LINE BALANCING USING LEAN MANUFACTURING TOOLS AT BALLOON PACKAGING DEPARTMENT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

by

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DECLARATION

I hereby, declared this report entitled "Line Balancing Using Lean Manufacturing Tools at Balloon Packaging Department" is the results of my own research except as cited in reference.

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Date : 22 June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Management) (Hons.). The member of the supervisory committee are as follow:

…….

(Associate Professor Dr. Mohd Rizal bin Salleh) – Signature & Stamp

ABSTRAK

Tujuan kajian ini ialah untuk menyeimbangkan beban kerja setiap pekerja di bahagian pembungkusan manual. Belon B100, bungkusan jenis A dipilih sebagai bahan kajian. Setiap barisan pembungkusan telah disediakan masa untuk menyiapkan pembungkusan belon walau bagaimana pun barisan pembungkusan menghadapi masalah untuk menyiapkan dalam masa yang diperuntukkan iaitu 11 jam. Masa sebenar yang diambil untuk menyiapkan pembungkusan produk ialah selama 13.5 jam bagi memenuhi kehendak pelanggan iaitu 13000 bungkus. Tujuan kajian ini ialah untuk mengkaji dan menganalisa potensi aktiviti yang tidak diperlukan semasa proses pembungkusan. Untuk mengenalpasti solusi dan tindakan yang perlu diambil, beberapa cara telah dilaksanakan iaitu rakaman video dan masa telah dicatat, temu bual dan lawatan. Untuk peringkat analisa, *time study, ishikawa diagam, pareto chart, takt time and line balancing* telah digunakan sebagai kaedah analitikal. Sub activiti setiap operasi telah di kelasifikasikan antara *value added* atau *non-value added activities*. Melalui pengenal pastian ini, *fragment task* telah ditentukan untuk membina *yamazumi chart*. Solusi yang telah disarankan adalah berdasarkan kiraan *line balancing*, susun atur stesen kerja direka semula berdasarkan bilangan pekerja yang diperlukan. Solusi pilihan kedua ialah dengan mengunakan alatan *Kaizen (2 Ways Moveable Container).* Alatan ini berfungsi sebagai alatan penegndalian bahan diantara dua stesen kerja. Pekerja perlu menolak atau menarik *moveable container* untuk membuang jarak perjalanan antara dua stesen kerja. *Takt time* untuk barisan pembungkusan ialah 3.05 saat, *line balancing ratio* meningkat ke 90.96%, *line arrangement efficiency* ialah 86.23% dan *expected output* ialah 13655 bungkus, melebihi kehendak pelanggan. Jumlah penjimatan kos ialah RM91.88 dan 19.50% jimat daripada jumlah asal kos pekerja dalam masa 11 jam.

ABSTRACT

The aim of the study is to rebalance the work load of each operator at the manual packaging department. The B100 balloon and packaging type A is chosen as the subject of this study. Every packaging line will have an allocated time to finished the packaging product, but this packaging line have a problem to finish it within the 11 hours given. The actual time the packaging line took to finish it is aproximately 13.5 hours to meet 13000 packs of customer demand. The objective is to study and analyze the potential wastes at the manual packaging line. Moreover, to propose an effective and efficient solution or action regarding the problem issued; Methodology used in preliminary stage are observation, video capturing and time recording, interview session and site visit to have a clearly view about the problem highlighted. The time study, ishikawa diagam, pareto chart, takt time and line balancing tools are used to analyze the current situation. Line balancing ratio, line arrangement efficiency and expected output had been obtained The sub activities of each operation involved had been declared either value added or non-value added activities. Through this identification, fragment task had been obtained in order to construct yamazumi chart. The work station layout redesign is based on the number of operator required. Second solution is by using Kaizen tool (2 Ways Moveable Container). This tool is functioned as a material handling tool between two work stations. The operator need to push or pull the moveable container in order to eliminate travel distance. The takt time of packaging process is 3.05 seconds, line balancing ratio is increased up to 90.96%, line arrangement efficiency is about 86.23% and expected output is 13655 packs, exceed the customer demand. Total saving cost of packaging line is RM91.88 and 19.50% saved from its original labor cost within 11 hours.

DEDICATION

Only

my appreciated mother, Miskiati binti Mohd Som

my beloved father, Abd Aziz bin Hashim

my adored brothers, Muhammad Rasta bin Abd Aziz & Muhammad Damaian Fitri bin Abd Aziz

for giving me moral support, money, time, cooperation, encouragement and also understandings.

Thank You So Much

Love You Forever & After

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In the name of Allah, the most gracious, the most merciful, with the highest praise to Allah that I manage to complete this final year project successfully without difficulty.

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Besides that, I would like to express my gratitude to my beloved friends, Faridah binti Dollah, Nur Syuhada binti Mat Adam and Norfarafazera binti Mohd Sidek who gave me much motivation and cooperation mentally in completing this report. They had given their critical suggestion and comments throughout my research. Thanks for a great friendship. Special thanks are given to Mr. Saran, leader at balloon packaging department who is assisted me about the balloon packaging process and Mr. Zariff bin Bajuri, Engineer Manager for permission to have a site visits at balloon packaging department.

Finally, I would like to thank everybody who is important to this final year project report, as well as expressing my apology that I could not mention personally each one of you.

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LIST OF ABBREVIATIONS

AL	-	Assembly line
ALB	-	Assembly line balancing
CVSM	-	Current value stream mapping
DES	-	Discrete event simulation
FVSM	-	Future value stream mapping
IMVP	-	International motor vehicle program
JIT	-	Just in time
LT	-	Lead time
MIT	-	Massachusetts Institute of Technology
MQMS	-	Multiple queues multiple servers
MQSS	-	Multiple queues multiple servers
NVA	-	Non-value added
OT	-	Overtime
OEE	-	overall equipment effectiveness
PDCA	-	Plan, Do, Check, Act
PT	-	Processing Time
QC	-	Quality control
QT	-	Queue/waiting time
SMED	-	Single minute exchanged die
SOP	-	Standard operation procedure
SQMS	-	Single queue multiple servers
SQSS	-	Single queue single server
TQM	-	Total productive maintenance
VA	-	Value added
VSM	-	Value stream mapping
WIP	-	Work in process/progress

LIST OF SYMBOLS

%	-	Percentage
Avg	-	Average
s	-	Seconds

CHAPTER 1

INTRODUCTION

Lean manufacturing is a powerful and robust cutting edge strategy that implemented by all manufacturing industries to eliminate and reduce unnecessary process, information or other elements in the production line (Khakdaman, 2013). The application of lean manufacturing has shown a great impact towards the productivity and efficiency of the organization. A better utilization of resources will result the higher productivity rate and it will give a significant impact towards reduction in production cost. This study is concentrating on the line balancing of a production line of balloon manufacturing company, Everts (Malaysia) Sdn Bhd which is located in Ayer Keroh, Melaka. Line observation and time study will be conducted in order to balance the cycle time of production packaging line. The first chapter of this report will explain and elaborate clearly background of study, identify problem statement, the objectives and scope that need to be covered and the end this study.

1.1 Background

In this topic matter, Everts (Malaysia) Sdn Bhd become the subject of the study and only focusing on a balloon manufacturing industry. In 1978, Everts (Malaysia) Sdn Bhd the second manufacturing plant that established at Melaka, Malaysia. Nowadays, Everts produces various level of quality (import and export), sizes, 60 colours, 45 shapes and printed

balloons by using natural latex. It is operated with automated balloon production equipment and silkscreen printing technology that can print 5 colours or all round prints. Annually the production demand over 1 billion balloons with capacity for more.

Everts (Malaysia) Sdn Bhd had been chosen for this study because of the lacking and inefficient of process and information flow at packaging department. Packaging department at Everts (Malaysia) Sdn Bhd is practicing flexible demand packaging that is each packaging line do not have any specific product to be packaged. Daily packaging process is follow the weekly planner.

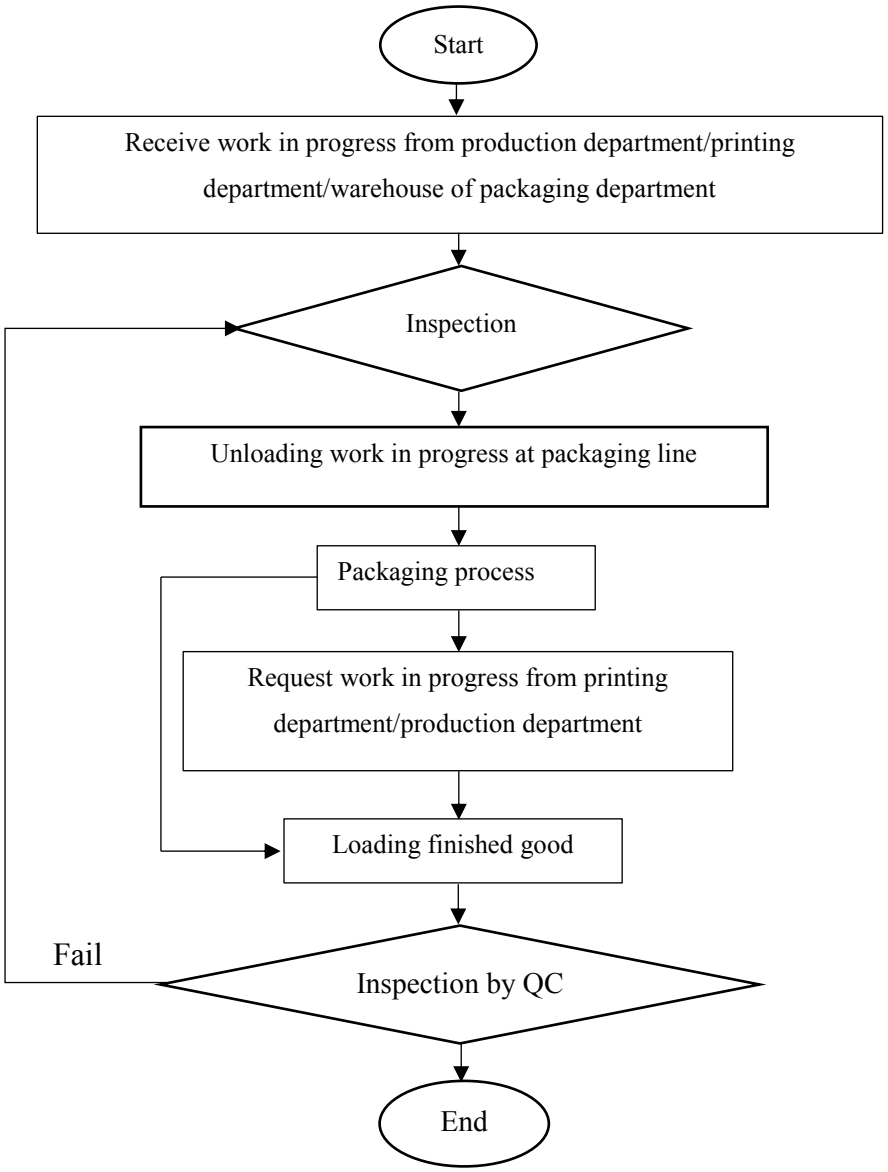

Figure 1.1: General process flow at packaging department.

Figure 1.1 shows that the general process flow of balloon packaging that have been practiced by the operators at packaging department.

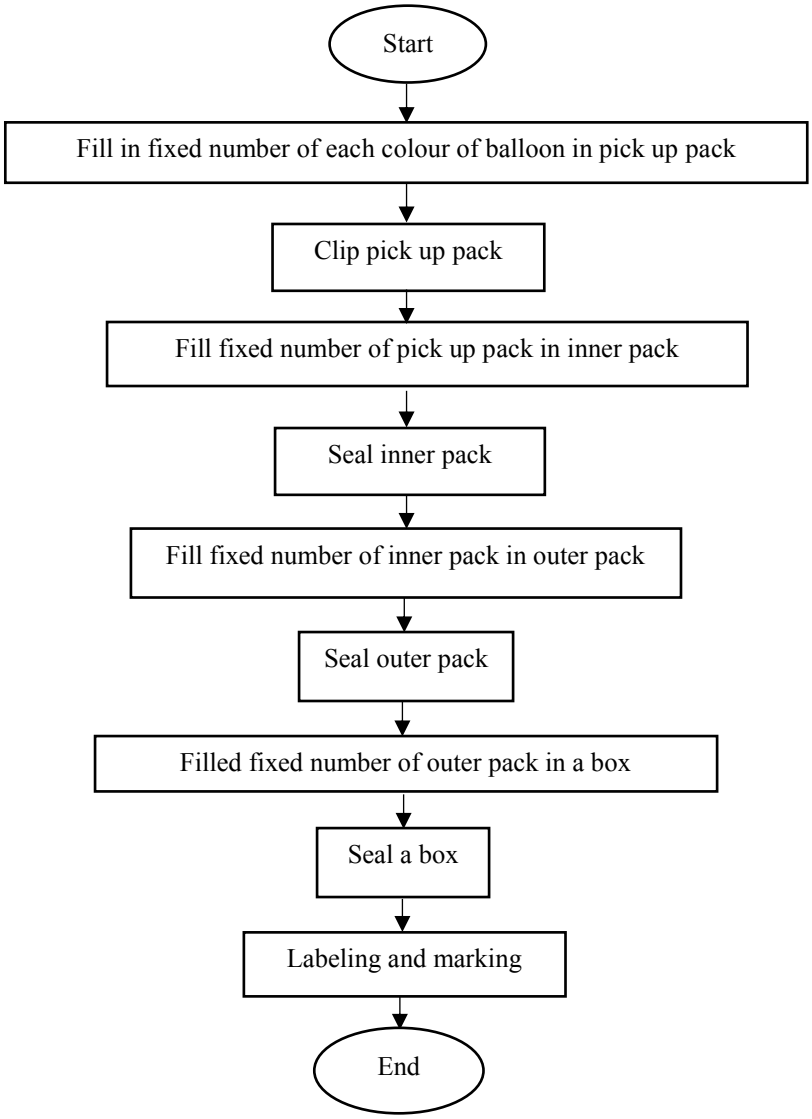

Figure 1.2: Details in Packaging Type A process flow.

Figure 1.2 shows that the detail of Packaging Type A of B100 balloon flow process that have been practiced by the operator at Line1.

The packaging production line is practicing semi manual handling. Basically, it has various different styles of product packaging. So that the packaging line need to adapt with the changes of packaging styles requested by customer.

Table 1.1: Type of process involved at production packaging line.

No.	Type of process
1	Picking up
2	Clipping
3	Inner packing
4	Sealing
5	Outer packing
6	Weighing
7	Box packing

Table 1.1 shows that the type of processes that have been involved in Packaging Type A of B100 balloon at Line 1.

Each packaging line has 7 to 10 operators that will work along the packaging process, each of operator is multi-tasking operator. They are trained to do various type of sub activities of packaging process.

At packaging department, there is high percentage of potential wastes that can be identified through out packaging process. Packing and packaging department has crucial responsibility in preparing a finished good before transferring packaged end product to warehouse or directly deliver to customer. A proper and fine packaging approach will ensure the finished good is in an excellent condition in order to maintain its long lasting quality and customer's first impression. The whole process and information flow must be well organized and known by operator in order to have a smooth working circulation system. The smooth flow process of packaging will give an impact to output and daily finished good productivity rate to meet the daily customer demand. Systematic process flow of packaging will ensure that customers will have the finished good as expected and satisfy themselves. By using lean manufacturing approach which is line balancing, the workload across all processes are levelling fairly at each workstation to eliminate bottlenecks and excess capacity. The application of line balancing ensures that each work element have an equal amount of work load, no overburdened, no one is waiting and they are working together in a balanced fashion.

1.2 Problem Statement

By using observation tool, researcher did observation study every week for 10 times to get understanding on the process and information flows. The potential wastes are recorded and measured at packaging department of Everts (Malaysia) Sdn Bhd. This balloon manufacturer had practiced the flexible demand and manufactured finished good based on customer demand. Variety of finished good is manufactured to meet monthly customer demand and packaging production line is involved to make product become a finished good. Each packaging line has been designed flexibly to packing various type of products. There is no specific product for each packaging workstation. So that, the production line needs to prepare the number of work station and man power required based on the type of packaging requested by the customer demand. The setup time of each type of packaging is different. Every week all the leaders at packaging line will have a list of products that are required by the custiners which is called as a planner. The planner will come along with the specification of each type of packaging for example the order of balloon colour, the quantity of each colour of balloon, the size of pick up, inner, outer and box packaging and so on. Operator have problem during setup time to ensure all planner information is correct. The setup time of each packaging line is averagely 15 minutes, each operator need to reconfirm the balloon colour, balloon size, balloon shape, quantity and type of packaging they are required.

Each operator or worker need to work for four days normal working hour and two days over time working hour per week. Total of working day is six days per week which have two shifts, shift A (11.00am to 11.00pm) and shift B (11.00pm to 11.00am). Packaging department is managed by a manager, supervised by a supervisor and few number of leaders to guide operators perform their works. Sometimes, they have a back stock which is uncompleted packaging task based on the expected time in the planner. Back stock is a unfinished product packaging within allocated time. This is due to several problem such as long cycle time at a certain work station and non-value added activities. Then it will produce a lot of work-in-progress and idle time to the next work station. Packaging line need to cover back unfinished packaging products by allocating few hours extra which is originally allocated for another product packaging task. So that, the company need to allocate extra cost for the operator salary and utilities using for during over time session.

Figure 1.3: Clipping operator need to walk and manually take WIP from inner pack workstation and bring it to his workstation.

Figure 1.3 shows that circled operator need to walk to workstation 1 to take the WIP and come back to his position which is workstation 2 before he can start clipping inner pack balloon job.

Figure 1.4: Sealing operator need to take his WIP manually from previous workstation.

Figure 1.4 shows that circled operator need to take his WIP from opposite workstation by passing a WIP box for refilling WIP before he can start inner pack sealing job.