UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS ◆

JUDUL: BENCHMARKING ON MANAGEMENT SYSTEM IN MANUFACTURING COMPANIES IN ESTABLISHING MAINTENANCE AWARENESS

SESI PENGAJIAN: 2008/2009

Saya **MOHD FAISAL BIN CHE YUSOF (860114-14-5161)**
(HURUF BESAR)

mengaku membenarkan tesis (Sarjana Muda / ~~Sarjana / Doktor Falsafah~~)* ini disimpan di perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	**SULIT**	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD**	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi / badan di mana penyelidikan dijalankan)
√	**TIDAK TERHAD**	

Disahkan oleh:

_____ (TANDATANGAN PENULIS)

_____ (TANDATANGAN PENYELIA)

Alamat Tetap:

LOT 2770, TAMAN PULONG,
KUBANG KERIAN, 16150 KOTA BHARU,
KELANTAN

MR LEE GEOK CHUI
(Nama Penyelia)

Tarikh: **10 NOVEMBER 2008**

Tarikh: **10 NOVEMBER 2008**

CATATAN: * Potong yang tidak berkenaan.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

◆ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara Penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).

BENCHMARKING ON MANAGEMENT SYSTEM IN MANUFACTURING COMPANIES IN ESTABLISHING MAINTENANCE AWARENESS

MOHD FAISAL BIN CHE YUSOF

Report submitted in partial fulfilment of the
requirements for the award of the degree of
Bachelor of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2008

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree Bachelor of Mechanical Engineering.

Signature : ……..
Name of Supervisor : MR. LEE GEOK CHUI
Position :
Date :

Signature : ……..
Name of Panel :
Position :
Date :

STUDENT'S DECLARATION

I declared that this dissertation entitled "Benchmarking on Management System in Manufacturing Companies in Establishing Maintenance Awareness" is the result of my own research except as cited in the references. The dissertation has not been accepted for any degree and is not currently submitted in candidature of any other degree.

Signature : ……..
Name : MOHD FAISAL BIN CHE YUSOF
ID Number :
Date :

To my beloved mother and father,

Mrs. Normah Binti Killa
Mr. Che Yusof Bin Che Ismail

ACKNOWLEDGEMENTS

Praise to Allah S.W.T, the Most Merciful and the Most Compassionate. Peace upon him Muhammad S.A.W, the messenger of Allah.

First and foremost, I would like to express my gratitude to my supervisor; Mr. Lee Giok Chui,SMP.,KMN., for his invaluable guidance, suggestions and continuous encouragement in making this research possible. I appreciate his consistent support from the first day I applied to graduate program to these concluding moments. I am truly grateful for his progressive vision about my training in science, his tolerance of my naïve mistakes, and commitment to my future career.

My sincere thanks go to all my fellow classmates and members of the staff of the Mechanical Engineering Department, UMP, who helped me in many ways and made my stay at UMP pleasant and unforgettable.

ABSTRACT

In manufacturing companies, gaining profit is the most obvious goal to be achieved. Many systems and application are being used by various international companies in improving their profit. Quality Management System (QMS) is among the system applied in achieving the goal of high maintenance awareness. This is because a good condition of the machines will give high productivity. Most of the companies are applying the recommendation based on the documentation to get the accreditation for ISO 9001:2000.This is significant to prove that the company is reliable and serves an international level of standards in their services. Companies are having their documentation on management of their own to observe the process executed and the weaknesses arise from the process. To be more advance, the maintenance awareness can be established in earlier stage such as in universities or college. This project is to benchmark the work applied by the companies in their process to maintain their status as an accredited company. It also a study to find a better systems and application that can be applied in the educational institution. To achieve the goal, every steps need to observed from the documentation until the production. The maintenance awareness will be observed and measured by using questionnaires sets and also interviews. With the lack of exposure to real working environment, the results show that respondents in an educational institution are able to have a higher maintenance awareness level than respondents in manufacturing companies.

ABSTRAK

Di dalam syarikat pembuatan, mendapat keuntungan merupakan matlamat utama yang perlu dicapai. Terdapat pelbagai sistem dan aplikasi yang digunakan oleh syarikat-syarikat antarabangsa untuk meningkatkan keuntungan yang dicapai. *Quality Management System* (QMS) adalah antara sistem yang digunakan untuk meningkatkan kesedaran dalam aspek penyelenggaraan.Ini kerana mesin yang berada di dalam keadaan yang baik akan memberikan produktiviti yang lebih tinggi.Kebanyakan syarikat mengaplikasikan cadangan-cadangan yang disyorkan di dalam dokumen ISO 9001:2000 untuk mendapat akreditasi daripada organisasi terbabit.Ini adalah sebagai bukti penting untuk menunjukkan bahawa sesebuah syarikat adalah boleh dipercayai dan menyediakan servis peringkat antarabangsa. Kebanyakan syarikat menyimpan dokumen mereka sendiri untuk memerhati setiap proses yang dilaksanakan dan sebarang kelemahan yang muncul dari proses tersebut. Untuk lebih maju ke depan, kesedaran dalam aspek penyelenggaraan boleh dipupuk bermula pada peringkat awal seperti di peringkat kolej dan universiti. Projek ini bertujuan untuk memerhati setiap langkah dan proses yang diamalkan oleh kebanyakan syarikat untuk mengekalkan status akreditasi mereka.Ini juga merupakan satu penyelidikan untuk mencari proses yang lebih baik yang boleh diamalkan di peringkat institusi pendidikan.Untuk mencapai matlamat ini,setiap proses dari peringkat dokumentasi sehingga proses terakhir akan diperhatikan.Kesedaran dalam penyelenggaraan akan diperhatikan dengan menggunakan beberapa set borang soal selidik and temu ramah.Walaupun kekurangan pendedahan terhadap suasana kerja sebenar, pelajar-pelajar di peringkat pendidikan menunjukkan mereka mampu untuk mempunyai kesedaran terhadap penyelenggaraan yang lebih tinggi berbanding pekerja di syarikat pembuatan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.0 Introduction

The topic of this thesis is **benchmarking on management system in manufacturing companies in establishing maintenance awareness**. Since most of the manufacturing companies are international companies, obviously they need to ensure a production with a high quality and meet the customers' expectations.

In achieving these objectives, the companies have applied ISO 9001: 2000 in their system .It is a Quality Management System (QMS) Standard that is applied so they can achieve the finest quality in their production.

Maintenance plays a key role in supporting the production systems and also contributing to the achievement of organization objectives. The objective of the maintenance function is to maintain current technological, managerial, and operating standards. The improvement function is aimed at improving current standards.

Under the maintenance function, the management must first establish policies, rules, directives, and standard operating procedures (SOPs) and then work towards ensuring that everybody follows SOP.

The types of maintenance that will be focused are the preventive maintenance, predictive maintenance and the continuous improvement. The review is also on what is the most effective way to establish a maintenance culture in an organization.

1.1 Problem Statement:

In the companies, the problem occurred is with the information flow from the upper management to the lower workers. The workers, usually the technicians, received the information but they did not execute it. This is obvious in the matter of maintenance in the companies.

In UMP, the problem assumed is the exposure about the maintenance culture. Students did not take maintenance as part of their responsibilities. As a result, they may not implement the culture in their daily life.

1.2 Objectives of this study:

The main objective of this project is to establish and implement maintenance culture in University Malaysia Pahang (UMP).This is done by benchmarking three manufacturing companies.

1.3 Scopes of the this study:

The scopes of this project is to benchmark the Quality Management System (QMS),in accordance to ISO 9001:2000,which is applied in all of the three companies.

In specific, the focus is on preventive maintenance, predictive maintenance and the continuous improvement.

The scope of the observations is on the machines used in the companies which are similar to the machines used in UMP (if possible).The milling machine section will be the focus for observations in UMP.

1.4 Thesis organization

The thesis is divided into five chapters. Each chapter has several sub-topics. The chapters are:

1.4.1 Chapter 1: Introduction

This chapter works as an early introduction to the topic of this thesis. It exposed a brief explanation for the entire report. Through to the end of this report, every topic will be explained in more details.

1.4.2 Chapter 2: Literature Review

Since the beginning of this project, some literature review had been done to make a clear understanding on the topic. There are some media that had been used including internet, booklet, and also all the maintenance forms from the companies.

1.4.3 Chapter 3: Methodology

In this chapter, all the methodology used to complete this thesis is stated. The flow of the project will be stated chronologically.

1.4.4 Chapter 4: Result and Discussion

All the data collected from the visits and observations will be gathered in this chapter. Analysis will be done based on the data collected from the questionnaires, interviews and observations.

The data and analysis will be discussed with the supervisors. This is important in order to get a valid and an acceptable analysis. Further elaborations after the analysis will be combined together in this chapter.

1.4.5 Chapter 5: Conclusion and Recommendation

The overall statement in this thesis will be stated clearly in this last chapter. After all the data collection and analysis, a conclusion will be presented in this chapter. Furthermore, recommendations will also be stated if any improvements can be made based on the conclusion.

CHAPTER 2

OVERVIEW ON ISO 9001:2000

2.1 INTRODUCTION

In this chapter the content will be about the literature review made in order to complete this project. It can be considered as the summary of the literature review. It is needed since the early stage of the thesis to understand the need of the topic. This chapter consists of companies backgrounds and products, machines, terminologies, how to construct questionnaires sets and how to analyze it. The previous study on related topic also is reviewed.

2.2 ISO 9001:2000

The International Organizational of Standardization (ISO) is a worldwide organization that develops many different kinds of standards.

ISO 9001 is a series of documents that define requirements for the Quality Management Standard. ISO 9001:2000 is one of the documents in this set. It contains the actual requirements an organization must be in compliance with to become ISO 9001 Registered.

Past version of ISO 9001 is ISO 9002 and ISO 9003, but those are no longer in use. ISO 9001:2000 is the current version of the Standard. It was revised in the year 2000.Companies are now only registered to ISO 9001.

Both companies and customers can gain benefits from the implementation of iso 9000.With a well defined organization and responsibilities, the grey areas and possible resources wastage can be minimize.

The standardize practices and establishment of proper communication channel can maximize the communication efficiency. In the same time, the productivity can also be increased. A greater degree of internal control can be established as well.

By the side of the customers, this can increase satisfaction and growth in confidence. It will reduce the audit needed to be done by the customers in order to get the highest quality possible in production.[1]

An organization with an effective QMS will typically meet customers' expectations better than an organization that does not have an effective QMS. Many organizations require their suppliers to have ISO 9001:2000 Registered.

Organizations worldwide are implementing an ISO 9001:2000 because it has proven over the years that it leads companies to better operations, improved performances, and improved profitability. In other words, ISO 9001:2000 increase internal effectiveness and productivity benefits.

2.2.1 Quality Management System

This term can be defined as a set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organization. Implementing a QMS within an organization needs to be a decision by the top management.[2]

QMS integrates the various internal processes within an organization and intends to provide a process approach for production.

QMS enables the organization to identify, measure, control and improve the various processes that will ultimately lead to improve the performance. The QMS consists of written a document that addresses the ISO 9000 standard.

2.2.2 Maintenance

Including tests, measurements, adjustments, and parts replacements, performed specifically to prevent faults from occurring.

2.2.3 Preventive Maintenance

The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.

The scheduling of a program of planned maintenance or equipments overhauls. The goal of preventive maintenance is to reduce equipment failure, and the need for corrective maintenance. It can be performed at regular time intervals ,after a specified amount of equipment use, when the opportunities arises, for example, at a factory's

annual shutdown, or when a certain preset conditions occur to trigger the need for action.

2.2.4 Predictive Maintenance

It can be defined as a type of condition-based maintenance emphasizing early prediction of failure using non-destructive techniques such as vibrations analysis, thermograph, and wear debris analysis.

PdM techniques help to determine the condition of in-service equipment in order to predict when maintenance should be performed. This approach offers cost savings over routine or time-based preventive maintenance because tasks are performed only when needed.

2.2.5 Statistical Process Control (SPC)

It is an effective method of monitoring a process through the use of control charts. Much of its power lies in the ability to monitor both process centre and its variation about that centre. By collecting data from samples at various points within the process, variations in the process that may affect the quality of the end product or service can be detected or corrected. This will reduce the waste and as well as the possibilities that problems will be passed on to customers. With its focus on early detection and prevention of problems, SPC has advantage over quality methods, such as inspection, that apply resources to detecting and correcting problems in the end product or service.

In addition, SPC can also lead to a reduction in the time required to produce the product from end to end. This is partially due to a diminished possibility that the product will have to be reworked, but it may also result from using SPC data to identify bottlenecks, what times, and other sources of delays within the process. Process cycle

time reductions coupled with improvements in results have made SPC a valuable tool from both a cost reduction and a customer satisfaction standpoint.

2.2.6 Continuous Improvement

An organization should have a continuous improvement in the matter of effectiveness of the quality management system. This is done through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and managements review.[3]

A continuous improvement can be implemented by using three sources. The first one is through the feedback from corrective actions. Corrective actions only been executed after a problem has been encountered.

The second way is by applying preventive actions. This is quite similar by preventive maintenance but maintenance actions are not executed. For example, calibration of machine should be done after a period of action. Through this way, the machine only been checked to make sure that the machine is in the condition it should be.

Lastly, it is by applying improvement in a big step. For example, this can be done by changing the whole machine. After considering the feedback, if a small change cannot prevent the failure from occurred again, then a big improvement should be executed. This is good for a long term plan.

2.2.6.1 KAIZEN

There are many approaches in having a continuous improvement in an organization. One of them is the application of Kaizen. Kaizen means “continuous improvement”. A Kaizen strategy call for never-ending efforts for improvements

includes everyone in the organization including from upper management until the ordinary employees.

Kaizen signifies all small improvements as a result of coordinated continuous efforts by all employees. Under the improvement function, management works continuously towards revising the current standards, once they have been mastered, and establishing higher ones.

Modifications are not limited to a specific area such as production or marketing only. Kaizen is based on making changes anywhere that improvements can be made.

It is a process-oriented thinking. This is because it concentrates at improving the process rather than at achieving certain results. Such managerial attitudes and process thinking will make a major difference in how an organization will achieve improvements in period of time.

2.2.6.2 5S Application

Revision is done on this topic because of it is applied in all the companies related to this project and also in UMP.

2.2.6.2.1 Seiri (Tidiness)

The first step of "5S" process, Seiri, refers to the act of throwing away all unwanted, unnecessary and unrelated materials in the workplace. People involved in Seiri must not feel sorry about having to throw away materials. The idea is to ensure that everything left in the workplace is related to work. Even the number of necessary items in the workplace must be kept to its absolute minimum. Because of Seiri, simplification of tasks, effective use of space, and careful purchase of items follow.

2.2.6.2.2 Seiton (Orderliness)

This step is all about the efficiency. It consists of putting everything in the right place so that it can be accessed quickly, as well as returned in the same place quickly. This can increase the efficiency of work flow, and the worker will also become more productive. The correct place and position for every material must be chosen carefully in relation how the work will be performed and who will use them. Every item and materials must be kept in its own place and each located need to be labeled in order for easy identifications.

2.2.6.2.3 Seiso (Cleanliness)

This step is about cleaning up the workplace. It must be done by everyone in the organization, from operators to managers. It would be a good idea to have every area assigned to a person or group of persons for cleaning. Everyone should see the workplace through the eyes of a visitor-always thinking if it is clean enough to make a good impression.

2.2.6.2.4 Seiketsu (Standardization)

In more specific, it can be translated as ‘standardized clean up’. It consists of defining the standards by which personnel must measure and maintain ‘cleanliness’.
As a start, the personnel must practice ‘seiketsu’ in their personal tidiness. Visual management is an important ingredient of seiketsu. Color-coding and standardized coloration of surroundings are used for easier visual identification of anomalies in the surroundings. Personnel are trained to detect abnormalities using their five senses and correct them immediately.

2.2.6.2.5 Shitsuke (Discipline)

This step denotes commitment to maintain orderliness and to practice the all the four previous steps as a way of life. The emphasis of shitsuke is elimination of bad habits and constant practice of good ones. Once true shitsuke is achieved, personnel voluntarily observe cleanliness and orderliness at all times, without having to be reminded by management.

2.3 Six Sigma

Six Sigma is a systematic methodology that provides an organization with the tools to improve the capability of their processes. The target in this system is to achieve only 3.4 defects per 1 million opportunities. Six Sigma utilizes information and statistical analysis to measure and improve an organization's operational performances, practices and systems.

It is done by identifying and preventing defects in processes. This improvement in performances and decrease in process variation leads to defect reduction. It will also increase the profits, employee morale and quality of products.

The main benefit of Six Sigma program is the elimination of subjective in decision-making by creating a system where everyone in the organization collects, analyzes, and displays data in consistent way.[111]

A survey of CEOs and other executives about Six Sigma programs reveals an awareness level of 85% for manufacturing, 34% for healthcare and other services, and 22% for education.[222]

Table 2.1: Benefits of Six Sigma of manufacturing process in industry

Company/project	**Metric/measures**	**Benefits/savings**
Motorola (1992)	In-process defect levels	150 times reduction
Raytheon/aircraft integration system	Depot maintenance inspection time (measured in days)	Reduced 88%
GE/Railcar leasing business	Turnaround time at repair shops	62% reduction
Allied Signal (Honeywell)/laminates plant in South Carolina	Capacity/Cycle time/Inventory/On-time delivery	Up 50%/Down 50%/Down 50%/Increased to near 100%
Allied Signal (Honeywell)/Bendix IQ brake pads	Concept to shipment cycle time	Reduced from 18 months to 8 months)

2.4 Questionnaire

Questionnaires are an inexpensive way to gather data from a potentially large number of respondents. Often they are the only feasible way to reach a number of reviewers large enough to allow statistically analysis of the results.

The steps required to design and administer a questionnaire includes:

1. Defining the objectives of the survey
2. Determining the sample group
3. Writing the questionnaire
4. Administering the questionnaire
5. Interpretations of the results

2.4.1 Steps in Response Scale

In general, it suggested using an odd number of steps in order to allow the respondent to express a middling or neutral strength of opinion. This can be problem with some respondents who refuse to express an opinion and give the middle category for all questions. However, the alternative can be even worse: respondents who have no or neutral opinion being forced to choose negative or positive and do it randomly.

Statistical reliability of the data increases sharply with the number of scale steps up to about 7 steps, and then it increases more slowly, leveling off around 11.After 20 steps, it decreases sharply. However, the more steps you have, the more difficult it is for respondents and possibly the less valid the responses because of that.

If variables are going to be combined additively, like when creating a scale or index, then the number of steps is not an issue for reliability. Two steps (true/false) option can be used as well. In some case, 3-point response scales are preferred because they are quick and easy for respondents.

2.4.2 Border in Writing Questionnaires

There are some parts that should be avoided when writing a questionnaire. The language that will be used must not depend on the interviewers understanding, but it depends on the respondents. The language must be simple and understandable by the respondents.

The researchers also cannot use emotionally loaded or vaguely defined words. This is one of the areas overlooked by both beginners and experienced researchers. Quantifying adjectives (e.g., most, least, majority) are frequently used in questions. It is important to understand that these adjectives mean different things to different people. In addition, overlapping response categories must also be avoided.

2.5 Interview

There are several types of interview that can be applied in doing a research. The types are as follow:

2.5.1 Personal Interview

An interview is called personal when the interviewer asks the questions face-to-face with the interviewee. Personal interviews can take place in the home, at a shopping complex, on the street, outside a movie theater or polling place, and so on. The advantage in using this method is the ability to find the target population. For example, the possibilities to find the manager of a company is higher than just using phone interview method. Furthermore, longer interview are sometimes tolerated. Particularly with in-person interviews, people may be willing to talk longer compared to other methods.

2.5.2 Telephone Interview

Surveying by telephone is the most popular interviewing method in the USA. This is made possible by nearly universal coverage (96% of homes have a telephone)
The advantage of this method is it van reduce the time taken to conduct the interview. In contrast; the cost of the interview can increase drastically based on the target population.

2.5.3 Mail Survey

Mail survey is among the least expensive method. The questions can be added with pictures-something that is not possible over the phone. The respondents can answer with more leisure so they are not considered as intrusive as other methods.

However, the mail survey has the highest possibility that the longer time will be taken to receive the feed back.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter can be considered as the extension of Chapter 2. This chapter used the content of the previous chapter as the guidelines. It is a set of explanations on how the project will be done. Figure below shows about the flow of the project.

3.2 LITERATURE REVIEW

Since the early stage of this project, some literature reviews have been made in order to gain a thorough knowledge on the topic. It consists of companies backgrounds and products, machines, terminologies, how to construct questionnaires sets and how to analyze it. The previous study on related topic also is reviewed.

3.3 MEETING

The first meeting with the companies is about their background and business activities. It is important to gain a basic knowledge about the companies. The content of the first meeting will be used as a guideline to establish an interview and questionnaires. The processes and systems applied by the companies are needed to be understood in order to measure the maintenance culture.

3.4 QUESTIONNAIRES

A questionnaire is one of the alternatives in this project to measure the culture. There will be several sets of questionnaires. It will be distributed among the management section and also to the technicians of the companies.

2 sets of questionnaires will also be distributed in UMP. The first set is distributed among the senior students and is used as a mock interview to observe the efficiency of the questionnaire. It also used to establish hypothetical result of this project. The second set of questionnaire is about the current maintenance culture in UMP and will be taken as the final and valid result for this project. It is distributed to the group of students that is using the milling machine section in the current semester.

The questionnaires will be provided with 5-points scale of answer. The scale is as shown below:

1	2	3	4	5

1. Strongly Disagree
2. Disagree
3. Fairly Agree
4. Agree
5. Strongly Agree

To analyze this set of answer, mark will be given for every answer.5 mark will be given for the fifth answer and 1 mark will be given for the first answer.

Statistical Package for the Social Sciences (SPSS) software will also be used to analyze the questionnaire. It is among the most widely used programs used by researchers and survey companies for statistical analysis. This software can be used to obtain valid analysis of the questionnaires.

The overall marks will be used to observe the level of maintenance culture in that company. These marks will be compared with a range prepared earlier. For example, the company that gains a full mark can be considered having an excellent maintenance culture.

3.5 INTERVIEWS

Some interviews will be held through this project. The interviews will be conducted only among the management department. In-person type of interviews will be used.

For the interviews in the companies, it will focus on the managers. The personnel will be Mr Ainin Akmar,Mr Zulkafly Ahmad and Mr Noor Akmar Mohamad.

3.6 VISITS

During the second phase, visits are the most important part. The data collected will be used to perform analysis on all the companies and also UMP. The results yields from the analysis are dependent on the data collected during the visits. Several sessions of visits is needed to collect an adequate data for the analysis. The dates of the visits done are as stated below.

Table 3.1: Visits done on companies

DATE	COMPANY
19 May 2008	Ire-Tex (Malaysia) Sdn. Bhd.
20 May 2008	GH Packaging Sdn. Bhd
22 May 2008	Styrotex (Asia Pacific) Sdn.
16 June 2008	GH Packaging Sdn. Bhd
17 June 2008	Ire-Tex (Malaysia) Sdn. Bhd.
18 June 2008	Styrotex (Asia Pacific) Sdn.
18 August 2008	Ire-Tex (Malaysia) Sdn. Bhd. And GH Packaging Sdn. Bhd
18 August 2008	Styrotex (Asia Pacific) Sdn. Bhd.

3.6.1 GH Packaging Sdn. Bhd.

Figures 3.1 until figures 3.5 show the machines used in the GH Packaging SDN Bhd.

Figure 3.1: Slitter Machine

Figure 3.2: Printing Machine

Figure 3.3: Glue Machine

Figure 3.4: Die Cut Machine

Figure 3.5: Tying Machine

3.6.2 Styrotex Sdn. Bhd.

Figure 3.6 (a)

Figure 3.6 (b)

Figures 3.6(a) and (b) show the thermoformorming machines used in Styrotex Sdn. Bhd. Meanwhile, figures 3.7 (a) and (b) are the working environment around the operational section.

Figure 3.7 (a)

Figure 3.7 (b)

3.6.3 Ire-Tex Sdn. Bhd.

Figures 3.8and 3.9 show the environment and the machines available at the Ire-Tex Sdn Bhd.

Figure 3.8: Assembly Line

Figure 3.9: Printing Machine

3.6.4 UMP

Figure 3.10(a)

Figure 3.10(b)

The Lathe machines used by the students in UMP are shown in figures 3.10 (a) and (b).

3.7 ANALYSIS

The analysis conducted is significant as the measurement of the maintenance culture. A part of the analysis is on the breakdown time.

Moreover, all the costs related to maintenance will be analyzed. This includes the cost of the maintenance and also the cost that can be saved because of the maintenance. The predictive cost that could be faced because of lack of maintenance will also be analyzed.

In specific, the data collected will be converted into a column chart. From the chart, a comparison will be made on all three companies and UMP also.

Every question in the questionnaires will also be given a mark. The overall marks will be calculated by using an interval of marks established earlier. For example, the company that collects a full mark will be considered as excellent.

3.8 DISCUSSION

In finishing this project, a lot of discussions are needed. The most important is the discussions with the supervisors. It will make sure that the study is in the right direction and purpose.

A continuous discussion is needed to make sure that every steps or process is acceptable. Furthermore, discussion is also needed in developing questionnaires and interview questions.

The discussion with the management department is also important to establish a good group of data for this project.

3.9 REPORT

For this project, all the data collected and analyzed will be documented properly. This is an important part to compose and submit a complete report.

3.10 IMPLEMENTATIONS

All the possible implementations will be suggested to UMP. However, this is only possible after observations and proper analysis has been done. It is also depends on all the procedures and processes that have already being applied in the university.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter, all the data collected from the companies and UMP will be gathered together and be analyzed. The data from the observation which is relevance to the scopes of the project is also discussed.

4.2 RESULTS

For the questionnaires done in the companies, the summary of the question sets will be summarized as below. The reasons and reliability of the answers also discussed based on the answers and observation done in the companies.

4.2.1 Questionnaires (Companies)

Sets questionnaires have been distributed among the workers in all the companies during the visits. The answers from the questionnaires will be calculated and discussed in thoroughly below.

4.2.1.1 Ire-Tex Sdn. Bhd. (56 Respondents)

Question 1

This question asked whether the company undergoes the maintenance work based on schedule.85.7% of workers do not know about this process. This shows that the workers do not take maintenance as a part of their responsibility. The result is shown in figure 4.1.

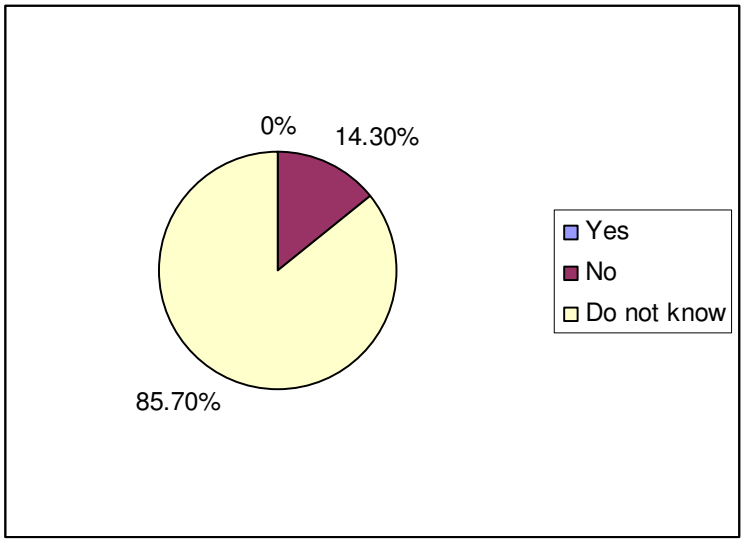


Figure 4.1

Question 2

In this question, the workers need to fill the maintenance work they have done on the machines and also the time range. None of the workers answered this question.

Question 3

This question is about the application of 6 Sigma in the companies. All of them said that they never heard and know about this term. Based on observation, this situation may occur because all of the workers are from Nepal and Vietnam.

Question 4

This question asked about the probability of defects per 1 million productions. In fact, this question related with the previous question. However, in this question, 80.4 % of the respondents took answer 4 and 19.6 % took answer 5.Observation shows that they answer this question based on their daily work. To be specific, they give approximate value defects done by their sections. The clear answer from the respondents is shown in figure 4.2.

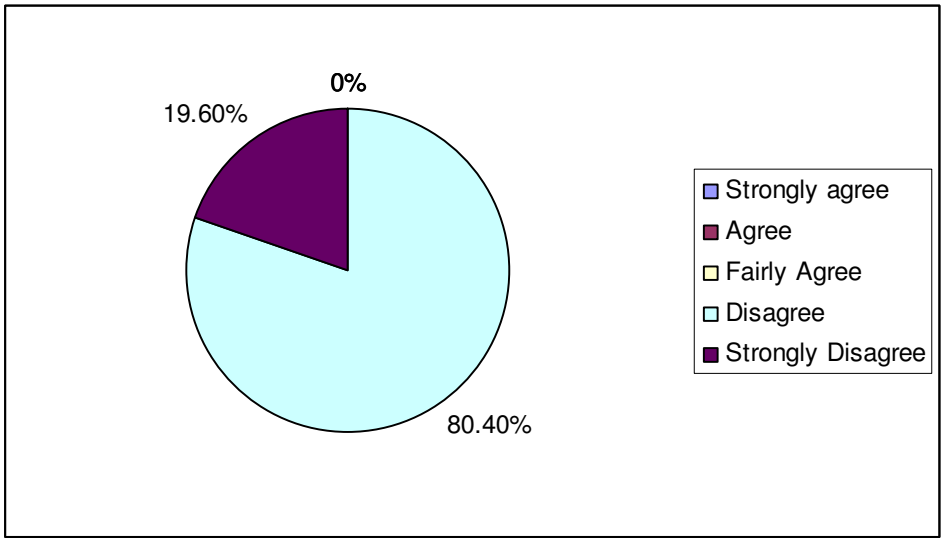


Figure 4.2

Question 5 asked about the mentality of the management system towards the importance of the continuous maintenance work.75% of the respondents pick the average answer. This is because the management did not train them in the matter of maintenance. Respondents are just trained on how to use the machine in their zones.

QUESTION	ANSWER	RESPONDENTS
5	1	0
	2	14
	3	42
	4	0
	5	0
	TOTAL	154 / 280

Question 6 simply asked whether the machine is always operates at it full potential. A variety of answers is given by the respondents. Through the observations, it is known that just several machines did not work properly. It is because that the machines need to be change with a new one but the management still hold the process until the machine is totally broke.

6	1	0
	2	0
	3	11
	4	33
	5	12
	TOTAL	225 / 280

Question 7 stated that the maintenance is done based on the manual provided by the manufacturer. All workers strongly agreed with the statement. This is because the maintenance is done by other department and they only have to shut down their machines for a day. In fact, the respondents actually do not know whether the maintenance is correctly executed or not.

7	1	56
	2	0
	3	0
	4	0
	5	0
	TOTAL	56 280

Question 8 stated that the workers are under continuous training to improve their skills in handling the machines. Results show as below because they only given the basic skills to handle the machine.

8	1	46
	2	10
	3	0
	4	0
	5	0
	TOTAL	66 280

In this question number 9, the level of exposure by the management towards the importance of maintenance is asked. The answers are because of workers who confused between the basic skills with the maintenance exposure provided by the management.

9	1	15
	2	30
	3	11
	4	0
	5	0
	TOTAL	108 280

This question asked whether the workers take maintenance as part of their responsibility.

10	1	56
	2	0
	3	0
	4	0
	5	0
	TOTAL	56 280

Total calculation:

Total = 154 + 225 + 56 + 66 + 108 + 56

= 665

Marks = $\frac{665}{(280 \times 6)} \times 100\%$

= 39.58%

The Scale:

0 - 20%	:	Really Weak
21 - 40%	:	Weak
41 - 60%	:	Average
61 - 80%	:	Good
81 - 100%	:	Excellent

Based on the calculation, Ire-Tex Sdn. Bhd. gain mark of 39.58 %.It shows the company's workers is having weak maintenance awareness. This data is also suits the informal data collected from in-person interviews with random workers. The question 1 until question 4 also proves the level of their mentality towards maintenance is very low. This is due to minimum exposure by their management.

4.2.1.2 Styrotex Sdn. Bhd. (5 Respondents)

Question 1

This question asked whether the company undergoes the maintenance work based on schedule. All the respondents said the maintenance must follow as stated by the manufacturer. This is because they are using high technologies machines in their department. They also need to make sure that the machine is in top condition because they only have several machines and they cannot take the risk to loss any machines due to break down.

Question 2

In this question, the workers need to fill the maintenance work they have done on the machines and also the time range. None of the workers answered this question.

Question 3

This question is about the application of 6 Sigma in the companies. All of them said that they never heard and know about this term.

Question 4

This question asked about the probability of defects per 1 million productions. The answer is actually the same from the previous company. They only give their approximate value based on their sections.

Question 5 asked about the mentality of the management system towards the importance of the continuous maintenance work.

QUESTION	ANSWER	RESPONDENTS
5	1	0
	2	0
	3	0
	4	0
	5	5
	TOTAL	25 25

Question 6 simply asked whether the machine is always operates at it full potential. All respondents choose the same answer.

6	1	0
	2	0
	3	0
	4	0
	5	5
	TOTAL	25 25

Question 8 stated that the workers are under continuous training to improve their skills in handling the machines. However, the training is only for handling the machines.

8	1	0
	2	0
	3	4
	4	1
	5	0
	TOTAL	16 25

In this question, the level of exposure by the management towards the importance of maintenance is asked.

9	1	0
	2	0
	3	0
	4	0
	5	5
	TOTAL	25 25

The last question asked whether the workers take maintenance as part of their responsibility.

10	1	5
	2	0
	3	0
	4	0
	5	0
	TOTAL	5 / 25

Total calculation:

Total = 25 + 25 + 16 + 25 + 5

= 96

Marks = $\frac{96}{(25 \text{ X } 5)}$ X 100%

= 76.80%

The calculation gives Styrotex Sdn Bhd a mark of 76.80%. Based on the scale used,it shows that the company is having a good maintenance awareness among it's workers. As the previous result is considered by its combination with the in-person interviews, it is also the same with this company.

4.2.1.2 GH Packaging Sdn. Bhd. (22 Respondents)

Question 1

This question asked whether the company undergoes the maintenance work based on schedule. All the respondents said the maintenance must follow as stated by the manufacturer.

Question 2

In this question, the workers need to fill the maintenance work they have done on the machines and also the time range. None of the workers answered this question.

Question 3

This question is about the application of 6 Sigma in the companies. All of them said that they never heard and know about this term.

Question 4

This question asked about the probability of defects per 1 million productions.As all the workers did not aware about this application,they cannot give a clear answer to this question.

Question 5 asked about the mentality of the management system towards the importance of the continuous maintenance work.

QUESTION	ANSWER	RESPONDENTS
5	1	0
	2	0
	3	2
	4	3
	5	17
	TOTAL	103 110

This question simply asked whether the machine is always operates at it full potential. A variety of answers is given by the respondents. Only printing machines did not work properly. Usually it is because of the molding.

6	1	0
	2	0
	3	1
	4	2
	5	19
	TOTAL	106 110

This question stated that the maintenance is done based on the manual provided by the manufacturer. This may occurred because of the variety of machines they have. Some of the machines such as the tying machines is using a simple system and the supervisor may troubleshoot any problems occurred.

7	1	3
	2	0
	3	15
	4	4
	5	0
	TOTAL	64 110

This question stated that the workers are under continuous training to improve their skills in handling the machines. It is only some of them is trained for handling machines such as the die cut machines.

8	1	18
	2	0
	3	0
	4	0
	5	4
	TOTAL	38 110

In this question, the level of exposure by the management towards the importance of maintenance is asked.

9	1	0
	2	0
	3	0
	4	0
	5	22
	TOTAL	110 110

This question asked whether the workers take maintenance as part of their responsibility.

10	1	0
	2	0
	3	6
	4	7
	5	9
	TOTAL	91 110

Total calculation:

Total = 103 + 106 + 64 + 38 + 110 + 91

= 512

Marks = $\frac{512}{(110 \times 6)} \times 100\%$

= 77.58%

The result of GH Packaging Sdn. Bhd. gives the marks of 77.58%.This shows that the company has a good level of maintenance awareness.

4.2.2 Questionnaires (UMP)

The answers and calculation of the questionnaires sets distributed in UMP will be discussed in detail under the subtopics below.

4.2.2.1 UMP (Recent Students)

The first question stated that the students know how to handle the machines in the right ways.

QUESTION	ANSWER	RESPONDENTS
1	1	1
	2	0
	3	7
	4	25
	5	14
	TOTAL	192 / 235

This question aimed to make sure that students are exposed about the importance and the basic maintenance steps for the machines. The results shows that the respondents have been exposed to basic maintenance skills before they are allowed to handle the machines.

2	1	1
	2	0
	3	3
	4	14
	5	29
	TOTAL	211 235

Question 4 stated that respondents understand and apply the 5S application at their working place. There are several figures shown after this subtopic to prove that they are applying the 5S System in their working place.

4	1	1
	2	0
	3	4
	4	19
	5	23
	TOTAL	204 235

This question said that the machines are always in good condition. Some of them were giving average answers because there are 3 machines that cannot work properly. But this is only because of the coolant that cannot be used because of there is no hose at the coolant section. However, the instructors stated that their work did not need to use coolant because of several factors such as the feed rate, workpiece and so on. The respondents also find some alternative to use coolant manually. This shows that they are aware about the condition of the machines.

5	1	1
	2	2
	3	12
	4	19
	5	13
	TOTAL	182 235

Question 6 gives the respondents several steps that show that the machines are not working properly and need to be reported to the instructor. The answers show that the respondents know the correct steps to be taken if there is any malfunction occurs while handling the machines.

6	1	2
	2	2
	3	8
	4	16
	5	19
	TOTAL	189 235

Question 7 gives the imaginary situation as of students is the designer of the machines, whether they would care about the aspects to simplify the maintenance works. The answers show that they care but actually they have no idea to simplify the maintenance works. They answered positively because for them the term simplify will only simplify their works too.

7	1	1
	2	0
	3	8
	4	22
	5	16
	TOTAL	193 235

This question stated that in budget management, the budget for maintenance is an important part of it. None of the respondents give reasons why they give positive answers for this question.

8	1	3
	2	0
	3	5
	4	18
	5	21
	TOTAL	195 235

Total calculation:

Total = 192 + 211 + 204 + 182 + 189 + 193 + 195

= 1366

Marks = $\frac{1366}{(235 \times 7)} \times 100\%$

= 83.04%

Thus, from the calculation we can say that UMP is having an excellent maintenance culture based on exposure and activities by the management system. However, this set of data must fit with the informal observation done before the questionnaire is distributed. Then, if it fit well with the observation, the questionnaire can be considered as reliable.

4.2.2.2 UMP (Mock Analysis)

The question asked in this questionnaire is the same as the recent questionnaire on UMP students. However the differences about this survey are the respondents are senior students. The respondents are also using the older version of milling machine, but the machines are still in good condition. On the other hands, the instructors are still the same. This should not give big differences to the result taken.

QUESTION	ANSWER	RESPONDENTS
1	1	0
	2	1
	3	10
	4	8
	5	1
	TOTAL	69 100

QUESTION	ANSWER	RESPONDENTS
2	1	1
	2	1
	3	6
	4	9
	5	3
	TOTAL	72 100

QUESTION	ANSWER	RESPONDENTS
4	1	0
	2	2
	3	8
	4	10
	5	0
	TOTAL	68 100

QUESTION	ANSWER	RESPONDENTS
4	1	0
	2	3
	3	3
	4	12
	5	2
	TOTAL	73 100

Total calculation:

Total = 69 + 72 + 68 + 73

= 665

Marks = $\frac{282}{(100 \text{ X } 5)}$ X 100%

= 56.4 %

By referring to the calculation, this group of respondents gives a result of 56.4%.When comparing the marks with the scale, it shows that the respondents for the mock analysis is having an average level of maintenance awareness.

4.2.3 Overall Results for Questionnaires

The table and chart below stated the results of all the companies and UMP. Even though the questionnaires sets between the companies and UMP are different, the contents are still the same. It is the summary about the respondents' awareness towards maintenance, exposure and also attitude of the management section in the matter of maintenance. So, the results can be compared together.

Table 4.1: Overall results for questionnaires

Company	Ire-Tex	Styrotex	GH Packaging	UMP	UMP (mock)
Marks	39.58	76.80	77.58	83.04	56.40

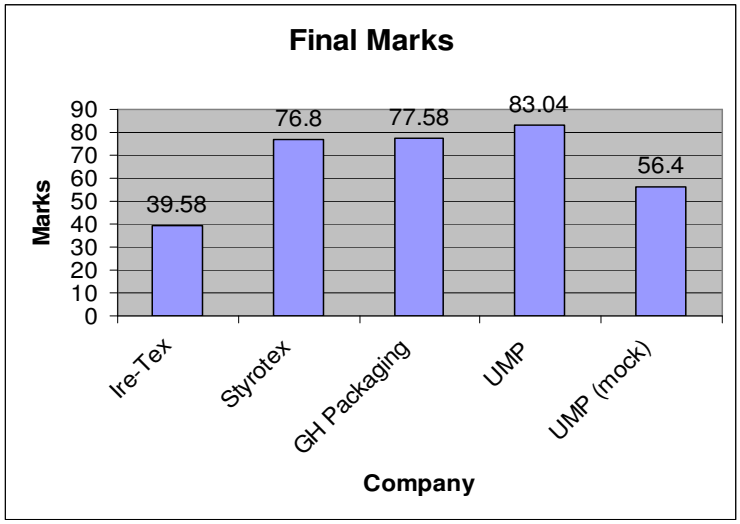


Figure 4.3: Results of all the questionnaires.

4.2.4 Interview Results (Management Section)

1. This question asked about the number of workers and supervisors for every shift.

Table 4.1: Overall workers for all companies

COMPANY	WORKERS			SUPERVISORS
	Full	Direct	Indirect	
Styrotex Sdn. Bhd.	8	2	6	1
Ire-Tex Sdn. Bhd.	89	99	34	2
GH Packaging Sdn. Bhd.	36	20	11	2

2. This question is to verify that maintenance works is responsible under which party.

- All the machines in Styrotex Sdn. Bhd. maintenance are fully under sub contractor. The maintenance works are done based on the schedule. This statement fit the maintenance sheet kept by the company.

- The machines in GH Packaging are maintained based on schedule and also under subcontractor. However, this fact does not fit the observation data on the maintenance sheet. This is due to their situation that needs to fulfill the demands by their customers. With lack of machines, the company cannot take the action to shut down any machine.

- The management of Ire-Tex Sdn. Bhd. admits that they did not do the maintenance based on schedule even though the maintenance is under subcontractor as well. This is because the maintenance is not like both previous companies. Maintenance will only be done when the company contacts the contractor.

3. In this question, the personnel need to give the risk in short and long term loss faced by the companies if the maintenance is not be done properly. If the maintenance works is not well maintained, it will result as the machines did not work at its full potential.

    - However, GH Packaging only can do this after they buy new machines to support their production. They are considering increasing the number of their machines and this issue is on the board of director level for this time.

    - As for Ire-Tex Sdn. Bhd. the assistant manager said that the maintenance needs to be in minimum level in order to minimize the operation cost.

4. For this question, it is about the actions taken by the companies or personnel if the workers did not do the maintenance based on the manual.

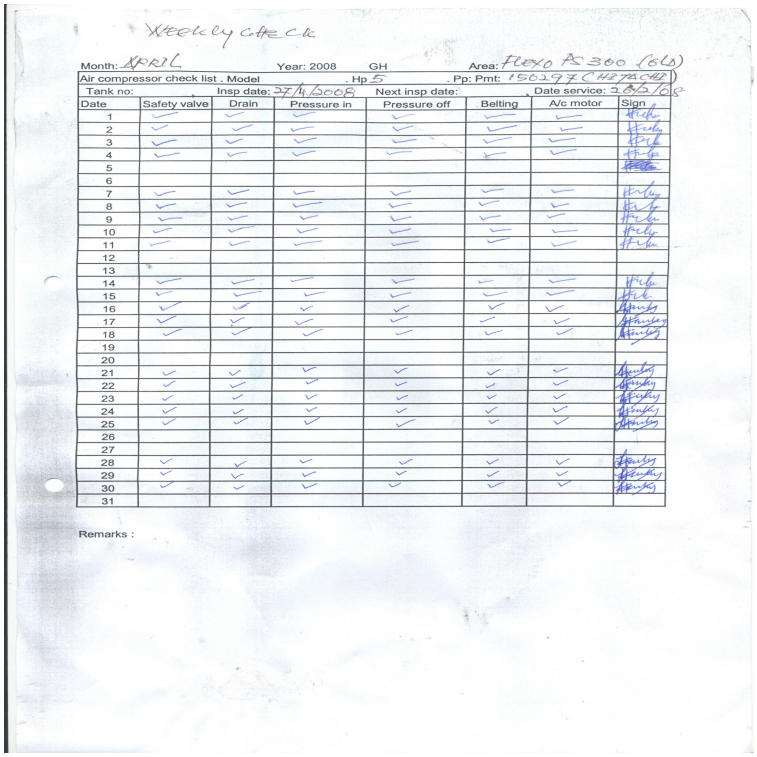
    - All of the companies did not take any actions if any slight mistakes are done by the workers during the maintenance. This is because their workers only do the minor maintenance. The major one is done by their contractor and the manufacturer of the machine. They also have to admits that they cannot give high expectations on their workers because they are foreigners.

4.3 DISCUSSION BASED ON SCOPES

Back to the scopes of this project, it is about to measure the awareness in the aspect of preventive maintenance, predictive maintenance and also the continuous improvement. The results are concluded in more detail under all the subtopics below.

4.3.1 Preventive Maintenance

Figure 4.4 shows an example of the preventive maintenance sheet taken from Ire-Tex Sdn Bhd. However, this data is gathered from the documentation of the company. Based on the observation, the sheet available at the machine is not fully filled. This shows that the maintenance is not done based on the schedule.It also proves that there are still weaknesses in the execution of preventive maintenance in this company.



Weekly check

Month: APRIL Year: 2008 GH Area: Flexo PS 300 (6L)

Air compressor check list . Model . Hp 5 . Pp: Pmt: 150197 CM27AC4T

Tank no: Insp date: 3/4/2008 Next insp date: Date service: 3/4/2008

Date	Safety valve	Drain	Pressure in	Pressure off	Belting	A/c motor	Sign
1	✓	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	✓	
5							
6							
7	✓	✓	✓	✓	✓	✓	
8	✓	✓	✓	✓	✓	✓	
9	✓	✓	✓	✓	✓	✓	
10	✓	✓	✓	✓	✓	✓	
11	✓	✓	✓	✓	✓	✓	
12							
13							
14	✓	✓	✓	✓	✓	✓	
15	✓	✓	✓	✓	✓	✓	
16	✓	✓	✓	✓	✓	✓	
17	✓	✓	✓	✓	✓	✓	
18	✓	✓	✓	✓	✓	✓	
19							
20							
21	✓	✓	✓	✓	✓	✓	
22	✓	✓	✓	✓	✓	✓	
23	✓	✓	✓	✓	✓	✓	
24	✓	✓	✓	✓	✓	✓	
25	✓	✓	✓	✓	✓	✓	
26							
27							
28	✓	✓	✓	✓	✓	✓	
29	✓	✓	✓	✓	✓	✓	
30	✓	✓	✓	✓	✓	✓	
31							

Remarks :

Figure 4.4: Preventive Maintenance Sheet

4.3.2 Predictive Maintenance

None of the companies is taking a proper ways to execute predictive maintenance. The management of GH Packaging Sdn. Bhd. is using an alternative by enhancing the ability to troubleshoot problem among their workers. However, this is done while the machine is still on run and not based on the final production. None of the workers is using Statistical Process Control in order to apply predictive maintenance. GH Packaging Sdn Bhd only planned to use this system in 2010 when they have bought their new machines.

4.3.3 Corrective Maintenance

The companies is applying the corrective maintenance by using the feedback from the quality control (QC) officer.The QC officer of GH Packaging is Mr. Zulkafly Ahmad and the QC Officer in Styrotex (Asia Pacific) Sdn. Bhd. is Ms. Maria.However,this type of maintenance is not in the scopes of this project.

4.3.4 Continuous Improvement

To achieve the maximum productivity in the process, continuous improvement should be applied as suggested in ISO 9001:2000 document. The improvement can be done on various sections. The most synonym system with this is the application of 5S system. This system is giving the best steps should be done on the working environment.

4.3.4.1 5S Application

5S System is applied in an environment in order to maximize the productivity. From the observation, all the companies realize about the importance of this system and applied it to their operation. UMP also has been applying this system for several years. UMP also has a committee to make sure that this system is applied in the laboratory.

4.3.4.1.1 GH Packaging Sdn. Bhd.

Figure 4.5 (a) and 4.5 (b) shows the 5S work executed at GH packaging Sdn. Bhd.

Figure 4.5 (a)

Figure 4.5 (b)

4.2.4.1.2 UMP

Figures 4.6 (a) and (b) shows the students in UMP applying 5S steps after they finish their works.

Figure 4.6 (a)

Figure 4.6 (b)

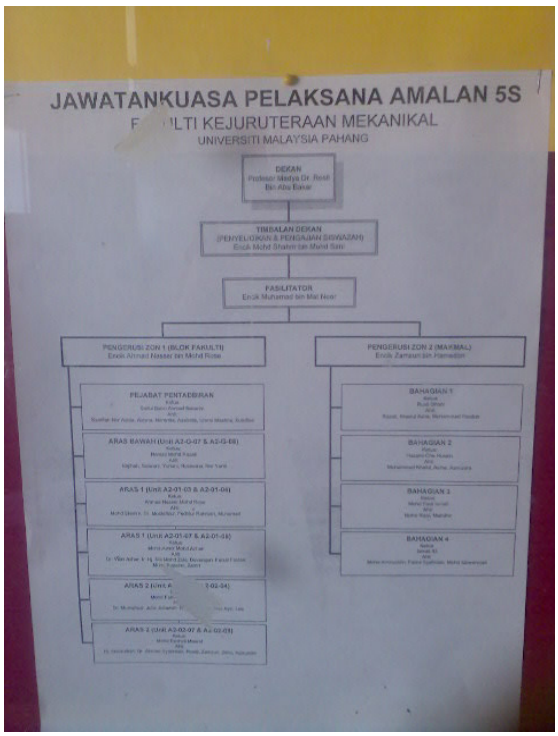


Figure 4.7: Execution Committee of 5S in UMP

Figure 4.7 proves that UMP is taking serious steps in having better maintenance awareness. Figures 4.6 (a) and (b) gives the impression of the effectiveness of actions taken by the management to apply 5S system at the working place.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Through the early stage to the end of this project, it is obvious that the recent students in UMP are having higher awareness in maintenance than the workers in the companies. Even though this can be said as impossible because the exposure towards real life of working environment, this result as may cause of the management in UMP efforts that yield such a result. The university also been accredited by ISO: 2000 and it may also gives reflects to the students as well.

The steps provided in the documentation should be really being executed in order to achieve high maintenance awareness. The other cause is some parties just take the accreditation as a title and not as guidelines. This is why the university is able to give better results because their operation is not based on any profit and loss.

5.2 RECOMMENDATIONS

The recommendations to further the study on this topic is to get a more reliable and acceptable respondents. This can be done by doing benchmarking on approved companies that have been successfully applying the ISO 9001:2000 and also the Six Sigma application.

The questionnaires and surveys must be related to the agencies that are experienced in getting valid results from it. Comparison can also be made among other universities which applying the ISO 9001: 2000 and the effectiveness can also be measured. This will give a higher probability to get a better system to be applied in the university.

REFERENCE

[1] Dr. Mustafa Hashim, 2007,Quality Management System, ISO 9001:2000

[2] Pyzdek, T, "Quality Engineering Handbook", 2003

[3] SIRIM, 2000, EN ISO 9001:2000.

[4] 111 Maleyeff &Kaminsky, 2002

[5] 222 R.Gowen III and J. Tallon, 2005

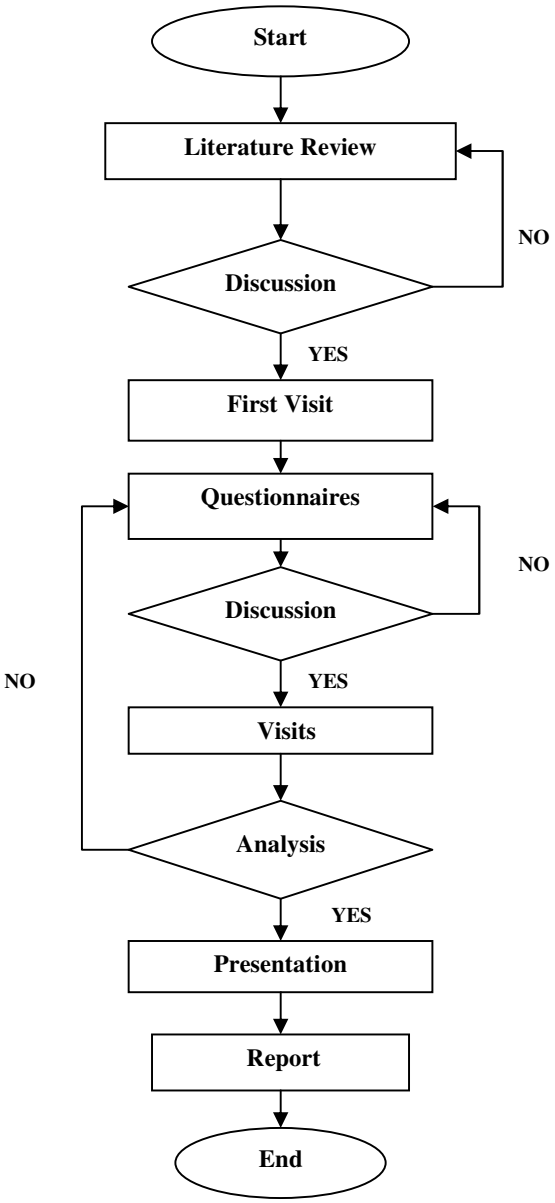
APPENDIX A1

Gantt chart for Final Year Project 1 and 2

PROGRESS		WEEKS														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FYP 1	Reviews on title															
	Find companies and contact															
	Submit proposal															
	Attend a briefing															
	Check project flow and planning															
	Arrange meeting with the companies															
	Study the collected data															
	Discussion and report															
	Approval from supervisor															
	Evaluation															
	Finalize all data															
	Compose full report															
	Presentation															
FYP 2	Attend FYP 2 briefing															
	Visits companies															
	Distribute questionnaire(UMP)															
	Data analysis															
	Compare results															
	Evaluation															
	Conclusion & Recommendations															
	Presentation															
	Draft final report															
	Submit report															

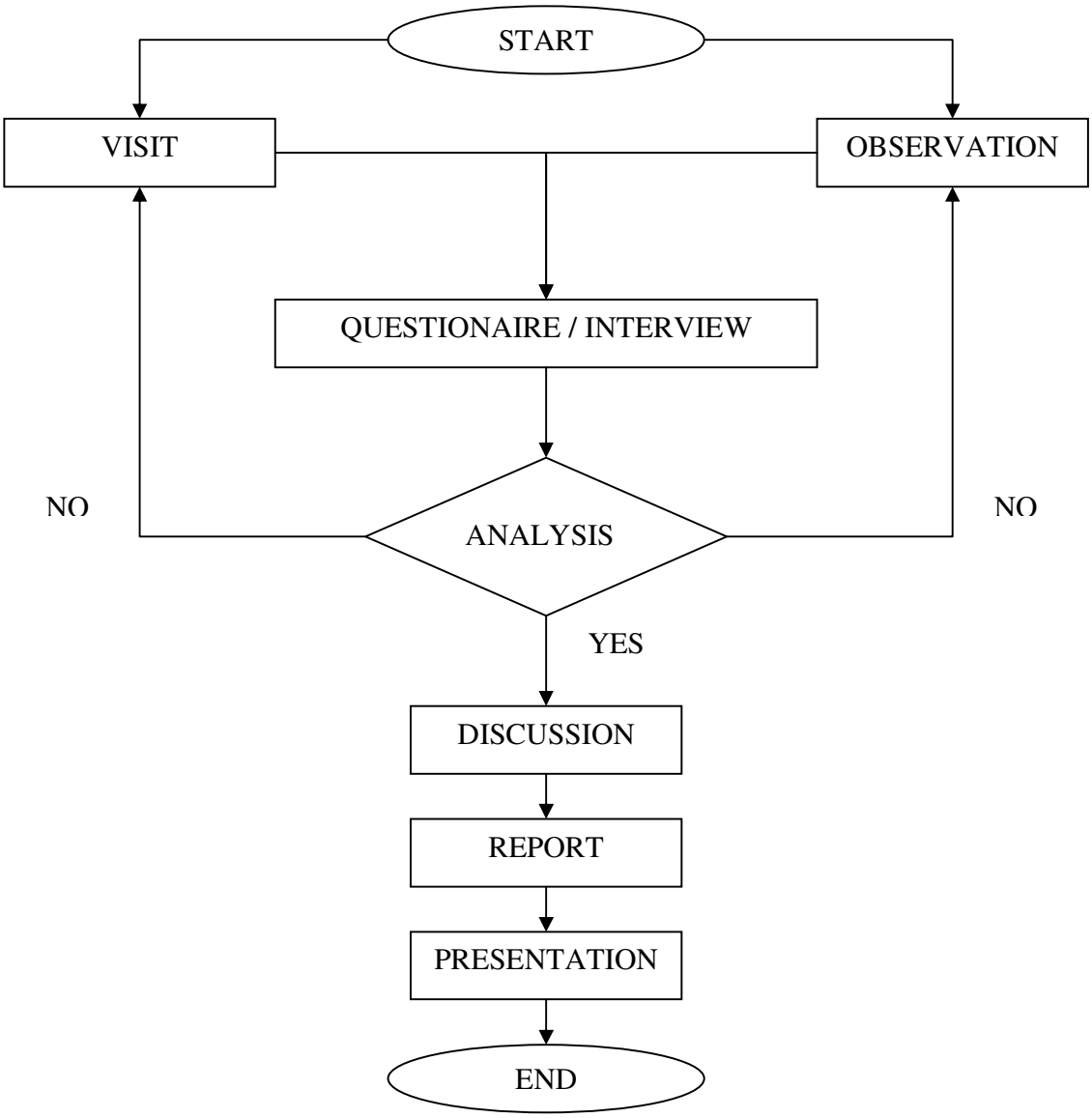
APPENDIX A2

Flow Chart for Final Year Project 1



APPENDIX A3

Flow Chart for Final Year Project 2



APPENDIX B1

QUESTIONNAIRE (UMP)

Jantina :_____

Program Pengajian :_____

Soal selidik ini dijalankan untuk mengkaji implimentasi proses penyelenggaraan mesin sebagai satu budaya.Sila jawab dengan jujur dan telus.Jawapan anda tidak akan didedahkan.Anda diminta supaya tidak berbincang semasa menjawab soal selidik ini.

Sila bulatkan (1) hanya satu jawapan untuk setiap kenyataan.

1 = Sangat tidak bersetuju
2 = Tidak bersetuju
3 = Berpuas hati
4 = Bersetuju
5 = Sangat bersetuju

1. Anda memahami tentang cara-cara mengendalikan mesin (*turning*) ini dengan betul.

1	2	3	4	5

2. Anda diberi pendedahan tentang kepentingan dan langkah-langkah asas untuk menyelenggara mesin ini.

1	2	3	4	5

3. Sila nyatakan langkah-langkah yang anda amalkan sebelum dan setelah selesai menggunakan mesin.

i) _____

ii) _____

iii) _____

iv) _____

v) _____

4. Anda memahami dan mengamalkan system 5S yang diaplikasikan di dalam makmal.

1	2	3	4	5

5. Mesin yang anda gunakan sentiasa berada dalam keadaan baik dan berfungsi dengan sempurna.

1	2	3	4	5

6. Anda akan melaporkan kepada Jurutera Pengajar sekiranya mesin tidak berfungsi seperti biasa.Contohnya :

1- Mesin bergegar secara berlebihan

2- Terdapat bunyi kuat di bahagian gear mesin

3- Sukar mendapatkan kejituan dalam hasil kerja

1	2	3	4	5

7. Sekiranya anda bertanggungjawab untuk mereka bentuk komponen atau mesin,anda akan mengambil berat tentang aspek untuk memudahkan penyelenggaraan mesin.

1	2	3	4	5

8. Dalam pengurusan peralatan kejuruteraan, belanjawan untuk penyelenggaraan adalah sangat penting.

1	2	3	4	5

APPENDIX B2

QUESTIONNAIRE (Companies)

Tujuan kaji selidik ini dijalankan adalah untuk mengkaji tahap pengamalan proses penyelenggaraan sebagai satu budaya di sesebuah tempat.Kaji selidik ini penting bagi melihat sama ada terdapat sebarang penambah baikan boleh dilakukan terhadap system yang sedia ada.Jawapan anda adalah sangat penting.Identiti semua responden adalah dirahsiakn.Anda diminta supaya tidak berbincang semasa menjawab kaji selidik ini.

1	2	3	4	5

1 Sangat Setuju
2 Setuju
3 Tidak Tahu
4 Tidak Setuju
5 Sangat Tidak Setuju

1. Kilang ini menjalankan proses penyelenggaraan secara berjadual.
   a) ya b) tidak c) tidak tahu

2. Sila nyatakan tentang proses penyelenggaraan yang dijalankan pada mesin ini.

Penyelenggaraan	**Jarak tempoh setiap penyelenggaraan**

3. Kilang ini mengamalkan prinsip 6 sigma.
   a) ya b) tidak c) tidak tahu

4. Pencapaian kilang ini berbanding yang disasarkan dalam 6 sigma adalah sangat baik. (3.4 kerosakan per 1 juta kemungkinan)

1	2	3	4	5

5. Tahap kesedaran pihak pengurusan kilang ini terhadap kepentingan penyelenggaraan yang berterusan adalah sangat baik.

1	2	3	4	5

6. Mesin-mesin di kilang ini sentiasa beroperasi dengan baik dan sempurna.

1	2	3	4	5

7. Kerja-kerja penyelenggaraan sentiasa dilakukan dengan mengikut setiap panduan yang diberikan oleh pihak pengeluar mesin.

1	2	3	4	5

8. Pekeja dihantar menjalani latihan yang berterusan untuk mengendali dan menyelenggara mesin dengan sempurna.

1	2	3	4	5

9. Pihak pengurusan memberi pendedahan yang meluas kepada pekerja tentang kepentingan proses penyelenggaraan.

1	2	3	4	5

10. Pekerja mengambil berat tentang isu penyelenggaraan mesin.

1	2	3	4	5

I.

11. Pernahkah berlaku masalah mesin yang tidak dapat digunakan atau rosak untuk masa yang lama?

a) ya b) tidak c) tidak tahu

12. Jika ya, sila nyatakan sebab berlakunya keaadaan sedemikian :

i) _____

ii) _____

iii) _____

iv) _____

APPENDIX B3

INTERVIEW (Companies)

1. Berapakah juruteknik yang bertugas pada satu-satu masa?

2. Berapa ramaikah personel yang berada di bahagian pengurusan (maintenance)?

3. Bagaimana pihak pengurusan memastikan kerja-kerja penyelenggaraan dijalankan dengan betul?

4. Sekiranya kerja penyelenggaraan tidak dijalankan dengan betul, apakah kesan jangka pendek / panjang yang ditanggung oleh syarikat?

5. Sekiranya terdapat pekerja / personel yang tifdak menjalankan proses penyelenggaraan tidak mengikut manual (tiada disiplin) apakah tindakan yang akan diambil oleh pihak pengurusan?