A VALUE STREAM MAPPING IMPLEMENTATION: A CASE of TEXTILE INDUSTRY

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Abstract: Lean manufacturing is a production strategy that has been used since 1950's. The main concern of this strategy is to determine resource of waste and try to eliminate waste. Companies do not only eliminate waste but also they try to keep their competitiveness as high as their competitors. Lean manufacturing has some tools such as Value Stream Mapping, Kanban, Kaizen, 5s, CONWIP etc. to imply over the production system to enhance its effectiveness. The aim of this paper is to apply Value Stream Mapping to improve production line of a textile company through a case study. Value stream mapping (VSM) is one of the most used lean manufacturing technique for illustrating and analyzing the logic of a production process and it provides companies to monitor all production line systematically. Value stream mapping is a projection of the flow of components and materials through a supply chain in an organization as well as the flow of information. The main idea of VSM is to control the system as a whole. In this paper, VSM was used to demonstrate the present production line and imply lean techniques. Selected company is a textile producer which exports their products from Istanbul to European countries. 5S principles were applied to reduce lead times and to increase productivity. Final results show that Production Lead Time (PLT) decreased 14.5 days to 5.2 days by applying lean techniques.

Keywords: Lean Manufacturing, Value Stream Mapping; 5s, Textile Industry

BİR DEĞER AKIŞI HARİTALAMA UYGULAMASI: BİR TEKSTİL ENDÜSTRİSİ ÖRNEĞİ

Öz: *Yalın üretim, 1950'li yıllardan beri kullanılan üretim stratejisidir. Bu stratejinin ana amacı israfın kaynağını bulmak ve elimine etmeye çalışmaktır. Şirketler sadece israfı azaltmak değil aynı zamanda rakiplerine karşı rekabet içinde olmaya çalışırlar. Yalın üretimin verimliliği artırmak için üretim sistemleri üzerinde kullandıkları bazı araçlar vardır, bunlar; Değer Akışı Haritalaması, Kanban, Kazien 5s, Conwip, vb. Bu çalışmanın amacı bir tekstil firmasında değer akışı haritalamasını kullanarak üretim hattını geliştirmektir. Değer akışı haritalaması üretim sürecini sergilemek ve analiz etmek için en fazla kullanılan yalın üretim tekniklerinden biridir ve bu şirketlere bütün üretim hattını sistematik bir şekilde görme imkânı sağlar. Değer akışı haritalaması, bilgi akışının yanı sıra, bir organizasyondaki tedarik zinciri aracılığıyla bileşenlerin ve malzemelerin akışının bir izdüşümüdür. Değer akışı haritalaması bütün üretim sistemini parça parça değil bir bütün olarak kontol etmek için kullanılır. Bu çalışmada değer akışı haritalaması ile mevcut üretim hattı sergilendi ve yalın*

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üretim teknikleri uygulandı. Bu çalışma İstanbul'dan Avrupa'ya tekstil ihraç eden bir firmada gerçekleştirildi. Üretimdeki hazırlık süresini azaltmak ve verimliliği artırmak için 5s ilkeleri uygulandı. Yeni hazırlanan değer akışı haritasında yalın teknikler uygulanmasıyla birlikte toplam hazırlık süresi 14.5 günden 5.2 güne düşürülmüştür.

Anahtar Kelimeler: *Yalın Üretim, Değer Akışı Haritalaması;5s, Tekstil Sektörü*

I. Introduction

Between 1900 and 2000, the increase in world population was three times greater than during the entire previous history of humanity an increase from 1.5 to 6.1 billion in just 100 years. As a consequence of this rapid increase in population as a consequence production rates also have had to be faster than ever before. Companies have tried to find a way to produce more and faster with lower cost. Scientists, engineers have investigated new techniques to remove waste and increase productivity (Tyagi et al., 2015). In today's world, many companies have faced with various problems such as resource waste, shortage, pollution. On one hand, companies have tried to find solutions for these problems, on the other hand, they investigate how to receive raw materials quickly and how to produce the products faster with minimum cost and high quality (Zahraee, 2016). There are some methods to help the companies to cope with these obstacles such as simulation, statistic analysis and lean production systems. These techniques improve productivity and efficiency by finding best organization (Zahraee, et al., 2014). One of the effective production approaches is lean manufacturing. Lean manufacturing was used first in Toyota automobile factory therefore, it is named Toyota production system in literature. Eiji Toyoda and Taiichi Ohno from the Toyoda family visited the Ford factory in USA and observed the mass production system and thought that the mass production system was not suitable for the Japanese economy. They developed the idea of Toyota production system as an alternative for mass production system. The main focus of the Toyota production system is on waste. Lean thinking's aim is to produce more output by using less input and satisfy customers need and present the best products (Ekizoglu, 2012). Lean manufacturing is based on eliminating waste that customers dont want to pay for it and tries to reduce cost for production (Inamizu et al., 2014).

This study is done over a textile company to examine the production process, find and reduce the wastes, improve the productivity by using less time and materials. To enhance the productivity and eliminate the wastes, some lean production tecniques such as 5s, kaizen etc. was used.

II. Literature Review

Rohani and Zahraee (2015), Value Stream Mapping (VSM) was applied in color industry to improve production line and eliminate waste, the result of this case study was Production Lead Time (PLT) and Cycle Time (CO) reduced. Zahraee (2016), affective activities and tools was defined in Lean Manufacturing

using survey method and showed the importance of conditions in Lean Manufacturing Application. Kumar and Kajal (2015), 5S was implied in small scale company in India. Non-value added items, searching time, unwanted materials and costs went down. Dora et al. (2015), LM tools was used to find out waste and categorize it in agriculture in Belgium. Mitsuo et al. (2016), Kaizen was applied to reduce Lead Time and Inventory Process in metalmechanical industry. Marodin et al. (2014), survey method was used to categorize the risks that influence Lean Manufacturing and to find the relation between these risks. Netland (2015), effect of contingencies for Lean Manufacturing was researched. Yang et al. (2015), simulation optimizing tool was used to eliminate non-value activities and reduce Constant Work In Process (CONWIP), increase service level. Castillo et al. (2014), LM tools was used to see the impact of Lean Manufacturing in mining industry in Chile. Tyagi et al. (2015),VSM was applied to reach lean thinking and in order to make product development and the wastes, inefficiencies and non-value added steps was eliminated. Azizi (2015), in order to improve the productivity in small medium enterprise by eliminating wastes and non-value added transactions, VSM and Kaizen activity was applied. Lacerda et al. (2016), Lean tool VSM was carried out in the production process of a major automotive company to eliminate wastes. Atieh et al. (2016), In order to enhance manufacturing process in a midsize glass fabrication company, VSM was applied. Simulation was done to remove bottleneck and decrease the production lead time. Jasti and Sharma (2014), Value stream mapping (VSM) was used to analyze materials and production process in an Indian auto components industry. Karakadilar and Hicks (2015), Structural Equation Modeling (SEM) was used to investigate the effect of Lean Manufacturing over suppliers's performance. Özdağoğlu and Rebiş (2016), Kaizen was applied to reduce Cycle Time in PVC Film producing in Turkey, the results of this case is overtime and cycle time decreased and productivity increased. Kılıç and Ayvaz (2016), VSM, 5S, SMED was implied to analyze the effect of gasket which is used in production line according to Lean Manufacturing.

III. Materials and Methods

Lean manufacturing dates back to 1950's thanks to Toyota corporations. In the 80's this manufacturing technique was called as The Toyota Way and have been studied by business gradutes and managers worldwide (Stampfl et al., 2017). The philosophy of foundation of lean manufacturing is to eliminate wastes and use work in process constantly. Companies which want to apply lean thinking firstly should restructure production layout. At this time current state is determined and employees are trained in lean thinking. Value Stream Mapping is one of the lean manufacturing methods that determines waste and resource of waste by visualizing all processes, in other words, VSM tries to look at the big picture not just in parts (Yurdugül, 2010). VSM helps companies for visualization, analysis, revision and redesign of a product and prepare a better

supply chain timing (Atieh et al., 2016). VSM brings value-added and non-value added activities in the process that is required for a product, in addition to eliminating waste, VSM also tries to reduce the production costs and time. Value Stream is a trip of a product which starts as raw materials and ends with delivering to the customer. All operations which are implied to create the product is defined to draw VSM. After Value Stream is created, the wastes are investigated on the production line and all engineering managing studies which are needed to remove wastes permanently is applied (Başer, 2011). It is obvious that the application of VSM gives effective benefits to the production process. That's why so many companies and several universities apply this technique (Forno et al., 2014).

IV. Case Study

A textile company which export most of its products to various countries in Europe was selected as the case study for this paper. The company is a midsize company in Turkey market. Products are produced according to customers order. This company produce shirt, t-shirt, polo shirt, sweatshirt and polyester. T-shirt production was selected and analyzed in this study. Company's minimum order quantity is ten thousand. Production line includes 4 destination (cutting, printing-embroidery, sewing, ironing-packaging). Following information is about production line: working day per week = 6, working shift per day = 1, working hours per shift = 10.5 hours, lunch break = 1 hours, tea break per shift = 2*15 minutes = 30 minutes, available time per shift = 9 hours * 60 minutes = 540 minutes, total daily demand = 1250 piece.

A. Analysis and Results

A.I. VSM: Current State Map

The information about the present state map of the company was collected based on the method which is recommended by Rother and Shook (2003). Simply, current state map is a screenshot of how the company's production process is done. It can be called flowchart or value stream map, it demonstrates the methodology of the company in order to produce products (Jasti and Sharma, 2014).

The present map was demonstrated in figure 1. In the map, every process was shown with small boxes. Cycle time, the number of workers, number of shift, machine reliability are in the boxes. Cycle times is a period required to complete the task in one section. All data and times were collected according to recent past data. There is a timeline under the map which shows two elements in figure 1, the first shows the lead time, the second shows the production time that spends in that section.

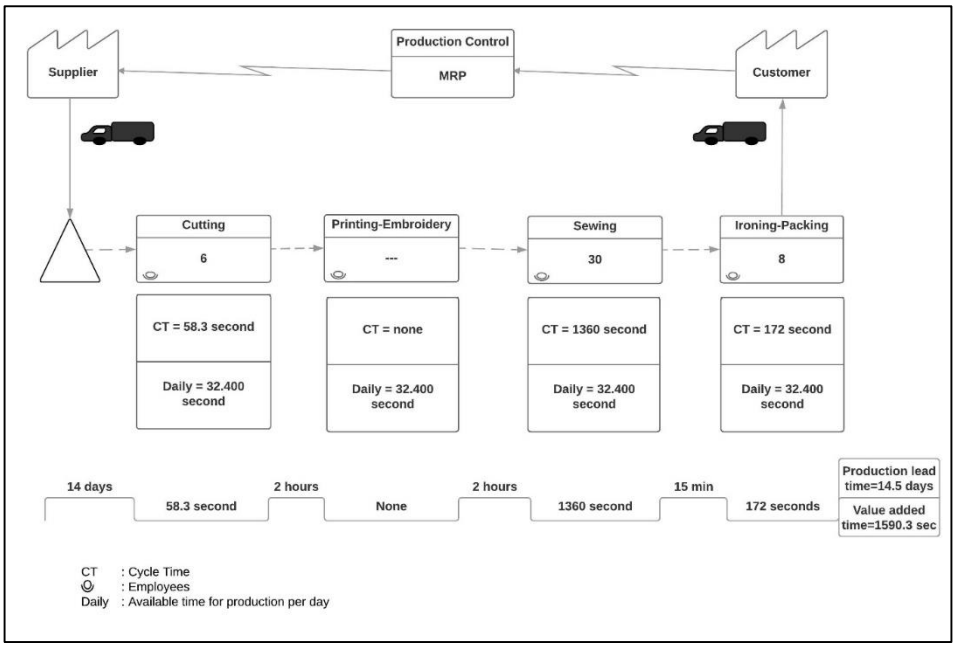

Figure 1. Current VSM

This textile company gives an order to supplier according to the customer orders. After giving the order to supplier, supplier company knits, paints and dries the fabrics and then they send. The production and deliver time take 14 days. The production line has four sections. The first section is cutting which fabrics are cut in this section. Cutting has 6 employees, the cycle time is 58.3 seconds and it takes 3 days to cutting section ten thousand t-shirts thereafter, the product goes to printing-embroidery, the company does not have the printing machine because of this machine's cost. For this reason, printing is done by an outsource company which is 2 hours away from the company. Outsource company works 5 days to produce this order. After printing, products go back to the factory. The third section is sewing which has the longest time of production line. Sewing has 30 employees, the cycle time is 1408 second (23 min) and it takes 14 days to sewing ten thousand t-shirts. After this section, the last one is ironing-packing. Transfer from sewing to ironing takes 15 minutes because it is sent together at the same time. Ironing-packing has 8 employees, the cycle time is 172 seconds and it takes 6.5 days to iron and package ten thousand t-shirts.

A.II. VSM: Takt Time

The main principle of lean manufacturing is required piece should be at required place with required amount. Takt time has to be known in order to carry out this principle. Takt time is defined as a time interval to meets the customer needs depending on the sales rate. When the production rate is higher than takt

time, a stock will occur otherwise when production rate is lower than takt time, customer needs can't be met. Each process has its own takt time. Takt time can be calculated by dividing available production time to customer demand for instance available production time is 12 hours and demand is 480 pieces per day. takt time is equal to 12*60*60sec/ 480 pcs which is equal to 90 seconds. It shows the time which you have to produce a finished product in every 90 seconds. higher cycle time than takt time causes wastes and ineffectiveness.

$$\text{Takt time} = \frac{available\ production\ time}{customer\ demand}$$

In this textile company 10.5 hours is workng time except 1 hour lunch time and 15*2 minutes break time.

$$\text{Takt time}=\frac{(10.5*60*60)-(5400\ seconds\ break)}{1250\ pieces\ daily\ demand}$$

$$=\frac{32400}{1250}=26 \text{ seconds}$$

A.III. VSM: Future State Map

The aim of the value stream is to show current state map and determine the deficient and mistakes furthermore finding a solution using lean principles. the sources of waste are revealed by applying future state map. Some tools such as 5s, Kaizen, Kanban, CONWIP are used to get rid of wastes. When we look at the current state map the highest lead time is delivery from the supplier (14 days), the supplier manufactures on order basis, they don't have stock to send quick delivery when customers want to order. Manager of this textile company should negotiate with the manager of the supplier company to persuade them to keep enough stock. The production process of fabric has knitting, printing, drying which takes 14 days. If the manager of the supplier is persuaded to have stock after knitting section, it cuts the production time nearly 9 days in figure 2. Supposed that supplier company would that offer, the delivery time of textile company down to 5 days. 5s principles are implemented to eliminate the waste. Printing-embroidery is outsourced and it takes 2 hours to send products to other company while there is traffic, if the company send the products to the printing company when there is no traffic, it takes 1 hour. Totally 2 hours was saved in the production lead time. The other suggestion is to build a canal between sewing and ironing-packing sections. Sewing is on the 3rd floor ironing-packing is on the 2 floor and it takes 15 minutes to carry all products from upstairs to downstairs. If the company make a tunnel between them, it decreases the lead time from 15 to 5 minutes.

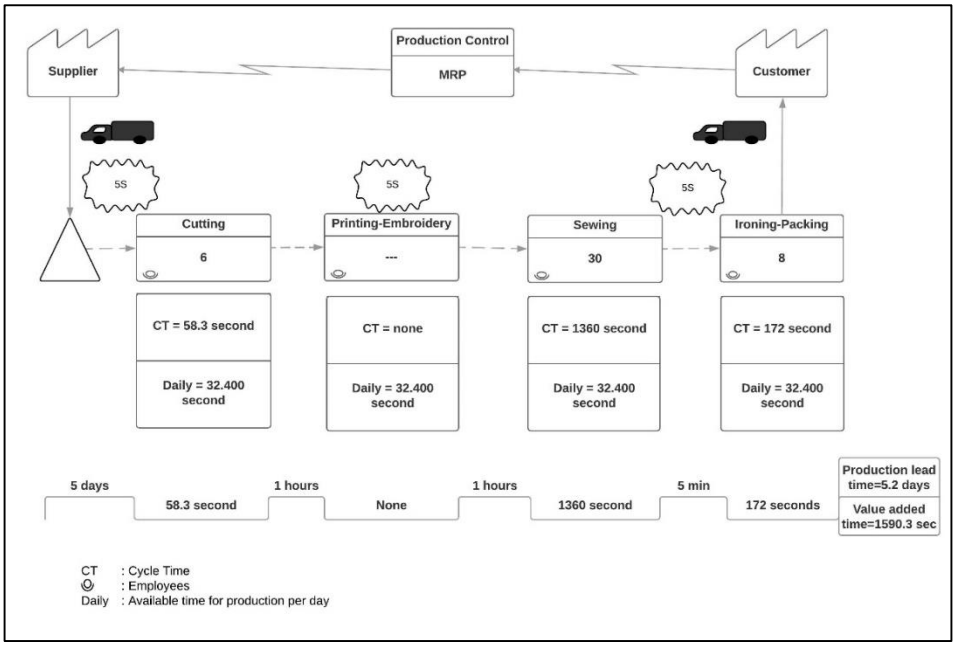

Figure 2. Future VSM

V. Conclusion

The aim of this paper is to develop a value stream map for a textile producer to find the resource of the wastes, non-value added steps and look for the appropriate solution for these. The other important time waste is production lead time, ıt also aimed to decrease the lead time or non-value added time. Lean techniques such as 5s, takt time, JIT was applied in this company and the results were shared with managers of the company. It can be seen that applying VSM made the company more productive and effective. This case study has not only showed the implementing of VSM but also showed that in mid-size companies, there are lots of lead time in production. This mapping showed that production lead time was removed by %64. The final result showed that there is a dramatic decrease at the lead time. Production Lead Time (PLT) downed from 14.5 days to 5.2 days (Figure 3). This decrease leads the company to deliver the order earlier thus the company can receive more order and produce more.

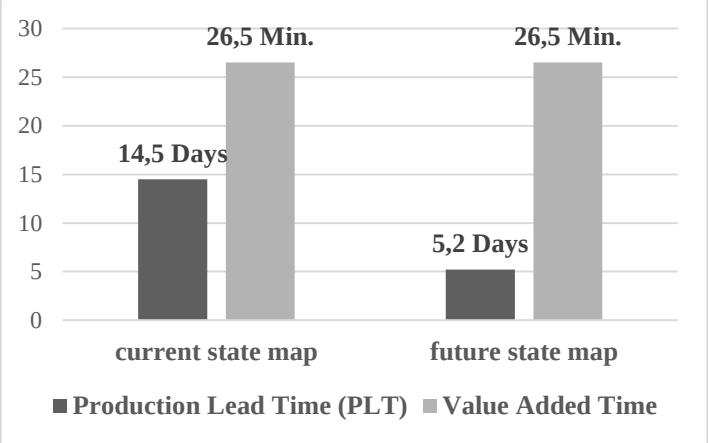

Figure 3. Current vs Future

Companies that want to simplify themselves should improve their existing production systems using lean techniques. The approach described in the study shows the viewpoint that must be in purely lean manufacturing enterprises. Improvement activities should always be initiated by rejecting the current situation and it should be done to improve more. Increasing competitiveness and profitability of enterprises is based on the continuity of this point of view. Thus, in contrast to conventional manufacturing, businesses can achieve the desired piece quality and process quality without incurring extra costs. For the future research the company can find better supplier to get raw materials earlier to develop production activity and reduce the time which passed in production. Another suggestion; getting a printing- embroidery machine to reduce the time passed in way. But the machine cost to the company must be calculated well.

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