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LIST OF SYMBOLS

%	Percentage
$	U.S Dollar
α	Chi-square critical value
X^2	The chi-square
<	Less than
>	More than
=	same as

LIST OF ABBREVIATIONS

DPMO	defects per million
CEO	Chief Executive Officer
e.g.	Example
DMAIC	define-measure-analyze-improve-control
US	United State
yrs	Years
no.	number
etc	et cetera
smwhat	somewhat
strngly	strongly

ABSTRACT

Six Sigma applications is a one of the effective Total Quality Management tools in order to improve productivity in industry. However, while many benefits of Six Sigma is increasingly reported in other country, it is not very common among local company because lack of disclosure and many companies afraid to take a high risk. Furthermore, although there have been numerous case studies, comprehensive discussions, books and websites addressing Six Sigma, a very little academic research has been done to examine the impact of the Six Sigma application in local industry. This project has been created to measure the impact on a profit side, improving productivity and the benefits to the companies that implementing Six Sigma application. Survey project were used as the main research instrument in this project. Test result based on sample of 36 different companies in Malaysia manufacturer electric and electronics industry revealed that the implementation succeed to achieve all the benefits and the impact in profit side.

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ABSTRAK

Aplikasi Six Sigma adalah salah satu alat pengurusan kualiti yang berkesan untuk meningkatkan daya pengeluaran didalam industri. Walaubagaimanapun, sewaktu banyak faedah Six Sigma semakin meningkat dilaporkan di negara lain, ia bukan menjadi kebiasaan dikalangan syarikat tempatan kerana kurangnya pendedahan dan kebanyakan syarikat takut untuk mengambil risiko yang tinggi. Tambahan lagi, meskipun terdapat banyak kes pembelajaran, pembincangan menyeluruh, buku dan laman web tentang Six Sigma, terlalu sedikit penyelidikan akademik yang dibuat untuk memeriksa kesan aplikasi Six Sigma didalam industri tempatan. Projek ini telah dicipta untuk mengukur kesan bagi sudut keuntungan, peningkatan daya pengeluaran, dan faedah-faedah kepada syarikat yang melaksanakan aplikasi Six Sigma. Projek tinjuan digunakan sebagai alat penyelidikan utama dalam projek ini. Keputusan ujian berdasarkan sampel 36 syarikat pembuatan elektrik dan elektronik yang berbeza di Malaysia mendedahkan pelaksanaan berjaya mencapai semua faedah-faedah dan kesan dari sudut keuntungan.

CHAPTER 1

INTRODUCTION OF THE STUDY

1.1 BACKGROUND STUDY

The Six Sigma story began created by Motorola Corporation .In 1983, reliability engineer Bill Smith concluded that inspections and tests were not detecting all product defects, customers were finding defects, and defects were causing products is fail. Since process failure rates were much higher than indicated by final product tests, Smith decided that the best way to solve problem of defects was to improve the processes to reduce or eliminate the possibility of defects in the first place. He set the standard of Six Sigma nearly perfect, 99.9997% or 3.4 per millions defects-free and coined the term for the methodology to reduce manufacturing defects. (Greg Brue, 2005)

Over the past few decades, Six Sigma has been espoused by many world-class companies and has also a lot of successful cases (Maleyeff &Kaminsky, 2002) and now days, Six Sigma is a top agenda for many companies that try to reduce cost and it has become of the most important subject to improve productivity. Many of the top manufacturing companies implement thousands of six sigma projects every year and this implementation demands a significant investment of capital that requires a careful analysis to make sure that the benefit obtained much higher than actual investment. (Kumar, Nowicki, and Verma, 2008)

Although there have been numerous case studies, comprehensive discussions, books and websites addressing Six Sigma, very little scholarly research has been done on Six Sigma. (Goffnett, 2004) and (Schoreder et al, 2005). In addition, Six Sigma application is not very common among local company. This is because lack of disclosure about the application and many of companies afraid to take a high risk and there has been very few empirical studies examining the impact of the Six Sigma application in local industry. So, this project has been created to measure the impact on a profit side and the benefits to the companies that implementing Six Sigma application in Malaysia using a survey project as the main research instrument. A set of questionnaire that focus on the impact of Six Sigma application on a profit side, and the benefits to the companies that implemented will passed trough to the selected companies and the feedback from the companies will be used to collect a data. A 36 feedback from different electric and electronic manufacturer sector in Malaysia has been chosen as data samples.

1.2 PROBLEM STATEMENT

The implementation of Six Sigma application not very common among local companies because lack of disclosure and many of companies afraid to take high risk of profit side when implementing this application and there has been a very few empirical studies examining the impact of the Six Sigma application in local industry. It necessary to study the impact and benefits of Six Sigma so that this project will be a platform to acquire Six Sigma among local industry.

1.3 OBJECTIVES OF THE STUDY

The main objectives of this study are as following:

1.3.1 To study Six Sigma impact.

1.3.3 To determine benefits of implementation the Six Sigma application.

1.4 SCOPES OF THE STUDY

In order to achieve the objectives, this project will focus on:

1.4.1 Survey project as main instrument where the set of questionnaire will passes trough to the samples and the feedback will be used as a data collection.

1.4.2 Impact of Six Sigma on a profit side, and benefits to the companies that implemented.

1.4.3 36 feedbacks from different companies will be used as a sample.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The main purpose of this chapter is to give the overview information about the title of this research. It also to explore and summarize the related literature about this title. This chapter will give the details explanations about the Six Sigma application in industry, the methodology of Six Sigma in order to increase productivity.

2.2 STUDY

Study is a process of gaining knowledge of a subject, especially from books. Study also means give one's time and attention to learning about something especially by reading, attending a class, listening, and many more.
(A.S Hornby, 2001)

2.3 SIX SIGMA

2.3.1 Introduction

Over the past few decades, Six Sigma has been espoused by many world-class companies and has also a lot of successful cases. 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. (Maleyeff & Kaminsky, 2002). Furthermore, the main objective of Six Sigma is focused around meeting the customer requirements and reducing process variations. (Kwak & Anbari, 2002)

Six Sigma, a trademark of Motorola, was introduced more than 20 years back as a method to reduce manufacturing defects. The concept behind this method was developed by William Smith to deal with the high failure rate experienced by the systems produced. Smith proposed Six Sigma as a tool to improve the reliability and the quality of products and thus, focused it at reducing defects by improving manufacturing processes. Initially developed as an operational strategy, Six Sigma has evolved into a competitive corporate strategy used extensively throughout the corporate world. Even traditional companies that adhere to conventional management frameworks have started embracing Six Sigma as a method of substance with the potential to increase market share and profitability (Harry, 1998).

Six Sigma at least have three different meanings, depending upon the context. The first meaning of Six Sigma is a management philosophy. Six Sigma philosophies are a customer-based approach used to recognize that product and service defects are expensive. Six sigma philosophies claim that the lowest cost, highest value producer is the most competitive provider of goods and services. Six Sigma is a way to achieve strategic business result. Another meaning is that Six Sigma is a statistic. Six Sigma processes will produce less than 3.4 defects or mistakes per million opportunities. Many successful Six Sigma projects do not achieve a 3.4 parts per million opportunities defect rate, or less, but this simply indicates that there is still opportunity. A third meaning of Six Sigma is a process. To implement the Six Sigma management philosophy and achieve the Six Sigma level of 3.4 defects per million opportunities or less there is a process that is used. Six Sigma is not a set of new or unknown tools. Six Sigma tools and techniques are found in many improvement methodologies, such as total quality management. Six Sigma is the application of the statistical tools and techniques to selected important projects at the appropriate time and in alignment with the organization’s strategic plans. (Cary W.Adams, 2003)

2.3.1 Six Sigma System and Process Improvement

The Six Sigma approach differs from previous process improvement programs in terms of being exclusively a customer-driven and data-defined system (Breyfogle, 2003). The Six Sigma concept originates from the lower-case Greek letter sigma, the statistical symbol for the standard deviation of a data distribution. A manufacturing or service process at the Six Sigma level would have only 3.4 defects per million opportunities, an extremely low error rate as described later. 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. (R.Gowen III and J. Tallon, 2005)

Process improvement to capture greater alignment with environmental change or creation of internal capabilities begins with the Six Sigma technical design dimensions. One of the technical design dimensions relates to the process of best practices sharing. The Six Sigma Roadmap for process improvement creates best practices (R.Gowen III and J. Tallon, 2005). Six Sigma begins by identifying the needs of the customer. These needs generally fall under the categories of timely delivery, competitive pricing and zero-defect quality. The customer's needs are then internalized as performance metrics (e.g. cycle time, operational costs and defect rate) for a Six Sigma practicing company. Target performance levels are established, and the company then seeks to perform around these targets with minimal variation. For Six Sigma to be truly successful in a manufacturing organization, it has to be proliferated across its various functions from design engineering, through materials and shipping, to sales and marketing, and must include participation from supporting functions such as information technology, human resources and finance. In fact, there is a single function that can remain unaffected by Six Sigma. While conventional improvement programs focus on improvements to address the defects on output, Six Sigma focuses on the process that creates or eliminates the defects and seeks to reduce variability in a process by means of a systematic approach called the

breakthrough strategy, more commonly known as the DMAIC methodology. DMAIC is an acronym for Define-Measure-Analyze-Improve-Control, the various development phases for a typical Six Sigma project. (Wiley, 2006)

Table 2.1 shows the rating percent impact of process improvement tool where the Six Sigma leading with 53.60 %.Six Sigma is the process improvement tool that has yield the greatest result. Moreover, the fact in this table shows that Six Sigma is ranked much higher than others, illustrates the effect of concurrently implementing various process improvement techniques given that most of these techniques constitute the Six Sigma toolbox. (Dusharme, 2006)

Table 2.1: Rating of process improvement techniques.

Process improvement tool	**Impact (%)**
Six Sigma	53.60
Process mapping	35.30
Root cause analysis	33.50
Cause and effect analysis	31.30
ISO 9001	21.00
Statistical process control	20.10
Total quality management	10.30
Malcolm Baldridge criteria	9.80
Knowledge management	5.80

(Source: Dusharme, 2006)

2.1.1 Benefits of Six Sigma of manufacturing process in industry

Motorola was the first organization to use term Six Sigma as part of its quality performance measurement and improvement program. Six Sigma has since been successfully applied in other manufacturing organizations such as General Electric, Boeing, DuPont, Toshiba, Seagate, Allied Signal, Kodak, Honeywell, Texas Instruments, Sony, etc. The reported benefits and savings are composed and presented from investigating various literatures in Six Sigma (Weiner, 2004, de Feo and bar-El, 2002, Anthony and Banuelas, 2002, Buss and Ivey, 2001 and McClusky, 2000). Table 2.2 summarizes the organizations, projects, benefits, improvements, and savings by implementing in Six Sigma application.

Table 2.2: Reported benefits and savings from Six Sigma in manufacturing sector

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)
Hughes aircraft's missile	Quality/productivity	Improved

Company/project	**Metric/measures**	**Benefits/savings**
systems group/wave soldering operations		1000%/improved 500%
Continental Teves/Brake and axle assemblies	Failure rate	More than 50% reduction in failure rate
Borg Warner Turbo Systems	Financial	$ 1.5 million annually since 2002
General electric	Financial	$2 Billion in 1999
Motorola (1999)	Financial	$15 Billion over 11 years
Dow chemaical/rail delivery project	Financial	Savings of $2.45 million in capital expenditures
DuPont/Yerkes plant in New York (2000)	Financial	Savings of more than $25 million
Telefonica de espana (2001)	Financial	Savings and increase in revenue 30 million Euro in first 10 months
Texas instruments	Financial	$600 million
Johnson and Johnson	Financial	$ 500 million
Honeywell	Financial	$ 1.2 billion
Ford motor company/exterior Surface defects	Financial	$500,000

(Sources: Weiner, 2004; De Feo and Bar-El, 2002; Antony and Banuelas, 2002; Buss and Ivey, 2001; and McClusky, 2000)

The Six Sigma concept for process improvement originated at Motorola (Folaron & Morgan, 2003). Before Motorola benchmarked against world-class Japanese electronics corporations in the mid-1980s, the overall product error rate was approximately “four sigma” (6200 defects per million opportunities, DPMO), as opposed to about “six sigma” (3.4 DPMO) at those Japanese companies (Behara, Fontenot, & Gresham, 1995). Training employees in Six Sigma methods and initiating process improvement projects improved Motorola's product quality to about five sigma (233 DPMO) by 1993 (Donlon, 1993). Motorola has achieved over $15 billion in cost savings due to Six Sigma in eleven years (DeFeo, 2000). Learning directly from Motorola's program and adding Black Belt training, Honeywell (formerly AlliedSignal) has reported Six Sigma program savings of more than $3.5 billion since 1995 due to the efforts of more than 3000 Black Belts and Master Black Belts.

The leading proponent recently has been the General Electric Company. In 1995, GE estimated the opportunity loss for their 3.5 sigma defect rate to be about $7 billion (Conlin, 1998). In pursuit of Six Sigma, recent annual program costs have leveled at $600 million, primarily for the salaries of 4000 Black Belts and training of 100,000 Green Belts. They have completed over 500,000 projects in the 6 years. The annual cost savings have been about $2.5 billion in the past few years. Furthermore, GE's innovative “At the Customer, for the Customer” initiative dispatches Six Sigma teams to resolve process inefficiencies for specific projects. At Wal-Mart, a GE team reduced the invoice error rate from 30% to less than 2%. GE expects that the annual 6000 projects and $1 billion savings “At the Customer” will create goodwill toward winning future customer orders.

The growth of Six Sigma programs has become explosive as more companies have discovered the competitive potential for the creation of unique dynamic capabilities. Early adopters in the mid-to-late 1990s included Black and Decker, Caterpillar, Dow Chemical, Dupont, Eastman Kodak, Gencorp, IBM, Johnson and Johnson, Raytheon, Weyerhauser, and Xerox. At Dow Chemical, the initial program year of 1999 realized an average of $500,000 in cost savings per project (Arndt, 2002). Although the cumulative cost saving was $750 million up to 2002, Dow

Chemical reported program savings of $750 million in 2003. The application of Six Sigma has also increased due to some large corporations requiring it from suppliers, such as NY Air Brake for GE, or joint venture partners, such as Union Carbide for Honeywell. Recent publications and websites reveal Six Sigma applications at additional manufacturing companies, such as Air Products and Chemicals, Albemarle, Avery Dennison, Danaher, Eaton, First Data Resources, Ford, Great Lakes Chemical, Home Depot, ITT Industries, Minnesota Mining and Manufacturing, NexusData, Northrup Grumman, Praxair, Rexnord, Rogers, Rohm and Haas, Schenectady International, SKF, Volvo North America, Woodward Governor, and W.R. Grace.(Kwak and Anbari, 2006)

2.3.4. Benefits and costs of Six Sigma management

A successful Six Sigma program will yield the following benefits to then management of an organization : improved process flows, improved communication trough Six Sigma terminology (for example; DPMO and process sigma), reduced cycle times, enhanced knowledge and enhanced ability to manage that knowledge, higher levels of customer satisfaction, increased productivity, reduced total defects, decreased work-in-progress (WIP), decreased inventory, improved capacity and output, increased quality and reliability, decreased unit costs, increased price flexibility, unit decreased time to market, faster delivery time, and increased liquid capital. (Cary W.Adams, 2003). Six Sigma projects generate an average of $250,000 in reduced costs or increased revenues. Additionally, these organizational benefits lead to the following stakeholder benefits; stockholders receive more profit because of decreased costs and increased revenues, customers are delighted with products and services, employees experience higher morale and more satisfaction from their joyful work, and suppliers provide higher-quality inputs. (Anthony and Banuelas, 2002)

On the other side of the profit equation, Six Sigma management requires the following resources, training time costs, material costs, material costs, training manual development costs, administrative and operating costs for DMAIC projects, infrastructure costs such as the costs of constructing and using organizational metric tracking systems, and monitoring DMAIC project costs. Anecdotal evidence strongly

indicates that the benefits of a Six Sigma committed to Six Sigma management for the long term. As an example, see General Electric's recent and current Annual Reports. (Hendricks and Kelbaugh, 1998)

2.4 MALAYSIA MANUFACTURER ELECTRIC AND ELECTRONICS INDUSTRY

Malaysia is one of the leading electrical and electronic product exporters worldwide. Almost 1000 companies in this industry are incorporated in Malaysia. The industry includes major brands like Panasonic, Sony, Philips and Samsung and local brands like I, MEC, Khind and Pensonic. The production range includes air-conditioners, refrigerators, washing machines, vacuum cleaners, electric fans, instant water heaters, rice cookers, blenders and microwave ovens. Malaysia is also a major exporter of semiconductor devices, which accounted for over 30% of total electronic exports in 2000.(MIDA, 2007).

2.4.1 Electronic Components

The products under this sub-sector include semiconductor devices (fabricated wafers, ICs and IC design), passive components (capacitors, inductors, resistors) and other components (such as storage media, disk drive parts, PCBs and metal and plastic parts/components for electrical and electronic (E&E) application). Capital investment for the year 2007 amounted to RM10.7 billion (US$3.45 billion). Within this sub-sector, the semiconductor industry is dominant in terms of production, employment creation and export contribution. Major semiconductor devices produced are linear and digital integrated circuits, memories and microprocessors, opto-electronics, discrete devices, hybrids and arrays. According to UNCTAD Handbook of statistics 2006-2007, Malaysia was among the five largest exporters of semiconductor devices in the world. Exports of semiconductor devices in 2007 were valued at RM96.5 billion (US$31.13 billion) or 39.4% of total electronics export. (MIDA, 2007).

2.4.2 Industrial Electronics

The products covers ICT products such as computer and computer peripherals, telecommunications, optics; and other industrial electronic products such as office equipment (copier machines, fax machines, typewriters, automatic data processing machines) and industrial controllers. Companies in this sub-sector have moved into production and development of higher-end industrial electronic products such as computer networking equipment, new generation audio-visual digital equipment and data storage devices (MR magnetic heads, compact discs (CD) media and hard disc drives). The capital investment under this sub-sector amounted to RM0.8 billion (US$0.2 billion) for the year 2007.(MIDA, 2007).

2.5 METHOD OF DATA COLLECTION

There are multiple ways to collect information to answer most questions. The ideal situation would be to collect from more than one source and/or to collect more than one type of information. The selection of a method for collecting information must balance several concerns including: resources available, credibility, analysis and reporting resources, and the skill of the evaluator.

As illustrated in Table 2.3, there are many examples for data collection methods. It summarizes the method of data collection and all the description for every method.

Table 2.3: Data collection methods

Data collection method	Description
Opinion Surveys	An assessment of how a person or group feels about a particular issue.
Delphi Technique	A method of survey research that requires surveying the same group of respondents repeatedly on the same issue in order to reach a consensus.
Questionnaire	A group of questions that people respond to verbally or in writing.
Time Series	Measuring a single variable consistently over time, i.e. daily, weekly, monthly, annually.
Case Studies	Experiences and characteristics of selected persons involved with a project.
Individual Interviews	Individual's responses, opinions, and views
Group Interviews	Small groups' responses, opinions, and views
Panels, Hearings	Opinions and ideas.
Records	Information from records, files, or receipts
Logs, Journals	A person's behavior and reactions recorded as a narrative
Judicial Review	Evidence about activities is weighed and assessed by a jury of professionals.

(Source, Stouthamer-Loeber, M. and Bok Van Kammen, W. 1995)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Chapter 3 will guide the overall process that will use to achieve the goals and the objectives of this study. The methodology is a well planned system of method that has been designed and illustrated clearly to make the study smooth and achieved the goals. Via this method we can finish this research with very well planning and successful way. This methodology also acts as the guidance to us if we lost our path because in the methodology all the process and procedure are explain very well and systematically.

3.2 FLOW CHART OF METHODOLOGY

Flowchart below show the flow work was done in this research. All the work to complete this project has been done step by step following the flowchart. In project, methodology is an important element to be considered to ensure that the project perform smoothly follows as planning. It is also as a guideline in develops the project so that the project is always following the guidelines based on the objectives which is states in chapter 1

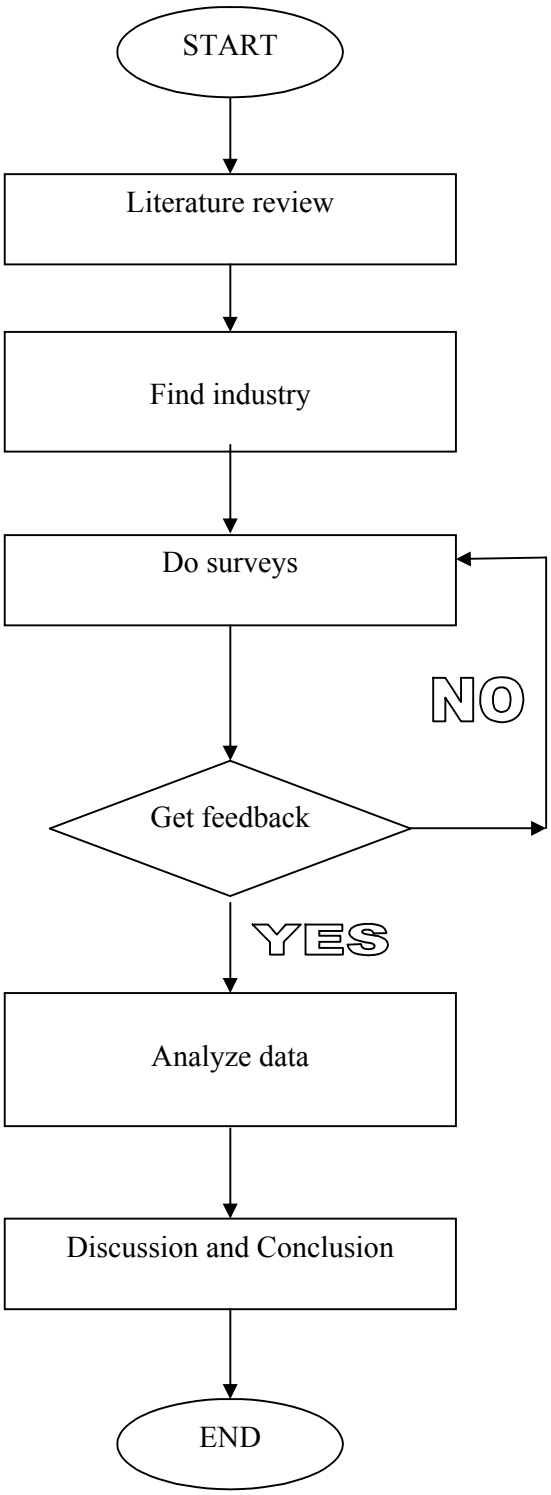

Figure 3.1: Flow Chart of Methodology

3.3 LITERATURE REVIEW

The flow chart is starting with the literature review. At the literature review, the research about the project has been done and all the information from magazines, books, journals, and internet has been gathering all together. The flow chart acts as a guide so that the project will not run from the objectives. Understand about the title of the project is very important step in the beginning of the project. The title of the project is study on impact of Six Sigma in Malaysia manufacturer electric and electronics industry. Furthermore, the objectives are expanded to determine the scope of the project. Moreover, it is very important to know the purpose of the development of the project which is stated in the problem statement. Besides that, the purpose and methods of implementation Six Sigma are also important. It is to ensure the purpose of the projects which known as problem statement are clear. Additional, it is important in doing literature review for more accurate information.

3.4 FIND INDUSTRY

Finding the industry or company is performing to get the feedback from the company in order to get the data collection. Firstly, make a literature about industry that suitable for this project because there are many companies operating in Malaysia. After doing literature, this study decides to choose manufacturer electric and electronics industry because 1000 companies in this industry are incorporated in Malaysia. Since this project is concern about the impact of Six Sigma application in manufacturer electric and electronics industry in Malaysia. So, only the companies in this field have been chosen.

3.5 CONSTRUCTION OF SURVEY PROJECT

In order to achieve the objective of this project which is to measure the impact of Six Sigma application in Malaysia manufacturer electric and electronics industry and determine the benefits that companies get from implementation of Six Sigma application, the survey project were developed as a main instrument of this project. There are 5 steps in survey projects:

3.5.1. Establish the goals of the project - What you want to learn

The first step in any survey is deciding what the study wants to learn. The goals of the project determine who will be sample and what the question will be asked to them. If the goals are unclear, the results will probably be unclear. To define the aims for academic, as opposed to market, research it will need to review the relevant literature and may need to do some preliminary research amongst target subjects. Fulfilling these aims should then drive the design of questionnaire and help select questions that are relevant, concise and efficient. Clear and concise questionnaires can help get the best response. Foddy, W. (1994)

3.5.2. Determine the sample and population- Whom you will interview

The population is simply all the members of the group that the study is interested in. A sample is a sub-set of the population that is usually chosen because to access all members of the population is prohibitive in time, money and other resources. A key issue in choosing the sample relates to whether the members have chosen are representative of the population. Often the sample is chosen randomly from a list that contains all the members of the population; such a list is called a sampling frame. Some methods of selecting samples, e.g. quota sampling, do not require a sampling frame. (Fink, A. 1995)

The next thing to decide is how many people that need to interview. This project will focus to feedback from the different electric and electronic companies as a sample in this project but the questionnaire that will be passes trough have to multiply to make sure that the target of feedback is not below than target and as a precaution that not all companies will give a feedback to the survey and for this project, a 200 persons from different manufacturer electric and electronic companies all over the country has been chosen as a population and from that. Only 36 population give a feedback and from that 36 feedbacks. Only 23 respondents from companies that implementing Six Sigma has been used as a sample from population.

3.5.3 Choose survey methodology- How you will interview

Once the sample has been decided the method of data collection will also be decided. Each method has advantages and disadvantages. In order to save the budget and times the mail, email, and telephone survey has been chosen to implement this survey.

The mail survey has been chosen as one of the way for survey due to several advantages as below:

1. Mail surveys are among the least expensive.
2. This is the only kind of survey you can do if you have the names and addresses of the target population, but not their telephone numbers.
3. The questionnaire can include pictures - something that is not possible over the phone.
4. Mail surveys allow the respondent to answer at their leisure, rather than at the often inconvenient moment they are contacted for a phone or personal interview. For this reason, they are not considered as intrusive as other kinds of interviews.

Email surveys are both very economical and very fast. More people have email than have full Internet access. This makes email a better choice than a Web page survey for some populations. On the other hand, email surveys are limited to simple questionnaires, whereas Web page surveys can include complex logic and for this project, email surveys has been chose due to several advantages as below:

1. Speed. An email questionnaire can gather several thousand responses within a day or two.
2. There is practically no cost involved once the set up has been completed.
3. You can attach pictures and sound files.
4. The novelty element of an email survey often stimulates higher response levels than ordinary “snail” mail surveys.

(Berdie, D.R. 1986).

3.5.4 Create a questionnaire – What you will ask

The first rule is to design the questionnaire to fit the medium. Keep it short and simple. If we present a 20 pages questionnaire most potential respondents will give up in horror before even starting. Avoid the temptation to add a few more questions. Start with an introduction or welcome message. In the case of mail or Web questionnaires, this message can be in a cover page or on the questionnaire form itself. If we are sending emails that ask people to take a Web page survey, put the main introduction or welcome message in the email. When practical, state who you are and why you want the information in the survey. A good introduction or welcome message will encourage people to complete questionnaire. (Vogt, W.P 1993).

The construction of questionnaire is the main part because from the questionnaire determine the data collection that needed. Design of the questionnaire can be split in to three elements: (Salant, P, and Dillman, 1994).

a) Determine the questions to be asked,
b) Select the question type for each question and specify the wording,
c) Design the question sequence and overall questionnaire layout.

3.5.4 Conduct surveys - Ask the questions

At this point, the surveys will pass through to the selected samples using selected method which a passing the questions through mail and email and waiting for the feedback from the companies. After all the above steps have been implemented, this is the most important part that has been considered. After make sure all the things have been done; now the questionnaire can be passed through according to the ways that have been planned. For email-survey, the implementation required no cost. So, it will be easier. But more things required when implementing mail-survey, the project needs to provide reply-envelope with the stamps so that it will be easy for the companies to reply. A cover letter also has to be included because a good cover letter or invitation to take a survey will increase the response

rate. A bad one or none at all, will reduce the response rate. The information must be including in the preceding two paragraphs and mention the incentive.

3.6 GET FEEDBACK

The feedback from the selected sample or companies is the important thing in order to get the right data collection which is to determine whether the objective of this project is achieved or not. If the data from the feedback is not satisfying the objective, the constructions of questionnaire and the surveys will be implementing again. Basically, after the implementation of survey project has been done, it has to wait within two weeks to see the feedback. For this project, the duration of implementation take quite long of time because not many companies interested to give a feedbacks and the project have to do a second round of mail-way survey in order to increase the feedbacks.

3.7 DATA COLLECTION

Data collection means gathering information to address those critical evaluation questions that have been identified earlier in the evaluation process. There are many methods available to gather information, and a wide variety of information sources. The most important issue related to data collection is selecting the most appropriate information or evidence to answer the questions. To plan data collection, it must think about the questions to be answered and the information sources available. Also, it must begin to think ahead about how the information could be organized, analyzed, interpreted and then reported to various audiences. (T.M. Archer, Shelby, 1998)

As mention earlier, a target 200 persons from different companies in Malaysia manufacturer electric and electronic industry was selected as population. The researcher unit will be individual plant because Six Sigma application practices are carried out at the plant level and the practices in different plants even those within the same company, may vary substantially (Flynn, 1995). The respondents included plant managers, operations managers, and quality managers. The instrument was administered as a by mail, email survey also telephone survey. Following Dilman's

(2000) total design methodology, four rounds of emails with the link to the web survey were sent to the target sample, and response were received from a total of 226 total plants resulting in an overall 26 % response rate. According to Flynn (1995) it is quite common for survey response rates to be around 20%, which means sending out five times as many questionnaires as wanted returning and this project has sent a set of questionnaire to 200 persons as expect that 25% will give feedback. Unfortunately, only 36 respondents give feedbacks.

Table 3.1 is a total responding from 4 ways of survey which is shows that the numbers of total sent and total respondents that have give feedback and all the percentage. The mail-way survey reported lowest percentage compared to others.

Table 3.1: The profile of responding persons

Source	Total sent	Respondents	Percentage
Mail	150	18	12%
Email	30	10	33.3%
Telephone	10	3	30%
Others	10	5	50%
Total	200	36	18%

Table 3.2 is a total number of respondents for duration of implementation. From 36 respondents 23 respondents have implementing Six Sigma which is most of them have implementing for less than 10 years and others respondents implementing other Total quality management and there are no duration implementation reported.

Table 3.2: The profile duration of implementation

TQM implementation	**No.of respondent**	**Duration implementation**				
		< 1yr	**< 3yrs**	**< 5yrs**	**< 10yrs**	**> 10 yrs**
Six Sigma	23	0	3	6	8	6
Others	13	-	-	-	-	-

Table 3.3 value in level satisfaction shows that 1 representing strongly disagree, 2 representing disagree, 3 representing somewhat agree, 4 representing agree and 5 representing strongly disagree and also the total number of respondents that answering the question due to level of satisfaction for impact in profit side

Table 3.3: Descriptive statistics of impact Six Sigma in profit side

NO	**IMPACT (PROFIT SIDE)**	**LEVEL SATISFACTION**				
		1	**2**	**3**	**4**	**5**
1	Increase profitability	0	2	1	12	9
2	Increase the revenues	0	1	2	10	10
3	Decrease the unit costs	0	0	2	12	9
4	Require higher training time costs	3	5	9	6	0
5	Require higher operating costs for DMAIC projects	4	6	10	3	0
6	Require higher infrastructure costs (i.e ; cost of constructing)	4	4	11	4	0

Table 3.4 value in level satisfaction shows that 1 representing strongly disagree, 2 representing disagree, 3 representing somewhat agree, 4 representing agree and 5 representing strongly disagree and also the total number of respondents that answering the question due to level of satisfaction for benefits that they get after implementing Six Sigma application

.**Table 3.4:** Descriptive statistics benefits of Six Sigma applications

NO	BENEFITS	LEVEL SATISFACTION				
		1	**2**	**3**	**4**	**5**
1	Increase the productivity of company	0	0	3	7	13
2	Improve the quality of product of company	0	0	3	4	16
3	Reduce the total defect of company	0	0	2	13	8
4	Reduce the cycle times of company	0	1	2	12	8
5	Increase the levels of customer satisfaction of company	0	0	1	10	12

3.8 DATA ANALYSIS

After complete the surveys project, all the data collection has been analyzed. A precursor to analysis is the coding, entry and checking of data. There are many software can be used to analyze a data from survey. (E.g. SAS, Minitab and SPSS, Excel. In all cases a similar approach is used for coding and formatting data. Usually the data is help on the computer in a rectangular data table where each row represents a ‘case’, i.e. a specific respondent and their data. Each column represents a specific variable, i.e. the data for that variable for all respondents. A question on the questionnaire may require more than one variable to specify the data collected by that question. A variable will have a unique title and a specific level of measurement. The measurement level of a variable is important because it determines the type of