

**LAYOUT OPTIMIZATION AND MANNING RATIO
IMPROVEMENT**

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LAYOUT OPTIMIZATION AND MANNING RATIO IMPROVEMENT

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A project report submitted in partial fulfillment
of the requirements for the award of the degree of
Master of Engineering (Industrial)

FACULTY OF MECHANICAL ENGINEERING
UNIVERSITI TEKNOLOGI MALAYSIA

MAY 2010

To my beloved mother and father

ACKNOWLEDGEMENT

Most importantly, I would like to express my greatest gratitude to my supervisor, Assoc. Prof Dr Abd Rahman Abdul Rahim . His professional guidance and support has certainly succeeded in bringing out the best in me during the completion of this project.

I would also like to thank the Industrial Engineering panel of the Faculty of Mechanical Engineering, Universiti Teknologi Malaysia for the fullest co-operation in providing the necessary resources in completing this project. My special thanks goes to Prof Dr. Sha'ri bin Mohd. Yusof and Assoc . Prof Dr. Masine binti Md. Tap for being the coordinators of the offshore Masters in IE program in Penang.

Last but not least, I would like to thank my beloved parents, Yeong Soon Wooi and Lau Lai Chee for being the cheerleaders in my life. Not forgetting too are colleagues of mine who have always been my source of encouragement. Thanks to all of you.

ABSTRACT

The objective of this study is to design a new layout for space optimization and improve manning ratio . An ergonomic new peripheral for IC bonding machine s is also designed to obtain space savings. The study is limited to the IC bonding process of one product on a single production floor of the factory with sampling done on one module containing two rows of machines. The study is divided into 3 major components which is layout optimization, manning ratio improvement and new peripheral design. Layout and peripheral design is mostly done using AUTOCAD and work sampling methods is used widely in data collection of manning ratio. Data validation is done by surveying production floor workers on their feedback during the ‘trial -run’ of the new layout, manning ratio and peripheral design. A semiconductor manufacturer is selected for this case study. Upon completion of this study, additional machines can be fitted into existing space, manning ratio is improved requiring less manpower for more machines and a new peripheral which is space saving and ergonomic is designed. As a result, there is significant cost savings and improved productivity. Finally, the machine capacity gap to meet customer demand is closed.

ABSTRAK

Objektif utama kajian ini adalah untuk menghasilkan susun atur mesin yang baru dengan tujuan untuk mengoptimumkan ruang dan mem pertingkatkan nisbah kerja. Rekabentuk baru yang ergonomik juga akan dihasilkan untuk perkakas bagi tujuan melengkap pengoptimuman ruang. Kajian ini terhad kepada proses *IC bonding* untuk salah satu produk yang diproses di satu tingkat dalam kilang. Sampling dijalankan untuk satu modul yang mengandungi dua baris mesin. Kajian ini dibahagikan kepada 3 komponen utama iaitu optimisasi ruang, peningkatan nisbah kerja dan rekabentuk perkakas baru. Kebanyakan kerja susun atur dan rekabentuk perkakas dijalankan dengan AUTOCAD manakala kaedah work sampling digunakan semasa mengumpul data nisbah kerja. Pengesahan data dijalankan dengan cara temubual dengan pekerja-pekerja kilang untuk mengetahui maklum balas mereka terhadap sesi *trial-run* yang dijalankan dengan susun atur, nisbah kerja dan rekabentuk perkakas yang baru. Sebuah kilang pembuatan semikonduktor dipilih untuk kajian ini. Setelah menghabiskan kajian ini, didapati bahawa lebih mesin boleh dimuatkan dalam ruang yang sedia ada, nisbah kerja dipertingkatkan dan rekabentuk perkakas yang baru dan ergonomik berjaya dihasilkan. Secara kesimpulan, kapasiti mesin berjaya ditambah bagi tujuan memenuhi kehendak pelanggan.

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LIST OF ABBREVIATIONS

ABC	Activity Based Costing
JIT	Just-In-Time
MRP	Material Requirements Planning
OEE	Overall Equipment Effectiveness
PPH	Parts Per Hour
SMED	Single Minute Exchange of Dies
SQFT	Square Feet
VSM	Value Stream Mapping

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter describes the introduction to this project by giving an overview of the importance and focus of the research. An overall picture and broad idea of project framework will be included in this chapter.

1.2 Productivity Improvement

One of the major roles of Industrial Engineering in a factory is to perform space planning according to the expansion plans for new machines to add capacity to the plant. More often than not, the Industrial Engineer can be challenged when there is a limitation to the space on a production floor. Particularly for cases where a certain production floor or area is designated for a specific product, space becomes an issue of greater concern when the product volume expands beyond the designated area.

When there is a mismatch between demand and capacity from the planning systems, it is time for the Industrial Engineer to seek actions needed for productivity improvement to close the capacity gaps in order to meet the demand of customers in a timely manner. By understanding the factors contributing to productivity losses, an Industrial Engineer can then work with the operations and engineering teams to identify the opportunities based on existing problems on the production floor. When space optimization can be obtained through improved layout and manning ratio, these gains can be further achieved with the implementation of an ergonomic and safe working environment.

1.3 Background and Rationale of the Project

To meet the 4Q09 demand, a minimum increase of 5% in production is required to increase machine capacity. Without the machine capacity in-house, the plant may suffer losses as capital and time is required to manufacture the production units at subcontractor plants. If the production units are not manufactured on-time, the company will also risk suffering from loss of goodwill and future business. To eliminate these losses, the plant needs to add machine capacity by purchasing new equipment. With the new machines, space and manning capabilities will then become issues of concern.

1.4 Research Problems and Hypothesis

1.4.1 Research Problems

How productivity improvement can be gained through space optimization and manning ratio enhancement by incorporating layout and ergonomics?

1.4.2 Research Questions

1. How can more space be made available to accommodate new machines for increased capacity?
2. How can the same number of production operators be used to man increased number of machines?
3. How can safety and ergonomics be maintained without creating an overcrowded situation?

1.4.3 Research Hypothesis

Layout is identified as one of the opportunities for improvement as this factor becomes a bottleneck when new machines which are purchased for additional capacity have no place due to space constraints. Therefore, layout optimization needs to be performed if productivity improvement is required to close capacity gaps. By laying out machines closer to each other, limited production floor space can be optimized to add more machines.

Besides space optimization, manning ratio improvement is also another factor which can help productivity improvement if the plant intends to use the same number of production operators to man an increased number of machines. The tasks of operators need to be scrutinized to identify areas for improvement and waste to eliminate.

When there are more machines added and compressed on the limited floor space, safety and ergonomics issues arise.

1.5 Justification of Research

This study becomes critical as it forms the basis for management decision after evaluating the possibilities to optimize the space on the production floor by adding new machines. Through space optimization, the management can obtain productivity gains and cost savings. On top of that, manning ratio can also be improved.

1.6 Methodology

The study will be divided into 3 phases which is layout implementation, manning ratio improvement and peripheral design to achieve the desired productivity improvement. Data collection, analysis and validation are performed in all 3 phases using selected methodology. The slanted layout method is used to optimize the layout. To improve manning ratio, time studies is conducted. New peripheral design is done to complement the layout optimization efforts.

1.7 Research Objectives

This study is done with the objective of gaining productivity improvement in a semiconductor manufacturing facility through layout optimization and manning ratio improvement. Productivity improvement must be gained without neglecting the ergonomics and safety aspects of the working environment on the production floor.

1.8 Scope and Key Assumptions

This study is limited to a specific process of one product on a single production floor of the factory. The focus of this study is not linked to other processes related to this product. A sample of one module containing 2 rows of machines will be used to represent the entire process area on this production floor. Cost evaluation will not be included in this study.

1.9 Definition of Terms

The following terms will be used to explain the case study done in the project.

ABC. Activity Based Costing, a method which models the relationships between products and the resources used in their production at all stages.

Balanced Plant. A plant where capacity of all resources are balanced exactly with market demand.

Bottleneck. Any resource whose capacity is equal to, or less than the demand placed on it.

JIT. Just-In-Time manufacturing. A “pull” approach where a work center finishes its operations and then requests the next job from the preceding work center.

JIT-Kaizen. Facilitated small group activities to address problems with quality, cost and delivery (QCD). Also known as process flow study.

Kaizen. Facilitated small group activities to address problems with quality, cost and delivery (QCD).

MRP. Material Requirements Planning. A ‘push’ system which schedules the jobs in advance for a series of work centers and each work center pushes its completed jobs to the succeeding work centers.

Non-Value Added. Activities or actions taken that add no real value to the product or service, making such activities or action a form of waste.

OEE. Overall equipment effectiveness.

Operations. Work or steps taken to transform material to finished product.

Problem Solving. Facilitated small group activities to address problems using a structured format (PDCA) with a formal close-off for outcomes.

Process. The flow of material in time and space. The accumulation of sub-processes, or operations that transform material from raw material to finished products.

PPH. A metric that indicates the amount of parts produced within one hour. PPH is a good indicator of process efficiency.

Quality. Meeting expectation and requirements, stated and un-stated, of the customer.

Resource Utilization. Using a resource in a way that increases throughput

Standard Work. Specifying tasks to the best way to get the job done in the amount of time available while ensuring the job is done right the first time, every time.

Standard Operations. The documented most efficient, safe method of completing a task in the required time.

SMED. (Single Minute Exchange of Dies). A technique to reduce the time taken to change any process from the last good part of the last product to the first good part of the new product.

Sub-Processes. A series of operations combined. part of a process

Task. A task means one or more elements that constitute a distinct activity that is a logical and necessary step in the performance of work by an employee. Tasks are the smallest elements of work job evaluation should address.

Throughput. The rate the system generates money through sales.

Value Added. Activities or actions taken that add real value to the product or service.

Visible Management. Clear (to the eye) control of the workplace with regards to output and inputs without having to ask questions to determine the status.

VSM. Value Stream Mapping, a time-based study of an entire process to establish the ratio of value-adding time to non-value-added time.

Waste. Anything that uses resources, but does not add real value to the product or service.

Yield. Produced product related to scheduled product

1.10 Research Contributions

At the end of the project, a feasible solution in terms of machine layout with improved manning ratio and space optimization through new peripheral design is anticipated to gain the required productivity to close the capacity gaps to meet customer demands. Key deliverables throughout the project are completion of an optimized layout design, new manning ratio plan and new peripheral design.

1.11 Outline of the Report

The project is divided into 6 main chapters. The report starts with Chapter 1 - Introduction which provides an overall picture and framework of the project. Chapter 2 - Literature Review discusses the journals, books and articles which relates to the theoretical background of this project. Methods applied in areas of data collection, analysis and validation are further discussed in Chapter 3. Chapters 4 and 5 contain the core of the research where details of data collection, analysis and problem identification, proposed solutions for each problem and validation are elaborated. Chapter 6 wraps up the project with conclusion and discussion of research implication, contribution, limitation and proposal of future works.

An overview of the entire project by chapter breakdown is shown in the Figure 1.1.

<u>Item</u>	<u>Description</u>	<u>Details</u>
Chapter 1	Introduction	Overall picture and framework of project
Chapter 2	Literature Review	Theoretical background to project
Chapter 3	Methodology	Discussion of methods employed in research
Chapter 4	Data Collection & Analysis	Data collection & analysis and problem identification
Chapter 5	Proposed Solutions & Analysis	Proposed solutions for each problem & Validation
Chapter 6	Conclusion & Future Works	Conclusion, research implication & contribution, limitation and future works

Figure 1.1 Report outline

1.12 Conclusion

This chapter has described the overview and the key objectives of the project. The background and rationale to complete the project has been outlined with statement of research problems. The objectives of the project are further explained with justifications and understanding of how the project can contribute to the company. The project scope, key assumptions and the most commonly used terms are described.