Optimization of Loading Time of Pallets on Shifting Truck by Suggested Operating Procedure (SOP) at a Fast Moving Consumer Goods Producing Company.

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***Abstract*—This study outlines the investigation and identification of existing loading time of pallets having pack-rite of detergent is done with the aim of making recommendations for optimizing the loading time. For this purpose, method study technique and Lean manufacturing tools are used. The study is based on a fast moving consumer goods (FMCG) industry. Initially the project work started with observing the existing process of loading pallets and examined through method study technique. Loading process was observed and keenly revised in order to suggest optimal loading time. Also layout of the area where the loading process is done was developed for the purpose of easy understanding of problems and recommendation for completing the loading cycle in optimal time. The significance of this research indicates that very little research have been done in this area, where as 5S, Value Stream Mapping (VSM), Single Minute Exchange of Dies (SMED) philosophies are used for designing a loading area and suggesting a procedure of desired activity instead of a manufacturing problem solution. The main achievement is development of Suggested Operating Procedure (SOP) for making the loading activity a type of standard. At the end of paper suggestions are made for future developments.**

Keywords—Optimization, Lean tools, Layout, Suggested Operating Procedure.

I. INTRODUCTION

Increasing challenges in today's global competition have prompted many manufacturing firms to adopt new manufacturing management strategies in order to enhance the firms' efficiency and competitiveness. Many manufacturing firms have adopted lean manufacturing system (LMS) as a role model management tool and benefited in many different forms and names [1]. Lean may be defined as "a systematic approach that seeks to reduce the cycle time to processes, increase the flexibility and improve quality" [2].Lean Manufacturing system is widely used by Toyota Production system which focuses on eliminating waste, reducing inventory, improving performance and encouraging employees to bring attention to problems and suggest improvements to fix those [4].

This research is done to investigate and identify the existing loading time of the pallets having pack-rites of detergent on the shifting truck (for the purpose of shifting pallets from packaging area to finished goods warehouse) and to make recommendations for optimizing the loading time. To examine the present status of the loading process, the Time and Motion study technique is used. Afterwards by using the philosophies of lean tools i.e. 5S, Value stream mapping and Single-Minute Exchange of Die, a Suggested Operating Procedure (SOP) is generated.

Value stream mapping (VSM) is a significant tool of lean manufacturing systems can create a high level look at total efficiency, presents a visual representation of material flow, product flow and information flow to identify improvement opportunities and thereby help to identify applicable lean improved tools and their implementation [6]. "A VSM is a simple diagram showing every step involved in the material and information flows needed to bring a product from order to delivery and a technique for visually managing process improvements. Mapping is a process that gives a clean picture of waste that inhabits flow" [9].

5S is widely used by Japanese organizations in order to increase human capability and productivity. Takashi Osada introduced it in 1980s; it is accepted that by applying the 5S techniques could considerably raise the environmental

performance in production line including housekeeping, health, safety and more. "The 5S is the acronym of five Japanese words which stands for:

1. Seiri (Organization),
2. Seiton (Neatness),
3. Seiso (Cleanliness),
4. Seiketsu (Standardization)
5. Shitsuke (Discipline)" [4].

The Single-Minute Exchange of Die (SMED) methodology is "a theory and a set of techniques that make it possible to perform the equipment's setup and changeover operations in less than ten minutes" [10].The above discussed tools are mainly use for manufacturing facility, but in this research the philosophy of lean tools are taken to optimize the shifting process or cycle of finished goods to finished product inventory.

"Lean Manufacturing is all about adding value and avoiding waste. Facility planning (land, buildings, equipment, and furnishings) provides the physical capability to add value". "Layout is an integral part of a Lean Manufacturing Strategy. Meaningful re-structuring requires corresponding physical changes in the layout". Getting a support from lean manufacturing in designing, may results in reduced storage and handling space and reduced cycle times [14].

This study was conducted at Colgate Palmolive Pakistan Ltd situated at Kotri site, Jamshoro, Pakistan**.**

II. AIM OF THE RESEARCH

The aim of this research is to investigation and identification of optimizing loading time of pallets

III. OBJECTIVES

Main objectives of this research are:

- To identify the existing time of loading pallets on a shifting truck by the help of a Fork lifter.
- To find the opportunities for increasing the efficiency of material transportation inside the factory.
- To develop a procedure by which loading can be done in optimal period of time.

IV. RESEARCH METHODOLOGY

The initial stage of the research was to observe the current process i.e. loading of pallets on the shifting truck, in order to understand and collect the numerical data of the loading activity.

"Time and Motion Study" is the technique of systematic recording and critical examination of existing and proposed ways of doing work and developing easier and economical methods. Method study is the technique used to study the existing process of the system, it helps to understand the flaws of the system and make an effective improvement [8]. Time and Motion study has been done by following tools.

1. Stop Watch
2. Camcorder

Stop watch which is used to determine the total time consumed by a particular activity and Camcorder used to record the visual scenario of the activities to analyze the processes keenly [11]. Then VSM is used to picturing out the activities involves in shifting cycle and in loading process [12].By the help of 5S concept management of layout is suggested for operating an optimal procedure [13]. "Internal tasks are those which can be performed while the process is running and external tasks are those that can only be performed while the process is stopped" [10].

In the last, the conversion of internal task into external task is done on the basis of SMED technique. Although, it is reverse of SMED technique, but it assist in achieving the objectives.

V. TERMINOLOGY

It is very helpful in understanding the research to discuss first some important terms used in this study.

1) *Pallet:* An equipment or container used to hold items such as pack-rites/cartons, boxes, barrels known as pallets [5]. In this study a pallet composed of 30 pack-rites arranged in 5 rows i.e.: 6 pack-rites in each row.
2) *Shifting truck and Fork lifter:* Power vehicles or equipment's self-propelled to relieve the worker of manually having to move the truck. These are commonly used in factories and warehouses. The main purpose of shifting truck is transfer bulk quantities from place to another whereas Fork lifter used for lifting loads. Fork lifters can also move load but at a shorter distance [6]. In this study fork lifter is used for lifting and loading the pallets on

the shifting truck and shifting truck is used for transporting the pallets from packaging department to finished goods inventory.

3) *Pack-rite:* A small, light box or container in which fast moving consumer goods (FMCG) are packaged. In this study the application of pack-rite is detergent packets packed in card boxes.
4) *E7C:* It is not an abbreviation but is the name of finished goods warehouse assigned by company.

VI. PROCEDURE

Before initializing the project, it is very essential to understand that what is loading activity? For this purpose we have to discuss the whole process of transporting finished goods from manufacturing area to finished goods inventory. The process or cycle of transporting or shifting Stock Keeping Units (SKUs) consists of four activities which are:

1. Loading of pallets at packaging area on a shifting truck by the help fork lifter (Lifter 1).
2. Shifting truck movement/travel (distance approximately 0.666km) from packaging area to E7C (finished goods warehouse)
3. Unloading of pallets from shifting truck by the help of fork lifter (Lifter 2) at E7C.
4. Shifting truck movement/travelling (distance approximately 0.666km) from E7C to packaging area for loading pallets.

This is a repetitive process of shifting SKUs therefore it is called as Shifting Cycle of SKUs. The shifting cycle is also shown by a figure V-I.

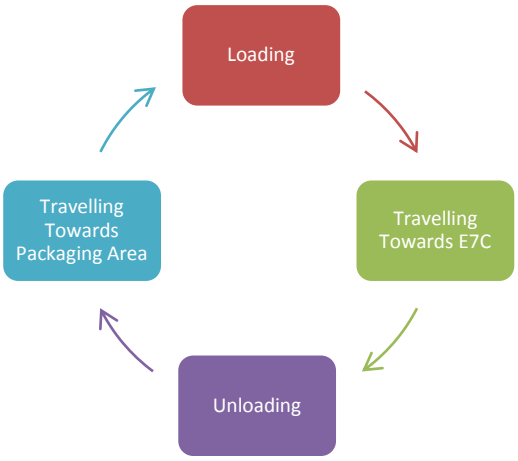

Figure V-I Graphical Representation of Shifting Cycle

This research focuses on one activity of shifting cycle which is “Loading” of pallets on a shifting truck by the help of fork lifter. During “Loading operation” a fork lifter lifts a pallet from a place where arranged pallets of detergent are placed and bring it to shifting truck and place on the truck then Fork lifter again goes for fetching another pallet for loading, Fork lifter performs this task 10 times because maximum no: of pallets which could be loaded on the truck are 10. Figure V-II shows:

- Place where the pallets are placed after packaging.
- Path of fork lifter movement by the help of two headed arrow.
- Place where the shifting truck is parked.

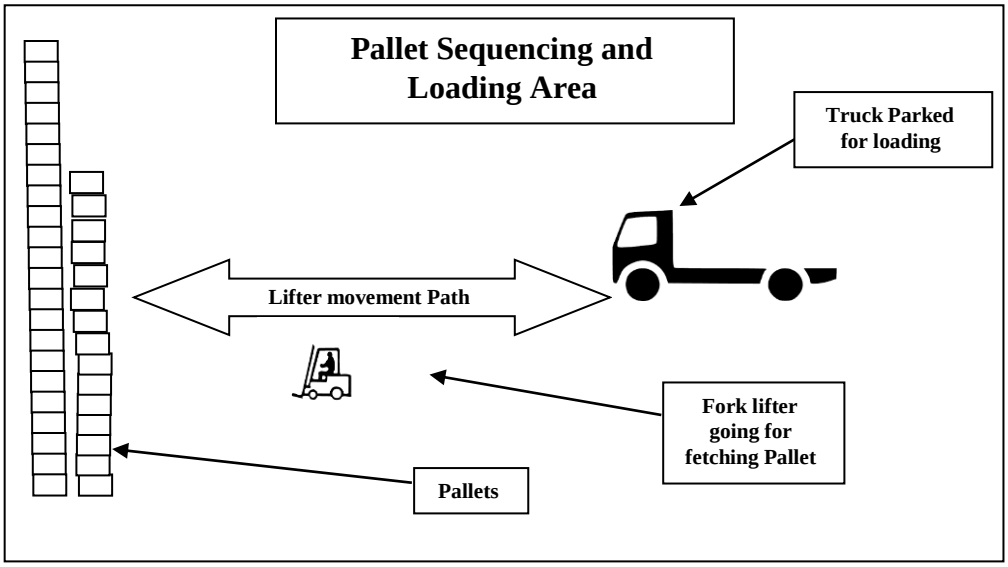

Figure V-II Place where Loading is done.

After loading of 10 pallets, loading activity is complete, shifting truck goes toward finish warehouse for unloading the pallets and the fork lifters wait at loading area for arrival of shifting truck after unloading at finished warehouse to perform another loading cycle and this process repetitively occur for 8 hours daily.

VII. DATA COLLECTION AND ANLYSIS

The loading cycle observed, recorded and data is collected by the help of research tools i.e. recording sheet, stopwatch and Camcorder. Data comprises of recording time of each activity by the help of stop watch and recording sheet. Also camcorder is used to study the activity keenly and deeply. For data collection purpose 4 observations are randomly made for 5 days. The time is recorded in seconds.

After the data collection a statistical tool is used which control chart to study the variability in the process. By the help of data collected a control chart is prepared. Mean time of 4 observations for each day is calculated and plotted here under.

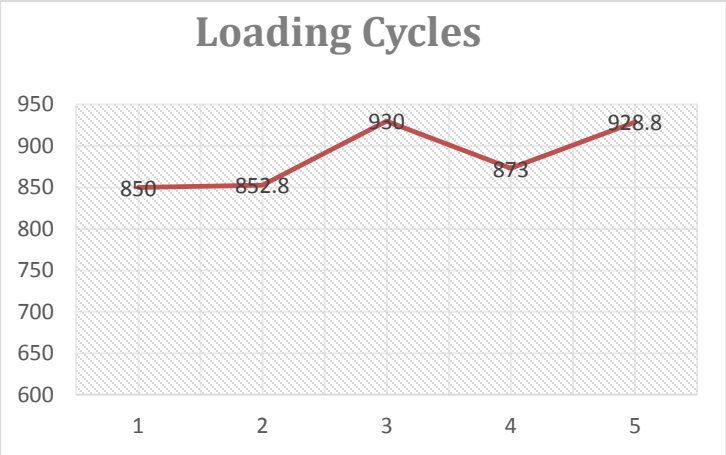

Figure VI-II Control chart of collected data.

X-axis shows the number of days and y-axis shows time in seconds. Plotted points on the graph are the mean times of observations of loading cycle taken for 5 days.

For the data it is also calculated that average time for completing one loading cycle is 886.92 seconds or 14.78 minutes.

VIII. SUGGESTED OPERATING PROCEDURE

After having a deep study of the loading procedure and video which is recorded by the help of camcorder (a method study tool) it is found that there are wide opportunities for improvement. Thus, for the sack of improvement an operating procedure is suggested which may result in greater benefits to the company. Marking/lines (for example yellow lines) should be drawn on the floor of loading area in order to guide the driver of shifting truck where he should park the truck during every loading activity. The Suggested Operating Procedure is stated as:

"As it is noted earlier that lifter lifts a pallet and travels a distance towards shifting truck in order to load the pallet on the truck and after completing loading cycle lifter remains idle unless the truck will come after unloading at finished warehouse. This study suggested that instead of fetching pallet during loading cycle, lifter should place 5 pallets on right side of the parking place and 5 pallets on the left side of the parking place of shifting truck when the shifting truck goes for performing other activities of shifting cycle. For clearer understanding a figure VII.I is drawn. This marking is suggested on the basis of 5S philosophy. After placing pallets on the suggested place and at suggested time the only task remains during loading is placement of pallets on the truck. In other words we can say that one activity is eliminated from loading cycle, hence the lifter is utilized in an optimal way. Also due to elimination of fetching task the reduction in time of loading is also held.

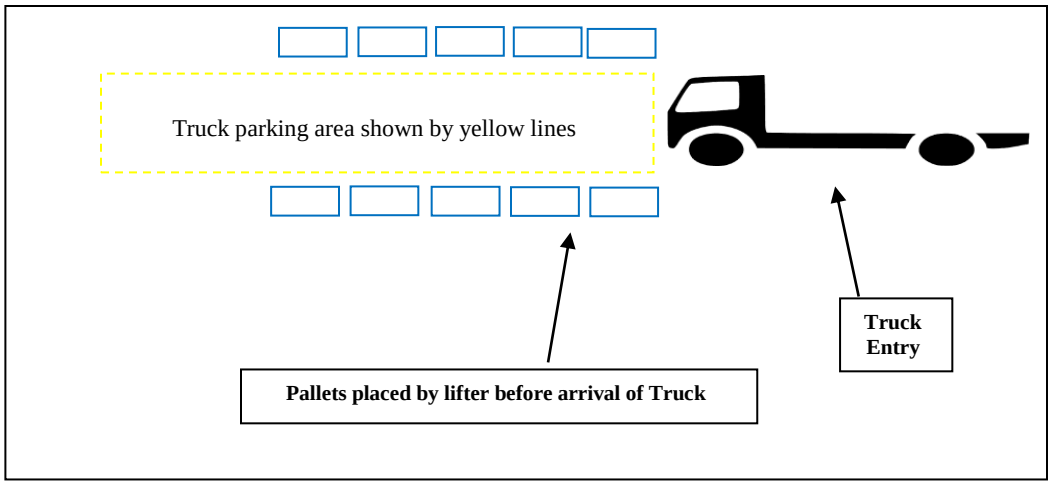

Figure VII-I Suggested layout of the loading area.

IX. RESULT

The suggested operating procedure is implemented in the company and the data is also collected after the implementation of SOP. Below graph shows points indicating the time of 5 loading cycle observed after implementation.

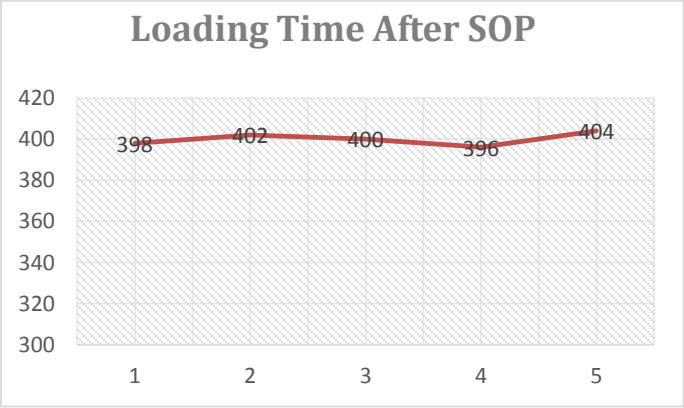

Figure VIII-I Data showing the time recorded after implementation of SOP.

X-axis shows number of observations taken whereas Y-axis denotes time in seconds and the plotted points denotes time of loading cycles. Figure VIII-II shows the comparison between the time before and after implementation of SOP. The green line shows loading time before SOP and red line shows loading time after SOP.
The average time to complete one cycle was **886.96 seconds 14.78minutes** but after SOP the average loading time is **400 seconds** or **6.66 minutes.** This means **54.9%** reduction in the loading time of each cycle.

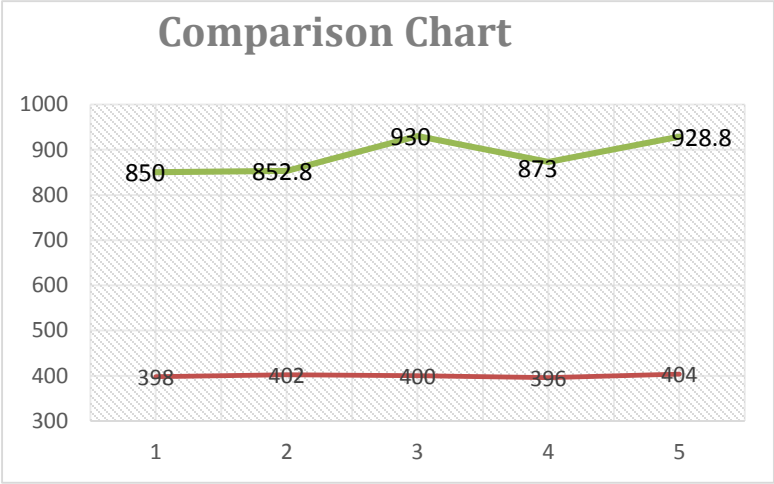

Figure VIII-II Comparison chart of loading time before and after implementation of SOP

X. CONCLUSION& SUGGESTIONS

From above results it is clear that there was a great opportunity of improvement in loading process which is achieved by implementing a ***Suggested Operating Procedure*** and also these are achieved according to objectives. The use of lean manufacturing tool is much effective in this research. 5S is a lean tool suggests proper management of working area or working station. In this research, the philosophy of 5S is applied for proper management of loading area or loading area layout instead of applying at workstation management. And another lean tool VSM philosophy which is used here for pictorial representation of loading process through mapping. Also the reverse of SMED philosophy used for converting internal activity into external activity i.e. Fetching pallet activity eliminated from loading cycle and included during idle time (Fork lifter is waiting for shifting truck). In this way the objectives stated above are achieved.

It is suggested that for further development or reduction in completing shifting cycle of finished goods, Lean manufacturing tools applied to other or remaining activities of shifting cycle. In this way continuous improvement in the shifting cycle of Stock Keeping Units (SKU's) will achieve.

ACKNOWLEDGEMENT

The authors are extremely thankful to the Colgate Palmolive Pakistan for their cooperation and permission to conduct the visit of the organization to make this work possible. The thanks are also due for our guide Dr Ghulam Yasin Shaikh and Dr Shakeel Ahmed Shaikh to encourage and guide time to time for sending this research work for international conference.

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Biography

Muhammad Zulfiqar is a student of under graduate in Industrial Engineering and Management at Mehran University of Engineering and Technology, Jamshoro, Pakistan. He has submitted his thesis project for partial fulfilment of the requirement for the degree of Bachelors of Industrial Engineering and Management. He is a member of Industrial Student organization (ISO), MUET chapter. He is first author of this research paper.

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