Journal of Engineering Research and Applied Science
Available at www.journaleras.com
Volume 7 (2), December 2018, pp 910-916
ISSN 2147-3471 © 2018



# Lean production in lift installation and vale flow mapping

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Accepted 1 October 2018

**Abstract**
Companies need to improve their quality, costs and shipments in order to be available in a sustainable competitive environment. The main objective of the Lean manufacturing philosophy is to realize the efficiency and efficiency analysis of existing processes, to reduce costs and to provide excellent value to the customer. Nowadays, with a traditional approach, it is thought that the production systems can be largely purified from the activities that do not create added value by using the resources in an uninterrupted and intense pace. However, in order to have a more efficient production process by eliminating the waste completely, the necessity of evaluating and evaluating the process from raw material to the delivery of the final product is ignored. In this study, a sample application was carried out in a company which is in the leading position in the elevator sector in Bursa by using the value flow mapping technique in order to increase the process efficiency and to achieve lean production philosophy by minimizing waste. As a result of the study, a road map which has been calculated and calculated by using the value flow mapping technique in order to reevaluate the production system as a whole, to examine the current situation as a whole, to see the sources of waste, to determine the root causes of wastes and to plan lean applications, and to obtain a calculated roadmap.

*Keywords:* Value stream mapping; lean manufacturing; elevator ındustry.

## 1. Introduction

Businesses, by analyzing the production processes in order to keep up with the market in today's competitive conditions, customer they must constantly renew themselves according to their expectations and needs. Customer satisfaction at the highest level the necessity to meet the new generation of efficiency-oriented understanding of production systems has led to the fore. This the most important and most successful production method is considered to be lean production (Kara, 2004).

Produced product or service; It has become very important for the enterprises to minimize the costs by eliminating all activities that are defined as wastage and not adding any value to the product during the time it has spent from the raw material procurement stage to reaching the customer. Lean manufacturing philosophy is based on the systematic elimination of all activities that do not add value by determining and adding value to the activities that add and do not add value in the production processes. Lean manufacturing, which was introduced to the world as a Toyota Production System by a group of engineers under the leadership of Taiichi Ohno in the 1950s, has been one of the most effective approaches that enterprises use to eliminate wastage of their processes.

Lean manufacturing; it is defined as a business system to organize and manage product development, production operations, suppliers and customer relations. The most important advantages of lean production are that it requires less human labor, less space, less investment and less time to produce with less cost and less waste with customer demands (Marchwinski and Shook, 2007). The focal point of the lean manufacturing philosophy is to eliminate all excesses of materials and information flow processes within the enterprise.

Morgan and Liker (2007) lean production; better, faster and cheaper; need less space, invention and working hours; stated that as a production system that eliminates wasted applications. The concept of wastage in the focal point of lean production is defined as all activities other than the minimum labor force, material and equipment required to produce a product. Anything that does not add value to a product or service as a matter of lean manufacturing philosophy is considered as wastage and is tried to be

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eliminated. Improvements in costs by eliminating wastes increase the competitiveness of enterprises (Hay, 2000).

According to Taiichi Ohno (1988); more production, waiting, excess inventory, handling, unnecessary operation, defective production and unnecessary movements are listed in the form.

The concept of value, which is the critical starting point of lean thinking, can only be defined by the final customer (Aydın, 2009). Activities that do not add value to the product are work pieces that the customer does not want to pay. In order for the definition of value to be meaningful, the activities of the said customers, customer needs; they should be able to contribute directly to a certain price and to meet with a certain product or service (Womack and Jones, 1998).

The first stage of transition to a lean manufacturing system for an enterprise is to analyze the value flow by identifying activities that add and do not add value to the product. The next step is to eliminate activities that do not add value within the value stream (Womack and Jones, 1998). One of the most effective methods used to reveal the value flow by analyzing all activities within the enterprise as a whole is the value flow mapping (DAH) technique. With the DAH method, an overview of the current situation in terms of material and information flow is obtained. Once the sources of waste have been identified, the lean means of production are determined to eliminate these activities.

## 2. Value flow mapping method

According to Gardner (2001), value is the best determinant of customer loyalty, the most important indicator of market share and competitiveness. The value flow is expressed as the whole of the activities that are essential for each product and which are needed to create a product throughout the main streams, which create and add value (Rother and Shook, 1999).

Value flow maps are tools that allow the depiction of all material and information flow processes within the enterprise (Womack and Jones, 1996). The value flow mapping method forms a basis for the production process and is used to improve the value flow (Abdulmalek and Rajgopal, 2007). The method is mainly directed to the determination of value-creating and non-generating activities in the material and information flow process from the raw material to the finished product. Rother and Shook (1999) have introduced a new tool in lean production literature by introducing the value flow mapping method in detail in their published works.

In Lean production studies, two separate value flow diagrams are used, which are the Future Status Map, which shows the future status of the system as a result of the current situation map and the improvements made.

According to Solding and Gullander (2009), DAH technique has important advantages such as being practical and practical in terms of practicality, being able to be created without the need for expensive software or programs, being easy to learn and understanding, and providing a wide perspective on the state of the system. Besides, studies showing that the DAH method, which is mostly used for the production of products, can also be used in service enterprises are included in the literature (Kim vd., 2006; Dickson vd., 2009). The fact that it can be used in both production systems and service systems provides a significant advantage to the DAH method.

Rother and Shook (1999) according to the value flow mapping method; The selection of the product family consists of four basic steps: presenting the current situation, designing the future situation, preparing and implementing the action plan . Value stream maps:

- To see the flow of materials and information on the process,
- Determination of wastes in value flow paths,
- Combining production processes in a common language,
- Demonstrate the relationships between information and material flows,
- It allows to see where to focus on continuous and uninterrupted flow (Birgün vd., 2006).

## 3. Application

In this study, value flow mapping technique was applied in a leading company in the elevator sector, operating in Bursa, in order to increase process efficiency and to achieve lean production philosophy

by minimizing waste.

Elevator installation, rail door process and assembly process are completed through two main processes. The rail door process includes two steps as rail mounting and door installation. The assembly process includes three steps as mounting of the machine room assembly, well installation and installation of the cabinet.

In the elevator sector, firms mainly supply materials. Therefore, the order process is gaining importance. Currently, orders are given by grouping the materials. Grouping is done considering the installation steps.

The first order group is for the rail door process. According to the length of the wells rails, according to the physical condition of the wall of the brackets and according to the width of the wells constitute the first order group. (Order1, S1)

The second and third order groups are for the assembly process. Motor, panel, outer button, inner button, flexible cable according to the size of the customer, cable, installation cables and other materials made of plastic and iron, second order group; According to customer preference, changing cabin, marble and mirror, changing panel according to the width of the panel and inner door form the third order group. (Order 2,3 S2,S3 )

**3.1. Process Analysis**

In order to implement the DAH method, a detailed process analysis study was carried out within the enterprise. The assembly process, which was selected as the product family, was examined from the beginning to the end. At this stage all the steps in the process from the order until the delivery of the elevator to the customer were examined and the data were obtained.

The elevator installation is basically divided into two as the rail door process and the starting process. The rail door process ends with rail mounting and case assembly. After this process, the site is expected to be prepared. When the job site is ready, the operation process is completed by installing the engine room, in-house installation and cabin assembly respectively. The materials required for the rail door process and the start-up process come first to the warehouse and the rail door goes to the site separately for operation.

To give some information about rail door and assembly processes ;

***3.1.1. Rail Door Process***

a. Rail Mount: Scaffold is mounted in the well where the elevator will be built. It is thrown from the four points to the well in order to determine the measurement misalignment in the walls and to provide the measurements in the project. This is the process of working and receiving relay. The brackets which will carry the rails to the measurement intervals determined by the help of the rope are inserted into the walls of the wells. When all consoles are ready, the rails are taken to the well and the rails are mounted to the consoles.

b. Door Installation: After the rails are installed, the floor doors are started to be installed. In order for the floor doors to be suitable for the project, the milling process is repeated. The elevator door consists of casing and panels. With the help of the consoles after the measurements are taken, the safes are mounted on each floor. The panels are mounted in the second stage of assembly.

***3.1.2. Assembly Process***

a. Machine Room Installation: The assembly process starts with the installation of the engine room. The motor which provides the movement of the cabin, the control panel providing the control of the cabin electronically and the regulator controlling the braking mechanism are placed in the machine room in accordance with the project. The motor stand is installed by considering the rail centers and by considering the strength values. After the installation is completed, it is mounted on the engine table with its balance. Control panel is mounted on the wall by taking into consideration the dimensions of elevator standards. The connections between the motor and the regulator and the control panel are provided by means of cables. After wiring, the motor is moved.

b. Well Installation: After the motor takes motion, in-house assemblies are started. First, the car suspension is installed, which allows the car to be mounted on the rails, which allows the car to move up and down. After the suspension installation is completed, the ropes are thrown to the motor pulley. One end of the rope assembly is connected to the suspension of the cab and the other end is attached to the weight suspension, which carries the weight barites (loads) and defined as the counterweight, by means of rope bottles. After this stage, the revision box which is connected to the panel by means of flexible cable, which enables movement of the suspension assembly is mounted in the cabinet suspension. After the suspension assembly has moved, the base of the cabin is placed in the well to

move safely in the well and after that the wells are started. In the well assembly, the wells are first drilled. After the channels are stuck, the cable length is calculated and all the cables are released from the engine room to the well. After the cable is released into the well, cable entries are separated on each floor. After the work is carried out and release of cable to the well, the door and door mechanism and panel are installed. At this time, door skirt plates are also mounted. The well assembly ends with well bottom assemblies. Borehole plate with well barrel weight barriers, well ladder that helps to enter and exit the well, bumpers which prevent the weight frame and cab suspension from settling into the base, and electronic assemblies such as stop, alarm, well lighting switch are completed.

c. Cab Assembly: After installation of the floor doors, start the cabin installation phase. The mechanical installation of the cabin is completed by installing the side bases, ceiling and cabin top railings of the cabin which has been previously installed. The cabin interior assembly is completed with the cabin interior button connection, cabin top tube, cabin ventilation, lighting and overload connections.

### 3.2. Product Family Selection and Value Flow Maps

While determining the process which should be analyzed in the product production process, interviews were made with the management of Ucak Elevator Company. As a result of these interviews, the assembly department was chosen, a section where costs, losses are high and development potential is high.

Elevators are divided into two main classes as electric and hirolik type. They are defined within themselves by various naming. Electric elevators were selected for the application. Electric lifts are divided into two classes as geared and gearless. As a further nomenclature, the machine room elevator is dealt with in practice. In the application, the value flow mapping of the installation of a machine room elevator has been removed.

The project features are as follows;
• Number of stops; 6 ( Travel Distance; 15 m )
• Capacity; 6 People / 450 KG
• Engine Power / Speed; 5.5 KW / 1 m / s

#### *3.2.1 Current Status Map*

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#### *3.2.2 Future Status Map*

After the current situation map was removed, the work steps were examined in detail. The analysis of the international elevator companies' organizations and the solutions to the problems in the study were produced. With the improvements and arrangements made, the interruptions in the flow have been reduced, the supply complexity has been eliminated and the delivery time has decreased. Improvements and arrangements related to the processes are as follows;

a. Relay Receiving: Wells are provided for elevators in constructions. When the measurements of the wells designed with architectural and static calculations are implemented, there are account errors. Therefore, the dimensions required for the elevator cannot be taken by looking at the architectural project. For this reason, it is expected that the well will be fully exposed in the construction in order to obtain the well measurement. After the well is ready, the relay and receive process is performed. After the relay operation, the order of the material can be given in bulk. With the bulk order, the cost of cash can be reduced.

b. Package Material: Most of the elevator assembly companies do not produce their own. Therefore, almost all materials are supplied ready for assembly. Since the material item is too high, the number of suppliers and therefore the number of transports are also high. As a result, the cost is increasing. In order to prevent this, all materials can be taken from a single supplier with the concept of package material. And so the transport traffic is eliminated and the delivery time is reduced.

c. Time to Construction Site: The run-through time for the rail door process differs from one

another. Rail doors can be reached after the roof is closed. The start-up time of the start-up process generally corresponds to the end of the construction site. Works can be carried out without any waiting between the rail door and the operation processes. With the time management of the site management and a change in the time of departure, the number of transports and the project cycle time decrease.

d. Trak Usage: With its own drive system, the machine, which can move up and down in the well and has a platform designed to work on it, is used in the elevator sector. Trak and rails are placed one by one starting from the ground. Each set of rail ensures that the track is raised to an upper floor so that the rail assembly is completed throughout the well. With the completion of the rails, the door and panel assembly are done along the well with the same working style.

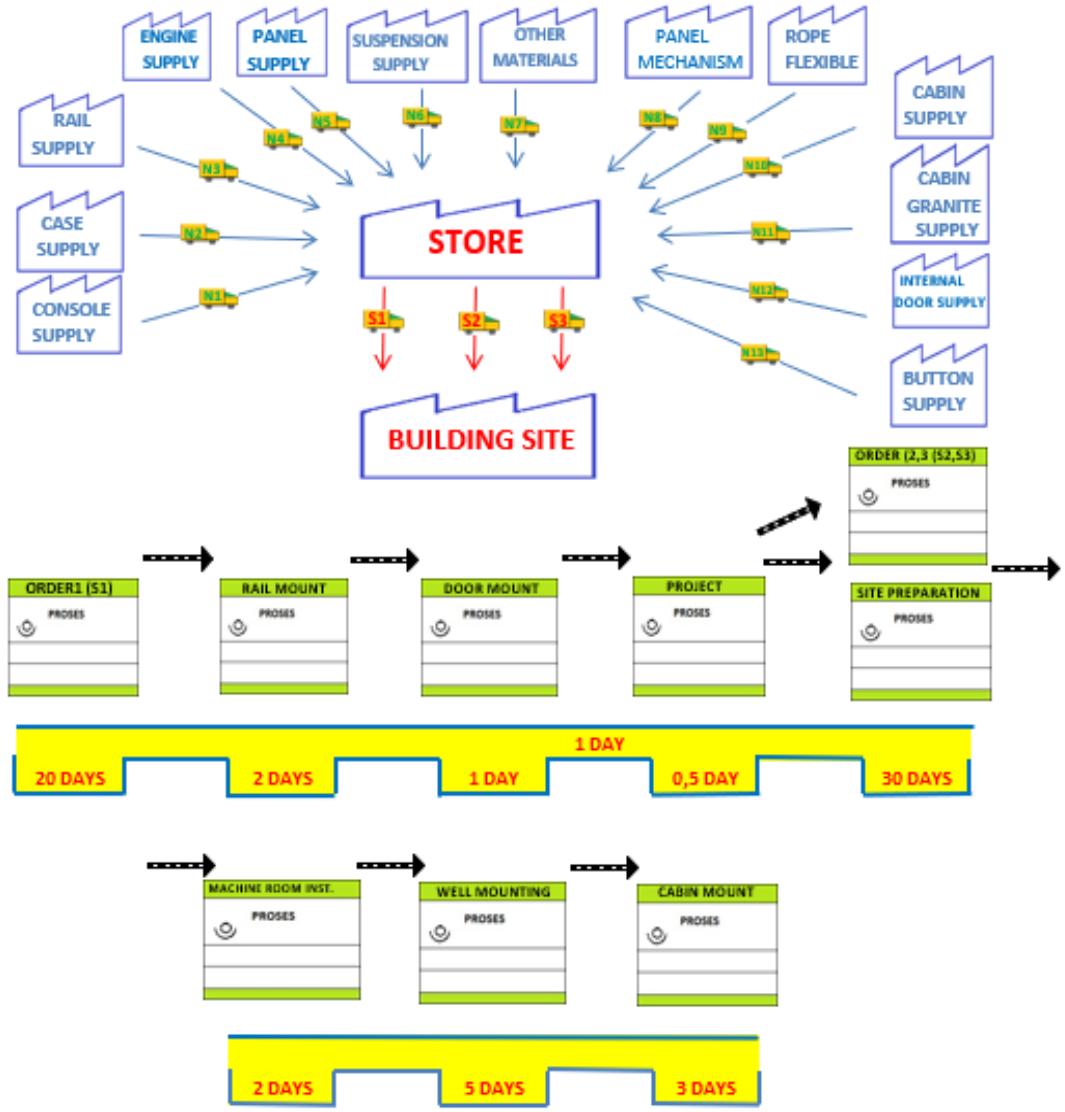



Figure 1 Current Status Value Flow Map.

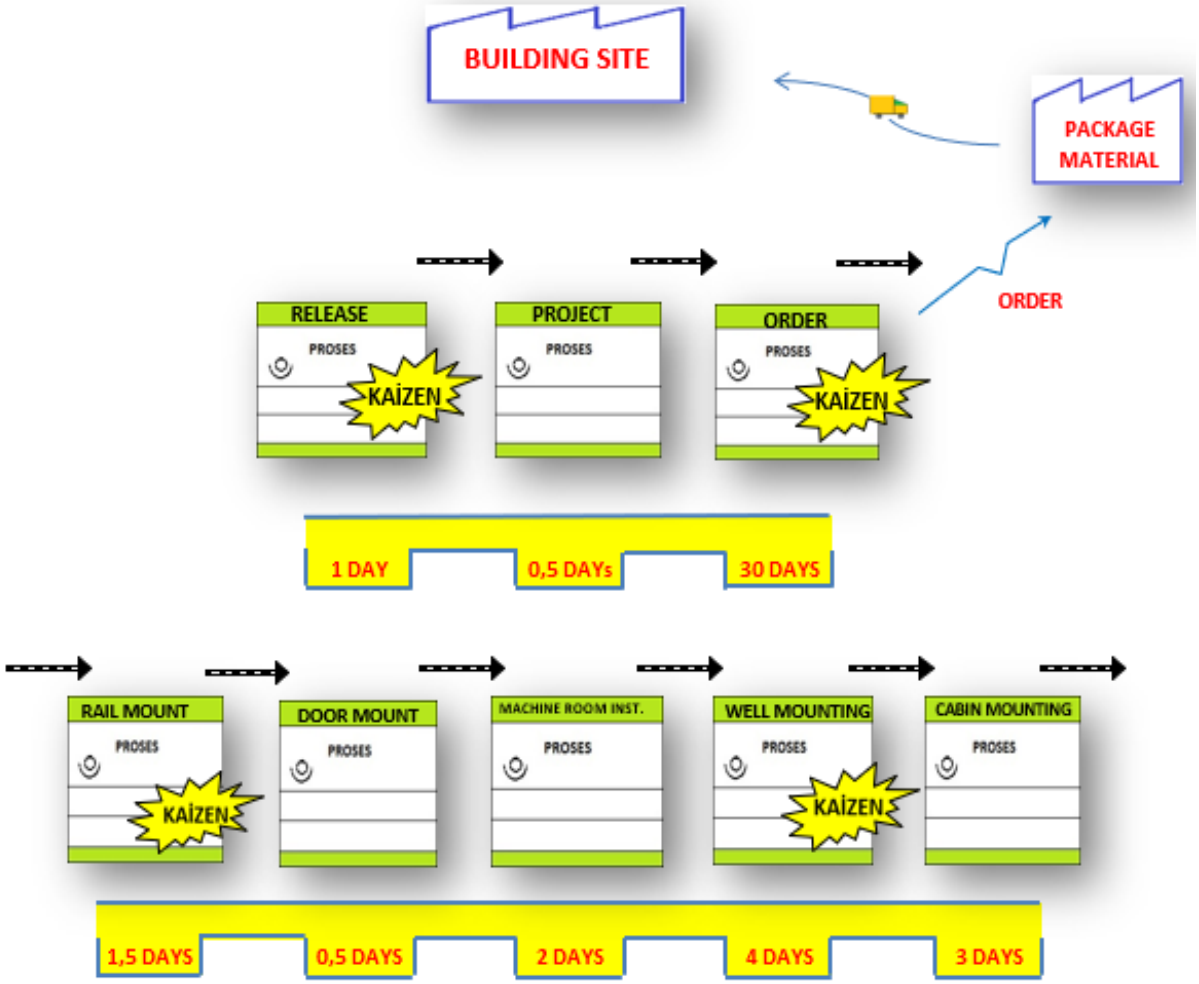



Figure 2 Future Status Value Flow Map.

## 4. Conclusions

Due to the increasing competition in the globalized world, enterprises have to make continuous improvements in their production processes. The regulation of production processes according to lean thinking has become an increasingly important concept. Lean thinking; It is a philosophy and way of thinking that aims to take necessary measures to eliminate all unnecessary practices, processes and functions that create no value, consumes resources and leads to waste (Womack and Jones, 1996). DAH technique; It is a tool that is based on lean thinking, which can be visualized more clearly and clearly. Thanks to the value flow mapping method, business processes can be examined in detail and the required improvements can be planned immediately.

In this study, the DAH method was applied for the assembly process which is important for the elevator operation. When the current situation map is examined, it is foreseen that some improvements will be made in transportation and material procurement processes, which have the necessary business time and unnecessary preparation times. After the planned improvements, the approximate gain amount was calculated. Table 1. shows the amount of gain that can be obtained from transport, procurement processes and thus cycle time.

Tablo 1. Amount of earnings

| | TRANSPORT | ORDER NUMBER | CYCLE TIME |
|---|---|---|---|
| **Current Status Mapping** | 16 | 13 | 63,5 DAYS |
| **Future Status Mapping** | 1 | 1 | 42,5 DAYS |

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