UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OPTIMIZING OPERATOR CYCLE TIME IN A SEMICONDUCTOR COMPANY

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

by

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APPROVAL

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

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(Project Supervisor)

ABSTRAK

Kecekapan dalam penggunaan sumber dan strategi pembuatan yang baik adalah penting untuk bersaing dan meningkatkan keuntungan. Keberkesanan penggunaan masa bagi pekerja dalam melaksanakan sebarang tugasan dapat memberi manfaat kepada pengilang. Projek penyelidikan ini dijalankan di sebuah kilang semikonduktor yang terletak di negeri Melaka. Pada ketika ini, „non-value added (NVA) activities" yang didapati di operasi „Front of Line" telah memberi kesan kepada masa kitaran pekerja. Kilang tersebut ingin menambahbaikan masa kitaran pekerja dengan mengurangkan „NVA activities". Tujuan projek penyelidikan ini adalah untuk menambahbaikan masa kitaran pekerja dengan mengurangkan pembaziran yang disebabkan oleh „NVA activities" di bahagian pengeluaran. Projek ini akan fokus kepada operasi „Front of Line" dimana proses tersebut adalah seperti ikatan mati, ikatan wayar dan „FAV (Auto Vision)". Kajian masa dengan menggunakan jam randik akan digunakan untuk mendapatkan masa pekerja kepada ketiga-tiga proses dan didapati proses ikatan mati mengambil masa kitaran pekerja yang paling banyak. „Value added dan NVA activities" akan dikenalpasti terhadap proses ikatan mati dengan menggunakan kaedah Lean dan MUDA. Alat bersesuaian seperti carta pie, „Ishikawa diagram" dan „Pareto Chart" akan digunakan untuk menganalisis „NVA activities". Cadangan penambahbaikan akan diberi untuk membuang dan mengurangkan masa terhadap „NVA activities". Kajian terhadap masa dengan menggunakan jam randik akan diulangi untuk mengukur perubahan selepas pelaksanaan penambahbaikan yang dijalankan. Daripada keputusan yang didapati, masa kitaran pekerja telah menurun sebanyak 9.70% selepas penambahbaikan. Kini, pekerja ada masa yang berlebihan untuk fokus kepada aktiviti produktif.

ABSTRACT

Proper use of resources and good manufacturing strategy are important to stay competitive and to increase profit. Effective use of time for direct labors to perform any type of work will benefit the manufacturer. This study was conducted at a semiconductor company located at Melaka. At present, non-value added (NVA) activities in Front of Line operation have significantly lengthen the operator cycle time. The company wants to reduce the efforts for unnecessary activities and free up some time to focus on value added activities. The aim of this study is to improve operator cycle time by minimizing time wastages caused by NVA activities in production floor. The processes in Front of Line operation are die bonding process, wire bonding process and FAV (Auto Vision) process. Stopwatch time study were conducted to obtain the operator cycle times and it was found that die bonding process contributed to the longest operator cycle time. Value added and NVA activities were identified for the die bonding process based on Lean philosophy and MUDA approach. Appropriate tools such as Pie Chart, Ishikawa diagram and Pareto Chart were used to further analyze the NVA activities. Some suggestions were proposed to the case company in order to eliminate or reduce the time taken on these NVA activities. Stopwatch time study was conducted again to evaluate the effectiveness of the proposed improvement. From the result obtained, operator cycle time in die bonding process has improved by 9.70% after implementation of the proposal. Operators are now having extra time to focus on more productive activities.

DEDICATION

This thesis is dedicated to my beloved family and friends.

Thank you for the endless support and love to me.

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I would like to take this opportunity to express my deepest gratitude and thanks to my supervisor, Associate Professor Dr Chong Kuan Eng. I am very fortunate to be blessed with the guidance and encouragement from him. He is willing to share his knowledge, explain details to me and always keep me on the correct path whenever I look for him.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

BE	-	Backend Operation
FAV	-	Front of Line Auto Vision
FE	-	Frontend Operation
FYP 1	-	Final Year Project 1
FYP 2	-	Final Year Project 2
MUDA	-	Wastes
NVA	-	Non Value Added
PC	-	Process Control
SPC	-	Statistical Process Control
VA	-	Value Added

CHAPTER 1
INTRODUCTION

This chapter explains the background of study, background of case company, details of problem statement, objectives of the study, scope, expected outcome and organization of the entire report.

1.1 Background of Study

This study is to analyze and optimize operator cycle time based on real case study in a semiconductor factory located at Malacca. In recent years, manufacturing industries in Malaysia grow rapidly and play an important role in country‟s economy. As stated from Altius Directory (2014), Malaysia is ranked in the 23rd position among the world countries in term of manufacturing industry. Apart from that, it is stated that major manufacturing industry in Malaysia are furniture industries, semiconductor industries and food processing industries. It was estimated that about 48.1% of Malaysia‟s GDP is contributed from manufacturing industry sector.

According to Modi and Thakkar (2014), to survive in a competitive and challenging market, industries need to improve their strength and concentrate on their process flow. Lean manufacturing is the solution to increase the manufacturing profit and quality. Idea of Lean manufacturing is to remove waste from manufacturing process. Waste or non value added activities refer to any activities that consuming more resources than necessary to produce the goods. Company need to identify and eliminate various types of wastes from the manufacturing process to move toward leaner operation. Skills and knowledge on manufacturing engineering are used to

conduct this study. For instance, appropriate methods, tools and techniques such as Lean manufacturing concept and stopwatch time study will be applied to solve the problem.

1.2 Background of Case Company

The case company is a German semiconductor manufacturer founded on 1999. As of 30 September 2013, the company has 26,725 employees worldwide. It is one of the biggest and well-known multinational semiconductor companies in worldwide. There are two factories located in Malaysia, one is at Kulim, Kedah and the other one is at Batu Berendam, Malacca. For Kulim factory, it is focuses on Frontend operation (FE) whereas for Batu Berendam factory, it is focuses on Backend operation (BE). Mainly, Frontend is the front portion of semiconductor supply chain for wafer fabrication. Backend is back portion of a semiconductor supply chain for assembly and test facilities. A backend manufacturing process comprises of wafer mounting, wafer sawing, die bonding, wire bonding, molding, marking and testing process.

Today, factory in Malacca sites has become one of the largest manufacturing sites of case company with the cumulative investment of EUR 1.0 billion. At present, this manufacturing site committed workforce of 7000 employees. In addition, there are four segments in this factory which are Discrete, Logic, Power and Sensor. Each of the segments comprises different packages of products. Therefore, each of the segments has their own specified production line. Examples of products manufactured by this factory are chip card and security, automotive products, industrial power control, mobile devices, power supply and so on. The products from the case company are able to stand out for their reliability, excellence quality and their innovative.

The company‟s products are exported globally through its distribution centers in United States, Europe as well as Asia region. The millions of semiconductor devices produced hourly lead to an annual export volume of over RM 3 billion. Thus, this company is contributing to Malaysia‟s trade balance and economic growth in the

state of Malacca. Besides, the company dedicated to the highest product quality providing exacting solutions to application requirements, increasing efficiency and productivity with unpromising adherence to deliver schedules and protect the environments. The company is looking forward to Zero Defects, continuous improvement and implements the Zero Defects strategy to the next level.

1.3 Problem Statement

Operators and machines are the 2 important resources in production line. Effective use of operators is important in manufacturing field for good return of investment. Based on the brainstorming session with company manager, wastes or non-value added (NVA) activities in Front of Line operation have significantly lengthen the operator cycle time. The Front of Line operation includes die bonding, wire bonding and auto vision process. The company does have a standard procedure to measure, track and analysis operators‟ performance. From the result, company believes that there are some improvements that can be made from operators‟ daily operation.

Eventually, company would like to improve operator cycle time by reducing the amount of time and effort for unnecessary activities. Company wants to free up some time to focus on value added activities.

1.4 Objectives

The main aim of the study is to improve operator cycle time in a semiconductor company. The specific purposes of this study are:

i. To conduct stopwatch time study on operators in Front of Line operation.
ii. To identify process with longest operator cycle time and the associated NVA activities.
iii. To propose and implement new procedures to minimize NVA activities.

1.5 Scope

Since the case company produces a lot of products therefore only one production line was selected in this study. Study covered only for Power Segment, X module and Front of Line operation. Only one package family was studied under X module. This package family consists of several package classes where the highest demand of package class was selected. The study covered only for Front of Line operation where processes included are die bonding, wire bonding and FAV (Auto Vision). Operators‟ activities, movement and time taken for each sub activities will be the main issue to concern throughout the study. Throughput for each machines and operators‟ movement with any unexpected situation such as no material and machines breakdown were excluded in this study.

1.6 Benefits to the Case Company

Key benefit of the study is to improve the operator cycle time in production line. This study helps manufacturer to identify NVA activities for operators in Front of Line operation. It helps to identify the operators‟ activities in production line and minimize the waste occurred at every production steps. In other words, it helps operators to focus more on productive activities as any non-value added activities will be minimized. Apart from this, this study can reduce operator fatigue and workload as any unnecessary activities will be eliminated. Better understanding of work performed by operators in production line helps to develop a better and effective working procedure in manufacturing process. This will help to improve overall performance of the production line. With a better performance, it helps to reduce the overall cost, increase the productivity as well as higher profit gain in future.

1.7 Organization

This report is included into six chapters. Chapter 1 is the research overview which is the introduction of this study. Chapter 2 provides the literature review where appropriate past research, journals and articles related to this study will be presented. Chapter 3 describes the methods, tools and techniques used to collect and analysis the data. In addition, Chapter 4 presents the process description, data collection and data analysis where it will explain the processes, data and details analysis of the results. Chapter 5 provides suggestions and implementation for operator cycle time improvement where improved data will be collected again and compared to the previous result obtained. Lastly, Chapter 6 includes the discussion of conclusion, major findings and future recommendations for this study.

CHAPTER 2
LITERATURE REVIEW

This chapter review past studies, books and journals to explain manufacturing operation, direct labor, productivity, Lean principles, Lean tools and techniques, work study and work measurement. Purpose of this review is to identify the related theories and applications in previous research. Furthermore, a flow chart is constructed to visualize the overview of literature review.

2.1 Manufacturing Operation

Manufacturing operations produce tangible product, physical goods which can be seen and held (Matthew, n.d.). Stevenson (2009) stated that manufacturing operations is that part of a business organization that is responsible for manufacturing goods. The creation of goods comprises transforming inputs to outputs. Examples of inputs are machines, labor, raw material and capital investment. According to Vitez and Osborne (2014), many companies use manufacturing operations to manufacture goods for customers. They claim that three critical parts of manufacturing operation are direct labor, direct material and overhead which include all the insignificant costs related with the manufacturing process. In addition to the general overviews, a good manufacturing operation able to improve competitiveness, profitability, reduce resources requirements and maximize the throughput. Expertise in manufacturing industry such as production director, factory manager, and industrial engineer always work hard to look for any possible improvement. Figure 2.1 shows the overview of literature review.

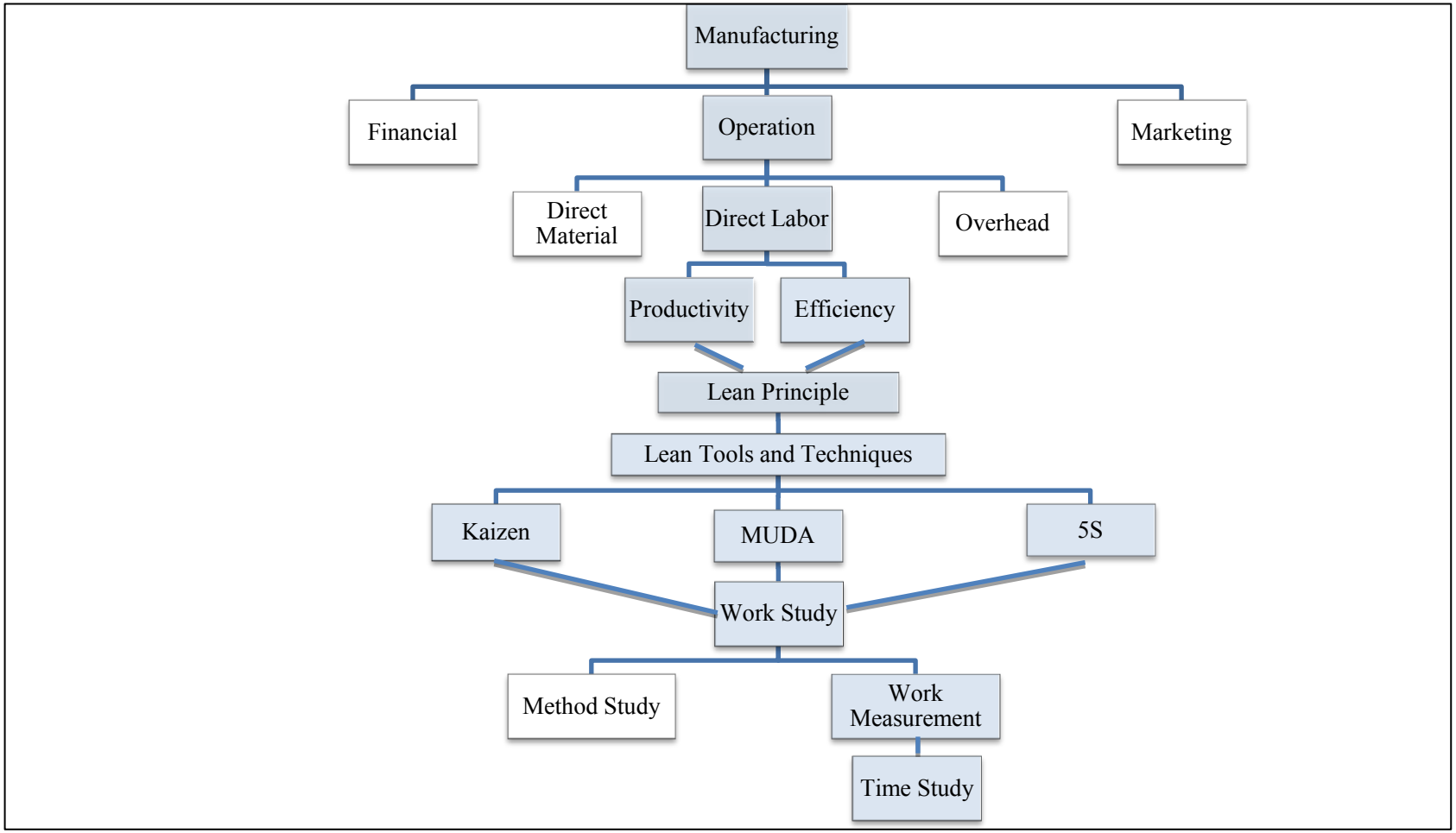

Figure 2.1: Overview of literature review

2.1.1 Direct and Indirect Labor

Direct labor is any type of work that is related to the production of goods. Activities of direct labors are involves with the actual process such as operating machine, getting raw materials from inventory, loading and unloading raw materials. Carreira (2007) stated that direct labor is someone who builds the product and directly involved in manufacturing process. In contrast, indirect labor is the work of those who indirectly produce goods but directly support the value added people. A shift supervisor can only be considered as indirect labor since his contribution does not really producing the goods.

2.1.2 Direct and Indirect Material

Direct materials include all the raw materials needed to produce a finished good. For example, a semiconductor manufacturer will require wafer, lead frame, clips and other pieces to make a single chip. Without these parts, company will not produce the goods required by the customers (Vitez and Osborne, 2014). Indirect materials are the materials consumed as a part of process. Examples of indirect materials are lot paper used for documentation, stationary such as glue and tape, and safety equipment such as finger coat and jump suit.

2.1.3 Overhead

Overhead or known as manufacturing overhead cost involves the costs that are incurred as part of the manufacturing process. Overhead cost excludes direct labor cost and direct material cost which typically used in the manufacturing process. In other words, manufacturing overhead cost is concerned with the expenses of indirect cost but still related with the production (Vitez and Osborne, 2014). Factory facilities, utilities bill and maintenance fees are considered as part of the overhead cost.

2.2 Productivity

Baines (1997) believed that the productivity movement has been around for more than 50 years. There are plenty of techniques, methodologies and productivity strategies have been developed so far. However, he claimed that the pursuit of improved productivity still seems an imperfect science. Sahar *et al.* (2013) defined that productivity is the ability of an organization or country to create greater income or value added. In addition, Sahar *et al.* (2013) also described that Malaysia is taking rigorous step to become an advanced country with high income status by 2020. Therefore, it is essential to have a high productivity in the production process.

The term „productivity" means different things to different people how people look from different angles. This term is interpreted differently by different organizations and in different countries (Baines, 1997). In general, productivity is defined as ratio of output to input, where "output" refers to anything that created from a production or service. In manufacturing perspective, "output" usually refers to finished good. "Input" can be a labor, machine, factory, materials and etc. in converting to an "output". Today's productivity improvement has becomes the approaches to enhance the productivity index. Figure 2.2 shows the conversion of inputs to output.

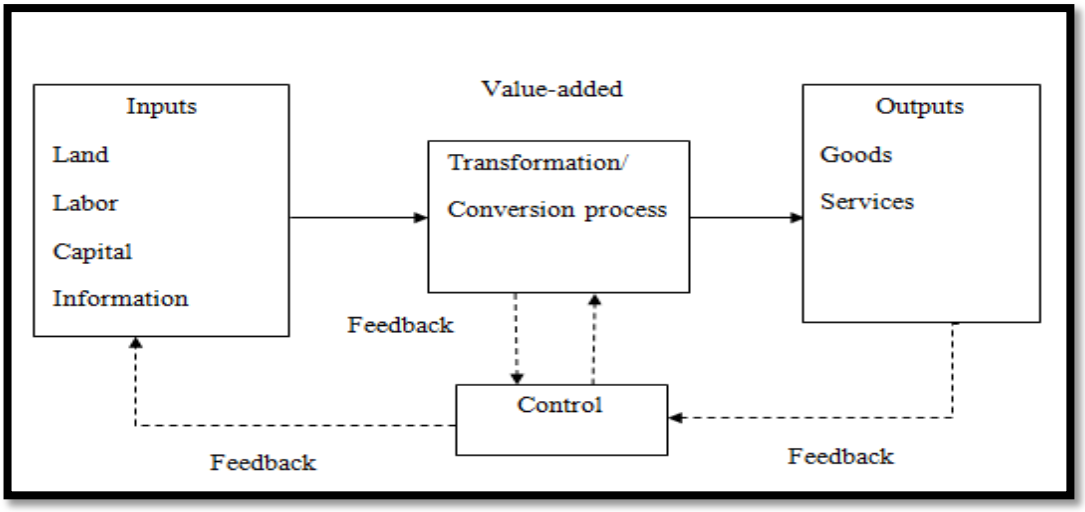

Figure 2.2: Manufacturing operation in the conversion of inputs into output (Stevenson, 2009)