick changeovers for machines. Companies have few or single supplier, communication are very important, and deliveries are directly made to assembly line. Production planning and controlling are simple and visual and they are control oriented. Product quality is continuous, managers carry out statistical process control, and quality starts from raw materials to finished-goods inventory. In the JIT system, machine maintenance is made by operators, and production system operates for 24 hours.

On the other hand, traditional system's capacity is high and processes are inflexible in the system. That is, companies using traditional production systems make production in mass quantities, accept all the orders and supply many different kinds of products. Traditional system's transformation system is job shop and layout include a large area. In a traditional system, workers are not multi-skilled, they are individualized and specialized. Traditional system's scheduling comprises long

setups and long runs. Companies adopting traditional system have large inventory and extra stockroom and they work with many suppliers. In the traditional system, planning and controlling are complex, computerized, and planning oriented. Quality control is made via inspections. Finally, machine maintenance is made by experts and operation runs one shift a day.

Chapter 3

RESEARCH METHOD

3.1 Case study

In case studies, data collection should be treated as a design issue that will enhance the internal validity, external validity, and reliability of the study Yin (1994). This study adapted both convenience and purposive sampling techniques in order to select the research sample (Altınay and Paraskevas, 2008). A qualitative research strategy was used as the most appropriate method for a case study of this kind because case studies are often associated with qualitative research design (Yin, 1994). Most of the field methods described in the literature treat data collection in isolation from the other aspects of the research process Yin (1994). According to Schweitzer, when writing a case study analysis, the researcher must first have a good understanding of the case study. According to Ryan et al. (2002), case studies provide a research method that can be used in a variety of ways by researchers. The following are some of the different types of case study:

3.1.1 Descriptive case study

Descriptive cases require a descriptive theory to be developed before starting the project. Ryan et al. (2002) state that the research objective of these studies is to provide a description of company process. However, such studies beg the crucial questions of what constitutes 'best' practice and 'successful' companies. Nevertheless, such case studies are useful in providing information concerning the nature and form of current process.

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3.1.2 Illustrative case study

According to Ryan et al. (2002), these are case studies that attempt to illustrate new and possibly innovative practices developed by particular companies. However, there is an implied assumption that the practices of these 'innovative' companies are, in some sense, superior to the practices of companies. These case study itself cannot provide a justification for this assumption.

3.1.3 Experimental case study

Researchers have frequently develop new procedures and techniques that are intended to be helpful to practitioner. Ryan et al. (2002) state that these procedures and techniques are developed from existing theoretical perspectives, using normative reasoning. However, it can sometimes be difficult to implement the recommendations of the researchers. An experimental case study could be used to examine the difficulties involved in implementing the new proposals and to evaluate the benefits which can be derived.

3.1.4 Exploratory case study

Exploratory cases are sometimes considered as a prelude to social research. Ryan et al. (2002) state that the researchers generate hypotheses about the reasons for particular practices. These hypotheses can be tested subsequently in larger-scale studies. As such, the case study represents a preliminary investigation, which is intended to generate ideas and hypotheses for rigorous empirical testing at a later stage.

3.1.5 Explanatory case study

Explanatory case studies may be used for doing causal investigations. Explanatory case study methodology has been used in research complex systems in the fields of business, public policy and urban planning (Fisher and Ziviani, 2003).

In this study, descriptive and experimental case studies were used. Descriptive case study was first used to describe the case company, portray its production system, and determine the research problem. Then, as a second step, an experimental case study was conducted in order to determine whether or not a JIT production system can be implemented in the case company.

3.2 Data collection methods

Yin (1994) identified six primary sources of evidence for case study research. The use of each of these might require different skills from the researcher. Not all of these sources are essential in every case study, but the importance of multiple sources of data to the reliability of the study is well established (Stake 1995; Yin, 1994). The six data collection methods identified by Yin (1994) are:

- documentation,
- archival records,
- interviews,
- direct observation,
- participant observation, and
- physical artifacts.

No single source has a complete advantage over the others; rather, they might be complementary and could be used in tandem. Thus a case study should use as many sources as are relevant to the study. Table 2 indicates the strengths and weaknesses of each type:

Table 2: Types of evidence

Source of Evidence	Strengths	Weaknesses
Documentation	<p>Stable - repeated review</p> <p>Unobtrusive - exist prior to case study</p> <p>Exact - names etc.</p> <p>Broad coverage- extended time span</p>	<p>Retrievability - difficult</p> <p>Biased selectivity</p> <p>Reporting bias - reflects author bias</p> <p>Access - may be blocked</p>
Archival Records	<p>Same as above</p> <p>Precise and quantitative</p>	<p>Same as above</p> <p>Privacy might inhibit access</p>
Interviews	<p>Targeted - focuses on case study topic</p> <p>Insightful - provides perceived causal inferences</p>	<p>Bias due to poor questions</p> <p>Response bias</p> <p>Incomplete recollection</p> <p>Reflexivity - interviewee expresses what interviewer wants to hear</p>
Direct Observation	<p>Reality - covers events in real time</p> <p>Contextual - covers event context</p>	<p>Time-consuming</p> <p>Selectivity - might miss facts</p> <p>Reflexivity - observer's presence might cause change</p> <p>Cost - observers need time</p>
Participant Observation	<p>Same as above</p> <p>Insightful into interpersonal behavior</p>	<p>Same as above</p> <p>Bias due to investigator's actions</p>
Physical Artifacts	<p>Insightful into cultural features</p> <p>Insightful into technical operations</p>	<p>Selectivity</p> <p>Availability</p>

Source: (Yin, 1994)

3.2.1 Document

Documents could be letters, memoranda, agendas, study reports, or any items that could add to the data base. The validity of the documents should be carefully reviewed so as to avoid incorrect data being included in the data base. One of the most important uses of documents is to corroborate evidence gathered from other sources. The potential for over-reliance on document as evidence in case studies has been criticized. There could be a danger of this occurrence if the investigator is inexperienced and mistakes some types of documents for unmitigated truth (Yin, 1994).

3.2.2 Archival record

Archival records could be useful in some studies since they include service records, maps, charts, lists of names, survey data, and even personal records such as diaries. The investigator must be meticulous in determining the origin of the records and their accuracy.

3.2.3 Interview

Interviews are one of the most important sources of case study information. The interview could take one of several forms: open-ended, focused, or structured. In an open-ended interview, the researcher could ask for the informant's opinion on events or facts. This could serve to corroborate previously gathered data. In a focused interview, the respondent is interviewed for only a short time, and the questions asked could have come from the case study protocol. The structured interview is particularly useful in studies of neighborhoods where a formal survey is required. The use of tape recorders during the interviews is left to the discretion of the parties involved.

company, as well as, to determine how the implementation of a JIT system could improve product quality and result in cost savings.

Yin (1994) suggested three principles of data collection for case studies:

1. Use multiple sources of data
2. Create a case study database
3. Maintain a chain of evidence

Levy (1988) used open-ended interviews as recommended by Yin (1984) to expand the depth of data gathering and to increase the number of sources of information. In this study, the researcher used the same interview questions and protocol that were used in the Levy's (1988) study. As it was used in the Levy's (1988) study, the survey was enhanced by interviews of key individuals so as to acquire information that might not have become available through the questionnaire. The interviews were conducted according to the interviewees' schedule and availability, as suggested by Feagin et al. (1991). When making interview, the researcher asked open-ended questions because open-ended questions provide the respondent with greater flexibility in answering a question. After each visit to factory, the researcher wrote up notes in order to analyze the production system, problems existing in the factory, and applicability of JIT system. Finally, data obtained through the interviews were filed.

Chapter 4

APPLICATION OF JIT SYSTEM IN THE DETERGENT FACTORY

4.1 Testing Applicability of JIT system in the detergent factory.

Nowadays, competitiveness is intensified in global markets. This is why, every company spend effort to use its resources efficiently, make savings by purchasing cheap labour force, and eliminate unnecessary processes and cost in order to be able to produce high-quality products with possible minimum cost. Unnecessary processes and resources refer to: extra labour force, extra cost, unnecessary work, and wasted time. Providing the products to the customers in a timely manner is distinctive mark for competition. In today's business environment, companies have to compete with international competitors. In that respect, companies are able to survive if they can supply products in a short time period, and keep lower prices, and offer high-quality products.

North Cyprus has been not politically recognized for almost 36 years. In this respect, it is expected that foreign investment will be coming to North Cyprus in the future. Moreover, in a small island economy like North Cyprus, companies' operating must be able to have competitive edge to be able to compete with international companies successfully. Therefore, developing strategies relating to producing products with high quality with minimum cost is of significant importance for these firms. In that

respect, implementing JIT production system in the companies operating in Northern Cyprus is important issue.

The aim of this study is to present whether or not a JIT system can be implemented in a detergent factory which is located in North Cyprus. The results of this study is considered to provide the managers of the case company with an opportunity to comprehend whether or not the implementation of a JIT production system is possible in their firm.

JIT production system is based on the careful use of a resource. A company using a JIT production system produces only necessary number of units in necessary quantities at necessary time. The implementation of a JIT system in the detergent company or in a firm which manufactures durable consumer goods is considered to be difficult. The aims of JIT are continuously improve quality of product and customer satisfaction by utilizing limited resources as efficiently as possible.

The most important factor necessary for successfully implementating a JIT production system can be through the workers' contribution. In order for the JIT production system to be implemented sucessfully, every employee must believe that the results of implementing a JIT system will for their benefits as well. Because of this reason, getting commitment of the employees is of absolute necessity for implementing a JIT system.

4.2 Case company

In this study, researcher applies JIT production system of Dağlı Trading Ltd. in North Cyprus.

4.2.1 The company's background

Dağlı Trading Ltd. started to operate as a distributor of a variety of brands of cleaning materials in 1982. After 1998, the company started to produce cleaning materials in its factory. Today, the company distributes its products generally to the domestic market; however 10% percent of its production is exported to foreign countries. Due to unrecognition of Northern part of Cyprus, it only exports to Arabic countries and to some Middle-East countries. Dağlı Trading Ltd.'s important foreign customers are in Iran, Lebanon, and Israel. However, freight costs are extremely high. Because of this reason, the company loses its competitiveness in front of other foreign companies. The Factory's production is under the annual production capacity because the company has stable market in the North Cyprus economy. It makes export only 5-6 times in a year. Company's revenue in 2009 is 10,328,768 Turkish Lira. Of this amount, 10,328,768 Turkish Lira is generated from domestic market, and 39,988 Turkish Lira is earned from exports to foreign countries. The case company has 2,000 square-meters manufacturing area, 5,000 square meters storage area, and 1,000 square meters cold storage area.

Today, Dağlı Trading Ltd. has 70 employees. Of this number, 16 are administrative personnel, and 54 are production workers. The case company produces approximately 100 different kinds of different products and it has "ISO 9001" quality certificate. The company's organizational chart is as follows as can be seen in figure 7 and the process chart is presented in figure 8.

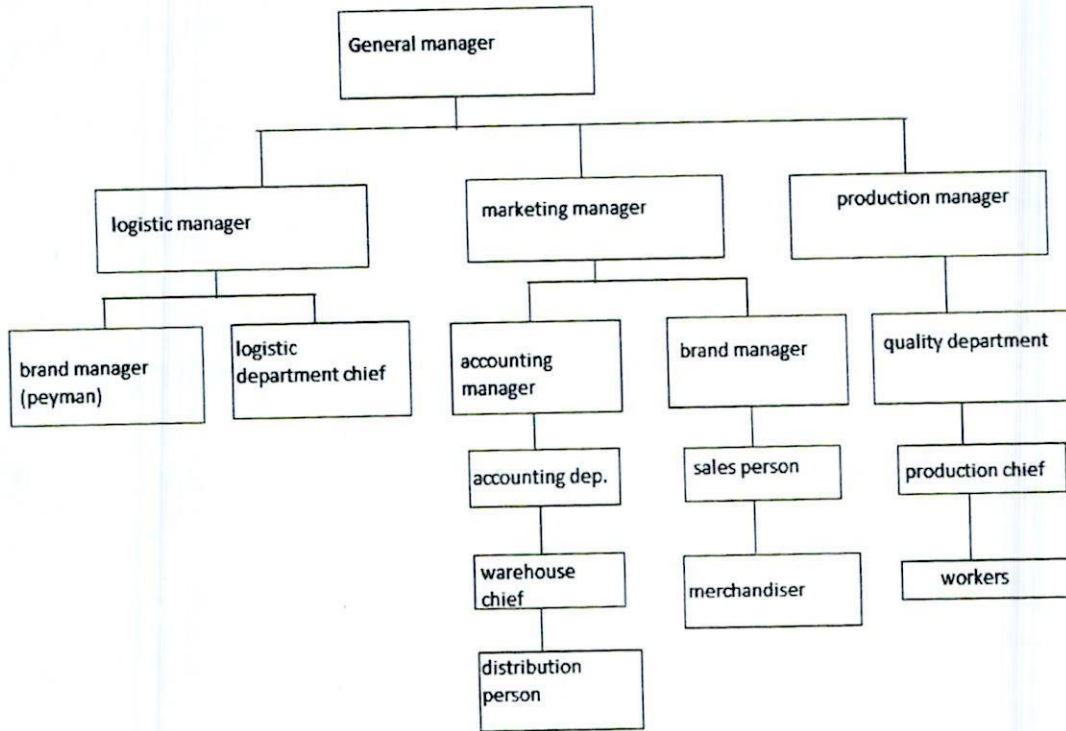


Figure 7: Organizational chart

Soap/detergent manufacturing process

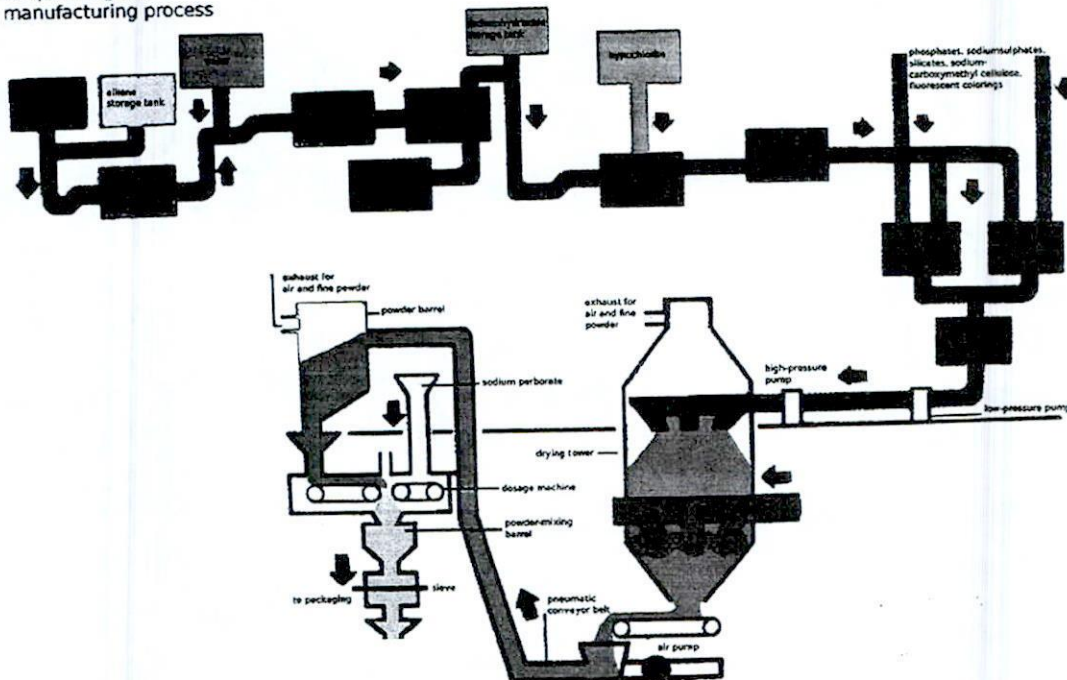


Figure 8: Process chart.

Source: http://en.wikipedia.org/wiki/File:Soap_Detergent_manufacturing.JPG

In Dağlı Trading Ltd., raw material quality is the very important because raw material quality directly affects quality of final products. The company has been making a lot of research in order for finding ways to acquire better raw materials. The factory has efficient process chart, but some changes may be necessary. Production area is rented from the government and before the case company; margarine was being produced in this factory. Therefore, the company has been facing some layout problems. Manufacturing is done in the following order: when sales person take an order, via portable terminal, the order is automaticly forwarded to the marketing department. Then, the marketing personnel control the warehouse in order to determine whether or not if the quantity of the ordered product is enough to meet the demand. If it is not enough, the order is forwarded to the factory manager and the starts to be produced in the order of urgency. After disturibution personnel distribute the product in the market, the merchandiser sells it to the final customers. Generally, Dağlı Trading Ltd. is a family-owned company. Big boss in the company is Okan Dağlı. Above all in the manufacturing only he knows everythink. If Dağlı Trading Ltd. wants to be profession business, they must break this circle.

4.2.2 Problem definition and understanding the necessity for implementing JIT in the case company

As a result of interviews and direct observations, the researcher identified several problems in the case company. In North Cyprus, raw material issue will constitute a serious problem for the companies which intend to implement JIT production system. This is due to the fact that, North Cyprus is not politically recognized by other countries and export to other countries is very limited. Moreover, whenever raw materials are imported from other countries, it takes time to transport the materials to the country. Because of this reason, companies must hold material

inventories as safety stock. For example, Dağlı Trading Ltd. keeps inventory which would be enough for minimum one-month production. The fact that manufacturing is limited because of small population of TRNC trigger the problem inventory pile-up because the monthly production is not enough to use up all of the raw materials which are kept in stock. Whenever the company intends to make savings, it must correspond minimum order quantity level for the supplier. It is a serious problem for the company because it must require minimum order quantity level for supplier and minimize its inventory.

As a result of holding such unnecessary inventory stocks, the case company incurs extra cost of raw material, insurance, and investment. Investment cost raw material purchasing cost. The amount of cost of investment is important for the company because ordering of the raw materials requires some amount of money for the supplier in cash. It is apparent that, the cost of investment decreases the company's profit by considerable amount. Since competition is directly related to company's cash capacity, this situation is negatively affecting the case company's competitive advantage. Another problem related to keeping inventory is concerning storing costs. These types of costs are: rental costs, insurance costs, air conditioning, heating, and lighting costs.

In Dağlı Trading Ltd. the other problem is concerned with its relationship with suppliers. This is due to the fact that, NC is a small market, and factory production is limited. Therefore, the case company buys small quantity of raw material from the supplier and it falls short in importance in the suppliers' eyes.

The other problem is related to machine and worker flexibility. Flexibility of machineries and workers directly affect the amount of inventory which must be kept in stock. Because workers are not skilled to replace one another and machineries are inflexible, the case company has to keep extra inventory in order to avoid production cut-offs which may result from disruptions that are likely to occur due to worker and machine inflexibility.

4.2.3 How can a JIT system be implemented in order to solve the problems existing in the case company?

If a JIT system is to be implemented in the case company, the above-mentioned problems will be solved spontaneously. However, in order for the case company to be able to implement a JIT production system, several conditions must be met. The following represent the necessary conditions for implementing a JIT system in the case company:

4.2.3.1 Minimizing Inventory and Establishing Reliable Relationship with Suppliers

Dağlı Trading's relationship with suppliers is not strong. The case company works with more than one suppliers. In most of the cases, the case company has to contact the branches of the main suppliers because usually it buys raw materials in small lots. This is due to the fact that it makes production in small quantities. Despite these disadvantages, the case company works with the same suppliers because these suppliers provide materials reasonable prices. If the case company is to implement a JIT system, it must establish a strong and long-lasting relationships with few suppliers. In this case, it will be able to order and obtain high-quality raw materials on time. In this case, it will not have to buy unnecessary raw materials and invest its money in an unnecessary way.

Moreover, If Dağlı Trading Ltd. establishes reliable relationships with few suppliers, it will be able to purchase raw materials in small lots. Currently, because the company works with numerous suppliers and because it does not have a strong long-lasting relationship with any of these suppliers, the suppliers are not willing to transport raw-materials in small quantities and batches. If the company solves the supplier problem, therefore, it will not have to keep extra inventory. Since zero inventory is one of the main aspects of JIT system, establishing strong relationships with only few suppliers will be a path to the implementation of the JIT system in the case company.

4.2.3.2 Achieving Efficient Worker Communication and Layout

The other important problem in Dağlı Trading Ltd. is that the internal communication within the company is not efficient. This is due to the fact that, company's manufacturing and administration areas are not in same place. This situation cause lost sales for the case company.

If the case company is to implement a JIT system, it must solve the communication problem between workers and departments. In that respect, it can use a kanban card. In this case, the managers of the case company will not encounter this type of problem because every purchasing activity will comprise a written kanban card. The use of kanban card will affect the company's efficiency and improve the communication between departments. The communication problem can also be solved through the cooperation among the departments of the company as a whole. This may, however, necessitate the revision of factory layout and change some operations.

4.2.3.3 Elimination of the possibility of producing defective products

In Dağlı Trading Ltd., sometimes defective products are produced because of poor-quality raw materials and machine-breakdowns. This, in turn, result in extra rework for the products. Extra rework means extra cost and wasted time for the company. Because of this reason, company keeps finished-good stock in order to eliminate any delay in delivering the goods to the customer in case of production of defective units. This, however, causes piled-up of inventory and result in additional costs for the company.

In the case company will implement a JIT system; it must eliminate the production of defective products. This can be achieved through purchasing high-quality raw materials and performing regular maintenance for the machineries. In this case, it will not have to keep extra inventory in the stock and, therefore it will not incur additional costs.

4.2.3.4 Employing semi-skilled workers

If a JIT system is to be implemented in the case company, workers should have familiarity with more than one part of the production process. If the company is to adopt a JIT system, everybody must dedicate himself/herself to the implementation and train themselves to be able to perform in different sections of the factory. But, in TRNC workers are not conscious about this situation. Mrs. Bertuğ, a manager in the case company, said that finding skilled worker is difficult because generally workers are primary school graduates. In the factory, there is no multiskilled worker. Moreover, if the JIT system is to be implemented, workers should feel the sense of organizational commitment.

4.2.3.5 Performing Regular Maintenance for the Machineries and Using these Machineries in a Flexible Way

In Dağlı Trading Ltd, machine maintenance is made once a year. This situation causes a serious problem for the case company because if a machine breaks down, it will result in lost of a lot of time. In case of machine break-down, engineers come from abroad in order to repair the machineries. This in turn results in loss of sales because production is stopped until the machine is repaired. Since this situation will cause delays in production, the products will not be finished and distributed to the customers. This situation, however, does not influence the production of "current water softener" because different machineries can be used to produce this product. In Dağlı Trading Ltd., machine cleaning is made after every production run and setup time is around 30 minutes for 3 workers.

In the Dağlı Trading Ltd. is to implement a JIT production system, it should minimize the possibility for likely machine breakdowns. Additionally, the company should find and employ an engineer who can repair the machines of this kind.

4.2.4 Can JIT system be implemented in Dağlı Trading LTD?

As a result of interviews and observations, the researcher has found out that a JIT system cannot be currently implemented within the case company because of the following reasons:

4.2.4.1 The case company cannot currently establish strong and reliable relationships with suppliers

TRNC's geographic location is not appropriate to solve the problem resulting from transportation and weak-relationship with suppliers. In addition, Dağlı Trading Ltd. acquires raw materials from different countries and from variety of suppliers. This is due to the fact that, different raw materials which are used for detergent production

are being produced in different countries. For example, while one type of material is produced only in China, another type of material is produced in an other country. This situation, therefore, inhibits the case company from establishing long-lasting and reliable relationship with only few suppliers.

The other important problem relating to this issue is that, the island is not politically-recognized by the other countries and transportation time is effected by this situation. This is due to the fact that, shipments are not directly coming to TRNC. Rather, goods are moved to Turkey first, and then they are transported to Cyprus. Moreover, if it is not appropriate for shipment, transportation may be further delayed. For example, when a raw material is ordered from China, it is received in minimum 45 days. On the other hand, this time is reduced for 35 days to a European Country and 5 days to Turkey. Because of this reason, if the case company does not have enough raw materials in the inventory stock, its production stops until the raw materials are received.

Supplier's material quality also directly affects quality of finished-goods. In the JIT system, company must blindly trust its suppliers. However, the case company also occasionally encounters problems concerning poor-quality raw materials. This, in turn, prevents the case company from implementing a JIT production system.

4.2.4.2 The case company cannot provide timely maintenance and repair for its machineries

In the case company, when the production was initially started, old machineries were being used. Then, the case company has replaced the old machines with new ones for the last decade. In spite of that, some old machineries are still used in the case company. Whenever company's new machines breakdown, the old machines are

used for production. The case company has only one water softener, therefore, when water softener is broken down, production is stopped in case company. Unfortunately, there is no technician in TRNC who can provide repair and maintenance service for water-softener machine. Therefore, whenever it is broken down, technicians come from Turkey. However, when the case company contacts the technicians, they are usually busy. Because of this reason, it takes minum 15 days, in most of the cases, for the machinery to be repaired. This situation, therefore, is an important problem which prevents the case company from implementing a JIT production system. Furthermore, if a machine breakdowns, the spare parts cannot be found in TRNC. Therefore, the spare part must be brought from the other countries. Therefore, it is difficult for the case company to solve the problem concerning machine repair and maintenance, and this is another factor which precludes the implementation of a JIT production system in the case company.

4.2.4.3 It is difficult for the case company to find out skilled workers and to achieve flexibility among the workers

As stated before, in Dağlı Trading Ltd., there is a problem concerning the flexibility of the employees. This is due to the fact that, people working in this industry are semi-skilled and they are not qualified. In the factory, there are 18 workers and all of the workers working in the case company are primary school graduates with an exception that there is one chemist. Thus, whenever one employee is absent, another one cannot replace him/her. Therefore, the case company is not currently able to solve worker flexibility problem.

If the case company is to implement a JIT production system, it's workers have to be knowledged and concerned about JIT system. However, in the case company, it is

not possible for such unskilled workers to understand JIT system philosophy. In the JIT system philosophy, each worker respects management's leadership position and follows orders exactly without mistakes. Moreover, each worker cooperates with coworkers, and generates ideas and creativity to improve the firm's competitiveness. This situation is directly related to public culture. According to Walsh (2003), JIT system gives workers responsibility for the quality of their work. JIT workers have authority to stop production or at least put it on hold, empowering them to eliminate defects at the source. JIT workers require and demonstrate exceptional problem solving skills. The JIT philosophy strives for zero defects. Workers will be continuously study to improve system. However, it is very difficult to impose this culture on the employees working in the case company. These factors, in turn, inhibit the implementation of a JIT production system in the case company.

Chapter 5

CONCLUSION

In this research, a case study is conducted to test the applicability of a JIT production system in a detergent company, Dağlı Trading Ltd., which operates in TRNC. In the case company, there are several problems that necessitate the use of a JIT production system. In the Dağlı Trading Ltd. keep unnecessary inventory stocks, workers are not qualified, raw-material and finished-good quality control systems are not efficient enough, and machines break down stop production for a long-time. The pile-up of inventories in the case company brings together extra costs for the case company and these costs can be eliminated with the use of a JIT production system. If the case company adopts a JIT production system, the inventory-related costs could be minimized or completely eliminated. The research portrays how the implementation of a JIT production system would bring solutions to the problems concerning inventory pileup, inefficient supplier relationship, machine flexibility and maintenance, worker skills and flexibility, quality of raw materials, and communication. However, results of the research reveal that, the implementation of a JIT production system is currently not feasible in the case company.

The reasons for this are as follows: First, The case company does not have long-lasting and reliable relationship with suppliers. Second, since TRNC is not politically recognized by other countries, it takes a long time for the raw materials to reach the island. Third, In Dağlı Trading Ltd., there is a problem concerning the flexibility of the employees. This is due to the fact that, people working in this industry are semi-

skilled and they are not qualified. Fourth, it is very difficult to impose the JIT culture on the employees working in the case company. Fifth, there is no technician in TRNC who can provide repair and maintenance service for water-softener and other machineries. Therefore, whenever they are broken down, technicians come from Turkey, which may take a long-time. Finally, whenever there is a machine breakdown, the spare parts cannot be found in TRNC. Therefore, the spare part must be brought from the other countries.

Chapter 6

RECOMMENDATIONS AND POLICY IMPLICATIONS

6.1 Recommendation

More advanced techniques such as logistic regression technique (based on questionnaire) can be applied on the same subject for further studies in order to get more accurate results. The model employed in this study can be developed using the concept of Just in time (JIT) as well as Total Quality Management (TQM) rather than old traditional ones. However, due to availability of the relevant type of companies and the time limitation, I have been confined to do more solid research on the relevant subject. I recommend that those master students who really want to analyse this subject; they can take those points mentioned above into account.

6.2 Policy Implication

Some important points can be deducted from the research findings as policy implications: First, the case company does not have long-lasting and reliable relationship with suppliers due to the political situation. Second, it takes a long time for the raw materials to reach the island because every single part is brought via Turkey. Third, there is a problem concerning the flexibility of the employees. This is because the relevant labors working in this industry are semi-skilled and they are not qualified. Technical schools should be encouraged to educate middle-man for the relevant market. Finally, whenever there is a machine breakdown, the spare parts and expert people cannot be found in the country, therefore, they must be brought from

the other countries. This could be solved by having some trade as well as training agreements between North Cyprus and Turkey.

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