

ASSESSMENT OF GRINDING MACHINE PERFORMANCE IN SUBSTRATE
HARD DISC DRIVE INDUSTRY

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DEDICATION

To my beloved mom and dad for their endless supports and to my beloved wife for her love, wisdom and the determination to succeed that she instilled to me.

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I would also like to convey my gratitude to my colleagues and friends from Universiti Teknologi Malaysia and Seagate International Johor Sdn Bhd who assisted me throughout the production of this thesis. Their view and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am also grateful to all my family members.

ABSTRACT

This cross-sectional study investigated the reciprocal relationship between productivity, capabilities and quality towards performance of grinding machine within a model which draws on the performance theory. Specifically, this study also examined the selection factor in productivity, capabilities, quality and performance of grinding machine based on employee's position and experiences. This study utilized a probability sampling method in the forms of simple random sampling. The questionnaires were personally administered and collected from 146 employees working in one of the substrate hard disc plant (Seagate Technology, Johor). Secondary data was used to support the research result. Factor analysis has confirmed the appropriateness of the aggregation of the questionnaire items in each variable and the values of Cronbach alpha indicated that all the measures are reliable. The data analysis was used SPSS/PASW version 24. Statistical analysis techniques used in order to achieve objective of research are descriptive analysis, different test including t-test and ANOVA, the multiple regression analysis method. Based on different test, workers who had more than 20 years working experiences and non-executive staffs were more satisfied with productivity, quality, capabilities and performance of machine. From a practical data analysis perspective, the results from the current study indicated that productivity was significantly related to the performance of grinding machine. Among six items in productivity, it can be seen that machine should have emergency button system that easy to push during emergency case is the most important criteria in determining the performance of machine. The result indicated that there is significant associated between capabilities and performance. The main item which mostly contributed performance of machine is can be handling with 1 operator/3 machines or equipment simultaneous. Next, there is exists relationship between quality of operation with performance and the main items in quality criteria contributed is the specification machine can come out with better product quality up to 80 percent performance yield. Secondary recorded that yield performance of machine was lies between 99.38 percent until 99.60 percent. The percentage of handling defects was low; less than 1 percent (range between 0.072 to 0.085 percent). Overall, the main factor influenced performance of machine is capabilities factor.

ABSTRAK

Kajian keratan rentas menyiasat hubungan atau kesan antara produktiviti, keupayaan dan kualiti terhadap prestasi pengisaran mesin mengikut teori prestasi mesin. Secara khususnya, kajian ini juga mengkaji faktor pemilihan yang merangkumi produktiviti, keupayaan, kualiti dan prestasi mesin pengisaran berdasarkan kedudukan dan pengalaman pekerja. Kajian ini menggunakan kaedah persampelan kebarangkalian dalam bentuk persampelan rawak mudah. Soal selidik peribadi ditadbir dan dipungut daripada 146 pekerja yang bekerja di salah sebuah kilang cakera keras substrat (Seagate Technology, Johor). Data sekunder telah digunakan untuk menyokong hasil dapatan penyelidikan ini. Analisis faktor telah mengesahkan kesesuaian pengagregatan item soal selidik dalam setiap pembolehubah dan nilai-nilai Cronbach alpha menunjukkan bahawa instrumen kajian boleh dipercayai dan sah digunakan. Analisis data menggunakan perisian SPSS / PASW versi 24. Teknik statistik analisis yang digunakan untuk mencapai objektif penyelidikan adalah analisis deskriptif, ujian yang berbeza termasuk ujian-t dan ANOVA, kaedah analisis regresi berganda yang dapat menentukan faktor yang mempengaruhi prestasi mesin. Berdasarkan ujian perbezaan, pekerja yang mempunyai pengalaman lebih daripada 20 tahun dan kakitangan bukan eksekutif lebih berpuas hati dengan produktiviti, kualiti, keupayaan dan prestasi mesin. Dari perspektif analisis, hasil daripada kajian semasa menunjukkan bahawa produktiviti adalah signifikan terhadap prestasi mesin pengisaran. Antara enam perkara dalam produktiviti, dapat dilihat mesin yang mempunyai sistem butang kecemasan yang mudah untuk menghindari permasalahan semasa kes kecemasan adalah kriteria yang paling penting dalam menentukan prestasi mesin. Hasil kajian juga menunjukkan bahawa keupayaan mempunyai hubungan terhadap prestasi mesin dan item terpenting dalam keupayaan adalah kemampuan mengendalikan dengan 1 operator untuk 3 mesin atau peralatan secara serentak. Seterusnya, wujud hubungan yang signifikan antara kualiti operasi dengan prestasi dan perkara utama dalam kriteria kualiti yang menyumbang prestasi mesin adalah ciri-ciri pengeluaran produk yang lebih baik sehingga 80 peratus hasil prestasi. Dapatan disokong oleh data sekunder yang menyatakan prestasi mesin adalah terletak di antara 99.38 peratus hingga 99.60 peratus penghasilan. Peratusan pengendalian kecacatan juga adalah rendah iaitu kurang daripada 1 peratus (julat

antara 0,072-0,085 peratus). Secara keseluruhannya, faktor utama yang mempengaruhi prestasi mesin adalah faktor keupayaan mesin.

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LIST OF ABBREVIATIONS

GDP	-	Gross Domestic Product
HDD	-	Hard Disc Drive
AOI	-	Automated Optical Inspection
OTR	-	Oliver Twin Rail
RTY	-	Raw Throughput Yield
RND	-	Research And Development
OEE	-	Overall Equipment Efficiency
ILT	-	Inliness Thickness Measurement
RTA	-	Return To Alum
SME	-	Subject Matter Expert
SPSS	-	Statistical Package for the Social Sciences

LIST OF APPENDICES

APPENDIX	TITLE
A	Statistical Analysis Raw Data
B	Questionnaire Sheet

CHAPTER 1

INTRODUCTION AND BACKGROUND OF STUDY

1.1 Introduction

The quality and economy of grinding machine and wash machine be contingent on suitable selection criteria of conditions for the materials to be ground working. In order to evaluate the effect of performance of machine in manufacturing fields, most of management considered the machine criteria including heavy-duty grinding, a new performance index, specific material removal rate, size accuracy, and grinding forces . According Khoie et. al (2010), basically, manufacturing industry assess the performance of machine based on operation and production productivity, machine capability and quality. Cheng (2009) mentioned that the quality of grinding machine and OTR wash machine examined by operation, process and specification of its. The evaluation of grinding machine is more on manufacturing process of great importance in contemporary industry. A lot of research pertaining to grinding and is performed through modeling and simulation instead of experimental investigation. Thus, it is important to investigate the characteristics of machine performance in order to gain the mission and vision of company. This chapter presents a broad overview of the current study. More precisely, the following topics are covered in this chapter; introduction, background of the study, problem statement, purpose of

research, research objectives, research questions, significance of the study, scope and limitation, structure of the study and summary of the chapter.

1.2 Background of the Study

Nowadays, in the fast changing and competitive global manufacturing industry has undergone dramatic changes due to significant and challenges in manufacturing sector. Even though there is a steady improvement in manufacturing productivity and it's still have a room for improvement for the global manufacturing sector. In fact, manufacturing is the all-industry leader in the rate of productivity improvement over the last 20 years. To remain globally competitive, the manufacturing industry fundamentally transformed itself through rapidly improving technology, implementation of lean manufacturing principles, multi-skilling, and innovative production process improvement techniques. This transformation, has led to a new manufacturing paradigm requiring fewer workers but higher skills for those remaining and high tech machinery. The result - even as overall employment in the manufacturing industry has declined, many employers report difficulty finding and hiring the highly-skilled employees they need to suit the high tech machinery and technology. In a recent study (McKinsey Global Institute McKinsey Operation Practice, November 2012), 80% of manufacturers stated a need for workers in one or more skill areas and high tech machinery to get the fast productivity and quality concurrently with the global demand.



Figure 1.1 Labour and Ratio Productivity per hour

Source: ECB calculations based on data from the Groningen Growth and Development Centre and the Conference Board, Total Economy Database, May 2006, <http://www.ggd.net>, and the US Bureau of Labor Statistics

The Gross Domestic Product (GDP) in Malaysia expanded 5.10 percent in the fourth quarter of 2013 over the same quarter of the previous year. GDP Annual Growth Rate in Malaysia is reported by the Department of Statistics Malaysia. GDP Annual Growth Rate in Malaysia averaged 4.65 Percent from 2000 until 2013, reaching an all time high of 10.30 Percent in the first quarter of 2010 and a record low of -6.20 Percent in the first quarter of 2009. Although the largest sector of the economy is services, manufacturing sector still remain important as it has been growing in recent years and accounting for a 35 percent of GDP.

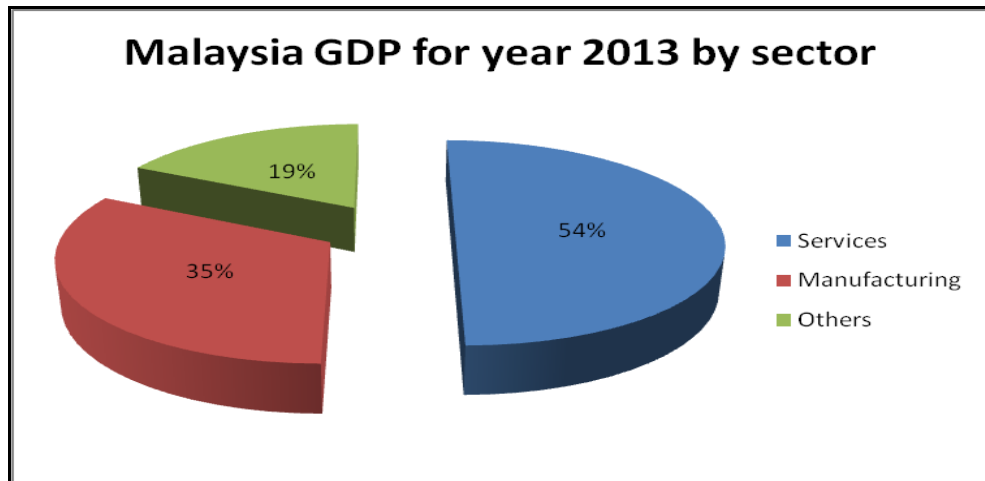


Figure 1.2, Malaysia GDP for year 2013 by sector

As per current condition, we know the manufacturing industries had been developed and need to be considered as to be emphasized. The Southeast Asian country experienced an economic boom and underwent rapid development during the late 20th century and has GDP per capita of USD 17,200 today, to be considered a newly manufacturing industrialized country. The conclusion can be made, the manufacturing quiet important and fast expanding. Hard disc drive manufacturing also can't be neglected as a fast pace in manufacturing sector.

Historically, manufacturing has a large influence in the country's economy. Since it became independent in 1957, Malaysia's economic performance has been one of Asia's best. Real gross domestic product (GDP) grew by an average of 6.5% per year from 1957 to 2005. Performance peaked in the early 1980s through the mid-1990s, as the economy experienced sustained rapid growth averaging almost 8% annually. High levels of foreign and domestic private investment played a significant role as the economy diversified and modernized. Malaysia today is a middle-income country with a multi-sector economy based on services and mainly in manufacturing. Malaysia is one of the world's largest exporters of semiconductor components and devices, electrical goods, solar panels, and information and communication technology products. Manufacturing is an important sector in Malaysia. Besides agriculture, Malaysian manufacturing sector is also labor intensive and is considered a high yield investment opportunity. The country's economic development driven by export orientated manufacturing sector makes Malaysia a top choice for foreigners to invest in the industry. The Hard disc drive products have been one of the largest

traded items for Malaysia for several decades since the industry inception in the 1970s. According to Trend focus global, the data storage industry specialist research house, the global shipment of HDD is very convincing from 565.85mil units to 579.76mil units in 2012.

One of the challenges to maintain the manufacturing industry is to sustain the condition. In manufacturing hard disc drive industry also can't be neglected. If the manufacturer mistake or some wrong decision to manage and handle machine equipment for the industry, it does will be a great massive impact to the hard disc drive industry to maintain and sustain in the global market. If that situation happens, it does will be directly impact to Malaysia GDP and manufacturing economic sector.

The electronics industry including hard disc sector is one of the leading sector in Malaysia's manufacturing industry, contributing significantly to the country's manufacturing output (29.3 per cent), exports (55.9 per cent) and employment (28.8 per cent). The Electronics including hard disc drive industry contributing 24.5 per cent to the manufacturing sector in the Malaysia's Gross Domestic Product (GDP). (*Malaysian-German Chamber of Commerce (MGCM), Market Watch, 2009-Electronics Industry*)

In Malaysia especially in Johor State, Substrate hard disc drive industry is only located at Taman Teknologi Johor in Skudai Territory. This Substrate hard disc drive manufacturing industry was facing a lot of challenges and opportunities around 2008 due to impacted with economical global down turn. The basic challenge was to continue to improve their financial performance with an increased focus on growth without sacrificed profitability. Although improving profitability was hard to implement, most of substrate hard disc drive industry struggle to driving lower cost, reduce assets or increase asset utilization, and increase sales. Equipment including production machinery also been affected and needs maximization on production machinery equipment as meet the high ability on producing the output, lower price on production machinery including the spare part for the production machinery and give high yield and quality. Based on common Substrate hard disc industry in Johor (Malaysia) process flow determine as below.

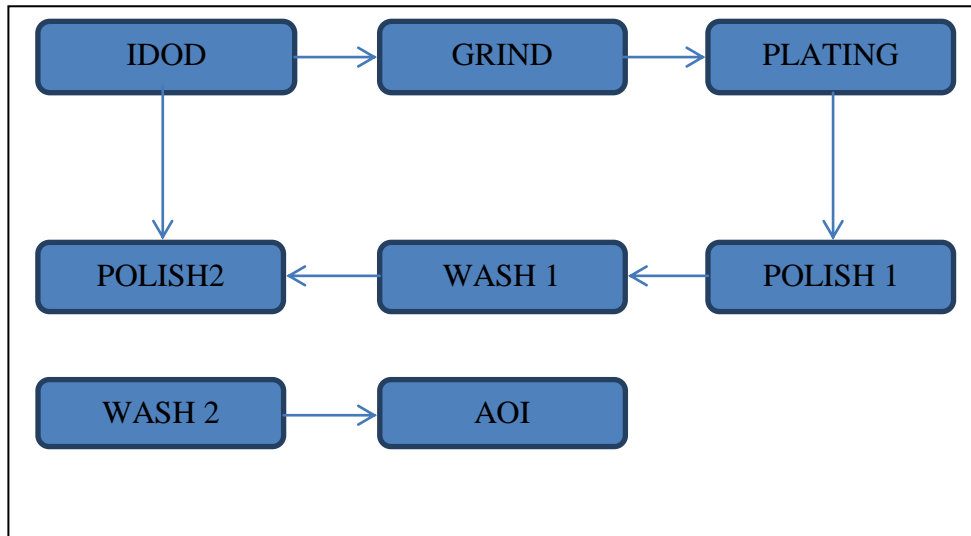


Figure 1.3 Substrate process flow chart

The challenges going forward are how to grow the Substrate hard disc industry machinery and equipment in a period of increasing competitive pressure among hard disc industry. An equipment purchasing decision impacts the capacity levels of a business (Mong 2011). Oversized equipment selections can be costly in multiple ways including the initial outlay of cash and the subsequent result of having too much capacity. A capital equipment selection decision emphasize the strategic infrastructural factors which is a capacity decision are an important source of competitive advantage. Capital investments have been viewed as decisions (Mong 2011). Capital equipment decisions based on engineering benefit analysis considering productivity factors have deep roots in the industrial community (Sage, 1983; Newnan, 1991)

This study intends to determine the characteristics or criteria machine performance in production line of Substrate hard disc industry manufacturing organization. This research will help management investigate the problems appeared when producing production of company, upgrade the machine system and help decision maker of company to give direction in term of quality manage of machinery and maintenance of equipment technical structural factors in a capital equipment selection decision. The capital equipment decision is made under experimental data collection. The objective for this scenario is to use the performance of equipment to

gain a sustainable competitive advantage. In order to make a study more specific, researcher will zoom into the final objective and focus on performance of machine.

1.3 Problem Statement

One of the key issues to have emerged in Substrate hard disc drive industry is ensuring the performance of machine. Grinding machine is a manufacturing process of great importance in contemporary industry. It is mainly used as a finishing operation, because of its ability to produce high workpiece surface quality. It is also used in bulk removal of material, maintaining at the same time its characteristic to perform precision processing and opening new areas of application in today's industrial practice. However, the energy per unit volume of material being removed from the workpiece during grinding is significant. There are cases always happened effects on machine performance which are failure from workers, defects, quality of machine and failure due to process. Grinding forces are essential for calculating grinding energy, which in turn is almost entirely converted into heat, causing a rise of the workpiece temperature and, therefore, thermal damage. This heat input is responsible for a number of defects in the workpiece like metallurgical alterations, microcracks and residual stresses Hovart (2003). High surface temperatures are connected to these phenomena and may lead to grinding burn. The areas of the workpiece that are affected are described as heat affected zones. The prediction of grinding forces and workpiece temperatures is considered useful for the assessment of the heat affected zones, for avoiding defects on finished products and the optimization of the manufacturing process. Nevertheless, due to machinery problems in manufacturing industry increased the cost production problems.

Many of manufacturing players choose based on a machine capacity and functionality criteria to choose the best performance to produce good product. In as early as 1975, Wild (1975) proposed an equipment selection procedure which involved breaking the decision into quantifiable and non-quantifiable factors that will drive to good decision in buy new equipment or machinery in industry. Most of them, choosing non-quantifiable criteria to justify on maintenance of performance of machine. Wild (1975) considered non-quantifiable factors to include such factors as automation integration capability. Since then others (Sage, 1983; Ancel and Griffiths,

1996; Lefley, 1996) continue to support the position of including infrastructural factors influences performance of machine. Machine capability one of the important criteria or decision making, based on Kalotay (1973) used the choice of machine types priority is capacity expansion under various demand or patterns.

The problem of grinding machine is a crucial issue in heavy-duty grinding. A large depth of cut and fast feed rate will cause a high grinding force. This can lead to many problems, such as size error, grinding chatter, and burn. If the wheel speed increases, grinding force and surface roughness will decrease. Therefore, high wheel speed should benefit grinding efficiency, but the wheel speed is limited by wheel structures and machine capability. Reduced grinding forces would expect components with small size error and superior surface integrity to be produced. In designing grinding fixture, it is vital to know the variation of grinding force and the maximum grinding force. To do this, grinding force models are necessary in order to help improve the fixture structure based on finite element analysis. Majority management of company's faced problems difficulty to know the issues that always happens to disturb the smooth of performance engine. Based on the problem statement, main issue was on problem of company to determining the factors contribute on machine performance accurately.

1.4 Purpose of the Study

This research aims to determine the factors contributes in performance of grinding and OTR wash machine in Substrate hard disc industry using multiple linear regression analysis and concept of quantitative research. Based on this research, manufacturer of hard disc drive industry can easily make this research of study as guidelines for their industry to choose the best and suitable criteria of grinding machine equipment to get more profitability, quality and productivity through purchasing new machinery. To the end of this research, researcher will find how grinding parameters influence the grinding machine performance.

1.5 Research Objective

The objectives of this research are:

- 1) To define the level of performance, capabilities, quality and productivity of machine.
- 2) To examine the best selection criteria of machine according position and experiences of staff.
- 3) To investigate the relationship machine's capabilities, quality and productivity towards performance of machine
- 4) To determine the main criteria contributes to the performance of grinding machine.

1.6 Research Question

Some importance question might be raise from the problem statement above such as

- 1) What is the level of performance, capabilities, quality and productivity of machine?
- 2) What is the best selection criteria of machine according position and experiences of staff?
- 3) Is there any relationships between machine's capabilities, quality, productivity and performance of grinding machine?
- 4) What is the main criteria contributes to the performance of grinding machine?

1.7 Significance of the Study

The research expects to contribute with its implications in theory and practice. Theoretical and practical implications of the work are listed as follows:

The concept of performance of machinery has been around for just over a decade (Serenko, Bontis, Booker, Sadeddin, & Hardie, 2010). Dominating manufacturing production processes, certainly, are so important in dealing with the global competitive edge (Bryant, 2003). This study contributed to the literature of performance of machine including capabilities, quality and accuracy of production in its own manner. Based on the existing literatures, it was found that there is lack of empirical evidence in the literature on machinery performance and engineering tools performance within the local context. This study has filled this gap by conducting a questionnaire survey in one of manufacturing company in Johor. No doubt, performance of machine is a relatively new function and theoretically, this study would possibly extent the stream of literature review on the subject matters concerned. Without this study, it is tough to prove how technology really acts as an enabler for leaders to cascade the machine processes smoothly.

The findings from the study is expected to provide as a guidance for major players such as manufacturer, company and management in hard disc drive industry in choosing the best criteria influenced performance of machine in production line. To equip the managers or engineers in hard disc drive industry to effectively make a decision making based on research because this research is more comprehensive and detail explanation to selects grinding machine in substrate hard disc industry. Since, all criteria identified in organization from suggestion method in this research, it will assists manufacturing management identify problems appeared, stable the quality f machine, avoid failure in process and good handling cost in departments.

It is also hope that this study would be able to provide an improve knowledge and the understanding about decision making in the hard disc drive industry especially in general and context particular in Malaysia. It is expected that this research can be used as a future reference by interest parties that seek to better

understand the problem pertaining to the development of model that is more reliable for future action.

1.8 Scope of study

In general, this research will be focus on criteria influences the performance of grinding machine and OTR wash machine in Johor Hard disc drive producer Seagate Technology (M) Sdn Bhd located in Senai, Johor. This study only covers detail in performance through the use of survey instrument comprised of 3 different parts; productivity, machine capabilities and quality. Questionnaire survey was used and interview staffs in production line of organization. In addition, the result of study will support by RTY (Raw Throughput Yield) historical data compiling and only involve operator that work at grinding department at Seagate JBS Technology to reconfirm decision judgement. Besides that, researcher used 3 months historical data storage and compiling from some others substrate hard disc drive plant.

1.9 Limitation of the Study

The research will be conducted by using quantitative approach in addressing the research problem. There are several numbers of limitation associated, this limitation will be discussed details under Methodology Chapter 3. Here are the some main limitations of the study:

1. Since this study only covers the performance of grinding machine and not coping entire process of substrate hard disc industry and would be the there is not significant impact to all front end to end process and entire product process of the organization.
2. This study only used RTY (Raw Throughput Yield) historical data compiling and only involve operator that work at grinding department at Seagate JBS Technology to reconfirm make decision judgement.

Impact on this, the data taken show on historical data and can be doubt.

3. This study use only for 3 months data storage and compiling from some others substrate plant and limitation to get more than 3 months data due to data can't be traceability issue (Data lost from others manufacturing plant). By considering this factor, it seems that there are some lacks of info in carrying out a good and comprehensive study.
4. This study does not consider in term of overall cost and details cost due to some private and confidential data and its expected will be impact the snapshot of the cost of the machine or the cost purchasing of the machine cannot be shared in this study.

1.10 Organisation of the Thesis

This thesis proposal is organised in three chapters, reflecting how the conceptual and analytical tasks will be carried out. The thesis outline is as shown in Figure 1 below:

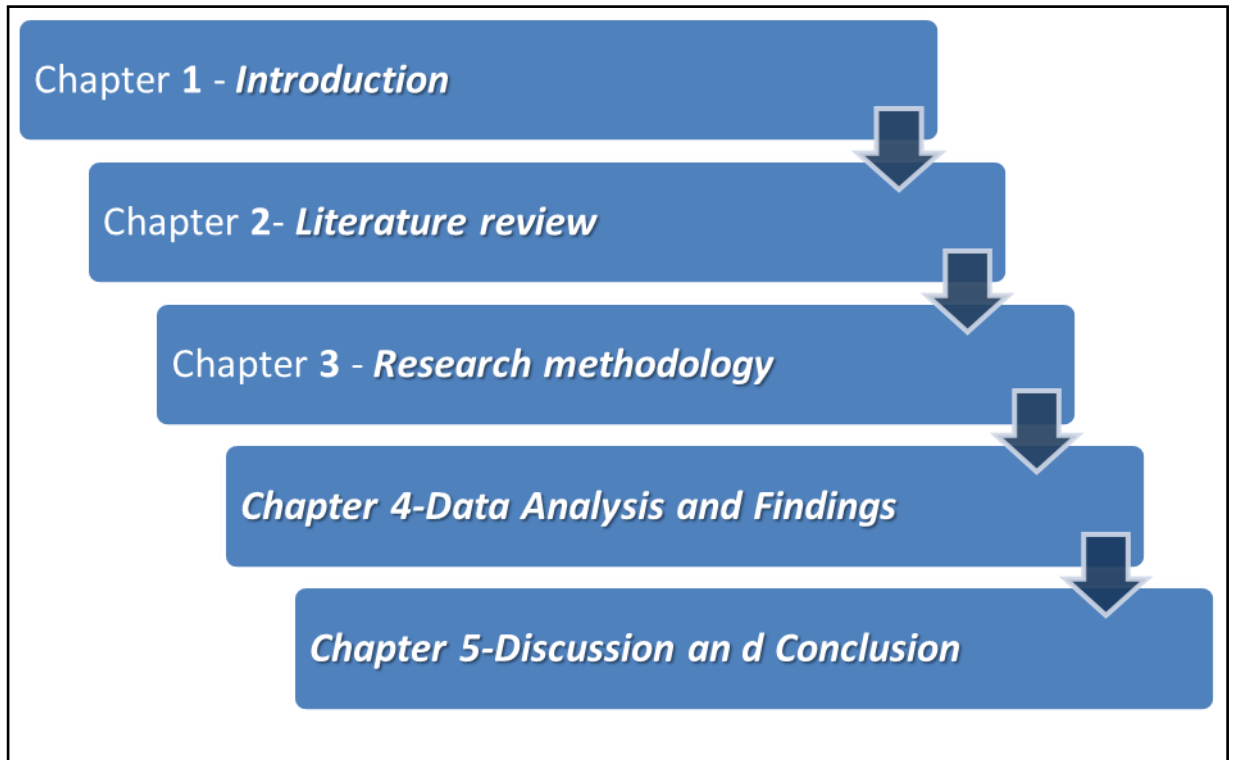


Figure 1.4 Thesis's Chapter

Chapter 1: includes this section, presents the reader a general introduction on background of this study into the subject matter and the specific issues under investigation. It also specified the research questions that lead to the objectives and significant of this study. This chapter also highlighted the scope and structure of the study leading the readers in better understanding and enhances subsequent discussions of the research. The final part on this chapter contents a brief summary of the structure of the thesis.

Chapter 2: extensively reviews the literature and underpinning theories. Such overview is necessary to provide the background on the subject matter for unfamiliar readers and help set boundaries on what will be addressed in this research.

Chapter 3: discusses the arrangement of the questionnaire, population, questionnaire administration and feedback. Explanation is made on the survey as strategy to collect necessary information to validate the findings. The analysis conducted on the data obtained from the main survey and its findings summarized.

Chapter 4: presents the results of this study using multiple and hierarchical regressions to answer the major research questions, and examining the objective of research.

Chapter 5: summarized the research, discusses the results and compare the results to those from previous studies, summarize the major findings of the study, the implications of the results of this study in relation to theory and practice, a description of the limitations, the recommendations for future research and the conclusion.

1.11 Conclusion

As a conclusion, this chapter explains about the identify the criteria and the factors which contributes the performance of machine or equipment in Substrate hard disc industry in deep explanation in details scope into machine specification and buying a new grinding machine use at hard disc drive industry.

Then, this chapter further describes the research objectives as well as the scope by explanation about the importance and the limitation of the research. Next chapter will be continued with the literature review that is related to the issue of decision making and approach in order achieve of performance machine in manufacturing industry.

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