THE RELATIONSHIP BETWEEN IMPLEMENTED LEAN SIX SIGMA TOWARDS PERFORMANCE OF LOGISTIC

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APPROVAL

I hereby acknowledge that this project paper has been accepted as part of fulfilment for the degree Bachelor of Supply Chain and Logistics

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DECLARATION OF ORIGINAL WORK

I hereby declare that all the work of this thesis entitled “The Relationship Between Implemented Lean Six Sigma Towards Performance of Logistic” is original done by myself and no portion of the work encompassed in this research project proposal has been submitted in support of any application for any other degree or qualification of this or any other institute or university of learning.

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DEDICATION

I would like to appreciate the dedication of my beloved family members who educated me and motive me to learn until degree level. And also, I express a deep sense of gratitude to my lecturer whom also my supervisor for my final year project, Dr. Nurhayati Binti Kamarudin and my fellow friends. They have provided me fully support and advice throughout this research. Without their blessing and encouragement, this research is impossible to complete within short period of time.

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ABSTRACT

Lean Six Sigma can be defined as a set of management techniques intended to improve business processes by greatly reducing the probability that an error or defect will occur. It emphasizes cycle-time improvements while reducing manufacturing defects to no more than 3.4 occurrences per million units or events. This study aims to examine the relationship between implemented Lean Six Sigma towards the performance of logistic. A probability sampling approach was used for the study and samples were taken from new groups in Malaysia. A five-point Likert Scale questionnaire will be used to obtain respondent information. The questionnaire was evaluated with the help of the Statistical Package for the Social Sciences (SPSS). The results show that all the independent variables are significantly correlated. The conclusion of this study is expected to provide a good aspect to the new group in Malaysia.

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Keyword: Lean Six Sigma, Technology, Performance, Logistic

ABSTRAK

Lean Six Sigma boleh ditakrifkan sebagai satu set teknik pengurusan yang bertujuan untuk menambah baik proses perniagaan dengan mengurangkan kebarangkalian bahawa ralat atau kecacatan akan berlaku. Ia menekankan penambahbaikan masa kitaran sambil mengurangkan kecacatan pembuatan kepada tidak lebih daripada 3.4 kejadian setiap juta unit atau peristiwa. Kajian ini bertujuan untuk mengkaji hubungan antara Lean Six Sigma terhadap prestasi teknologi logistik. Pendekatan persampelan kebarangkalian telah digunakan untuk kajian dan sampel diambil daripada kumpulan baru di Malaysia. Soal selidik skala Likert Lima mata akan digunakan untuk mendapatkan maklumat responden. Soal selidik telah dinilai dengan bantuan Statistical Package for the Social Sciences (SPSS). Keputusan menunjukkan bahawa semua pembolehubah bebas mempunyai korelasi yang signifikan. Kesimpulan kajian ini diharapkan dapat memberikan aspek yang baik kepada golongan baharu di Malaysia.

Kata kunci: Lean Six Sigma, Technologi, Prestasi, Logistik

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In today's competitive world, enhancing the quality of the products and processes through continuous improvements is one of the prime objectives for any organization. With a focus on customer delight, profitability and reduced cost, "quality" emerged as a central point for the organizations (Sunder, 2016a).

As a continuous improvement approach, the lean concept originated from the TPS, focusing on doing more with less (Prasad et al., 2016). On the other hand, the Six Sigma approach initiated, aiming to reduce variations in the process at Motorola and resulted in dramatic improvement (Kuvvetli et al., 2016). Since the inception of Lean and Six Sigma, the number of the organizations adopted Lean and Six Sigma individually during the last 20 years of the 20th century and successfully achieved the improvements in the organizations and realized a positive impact on the firm's performance (Antony et al., 2017; Sahoo and Yadav, 2018).

Lean and Six Sigma were emerged during the last half of the 20th century and were the field of investigation for the researchers and practitioners. Both approaches were widely adopted in different organizations resulted in enhancement in performance.

However, at the beginning of the 21st century, Lean Six Sigma methodology turned up as a methodology for continuous improvement, got the attention of academicians, researchers and practitioners, and widely adopted in organizations. Lean Six Sigma is reported as a fine blend of Lean and Six Sigma and complementary. (Rodgers et al., 2019; Sunder, 2016b; Yadav et al., 2018a). According to few researchers, Lean Six Sigma helps to reduce non-value-added activities, wastes, defects and nonconformities encountered during various processes, addresses the issues related to waste and process flow with a focus to reduce the variation in product and process as well.

This chapter explains all of the important details about the research topic, which is the relationship between implemented Lean Six Sigma towards performance of logistic. In addition, the Lean Six Sigma concepts result in a potent mix of management and control analytical tools, methodologies and approaches. Using Lean Six Sigma approaches in the logistics and supply chain results in waste reduction due to regulated attempts to understand and reduce variance, while simultaneously enhancing velocity and material flow performance. (Al-Qatawneh et al., 2019) Furthermore, the researcher discusses the research context, the problem statement is that the Lean Six Sigma are consistent and easy to implement to all manufacture, the research problem created based on the problem, the research purpose and scope of study, research limitations, and the significance of the research.

1.2 Background of Study

In recent years, rapid advancements in information technologies have facilitated and broadened access to information. In addition to the concepts, pricing, location where the product is sold, distribution channels, and promotion, or the 4P approach (Product, Price, Place, Promotion), performance and process management have become crucial as a result of technological improvements globally reducing local barriers. Products developed as a consequence of large-scale surveys must also be backed up by well-thought-out tactics in order to obtain the desired market share. (Kasim & Gokhan, 2014)

Companies must be able to supply quality products or services in the face of competition, both in terms of pricing and service speed. Customers who are satisfied with the services given are more likely to remain loyal to the company and not switch to a competitor's service offering. If this is not met, their loyalty will be lost, and they will transfer to buying items or services from competitors. Dissatisfaction will lead to a drop in sales, resulting in lower earnings or even losses for the company.

Lean Six Sigma and Six Sigma are two similar process improvement methodologies. Both can assist businesses in making significant gains in quality, efficiency, and time utilisation by analysing how their processes work. The DMAIC phases/method is used by both (Ubaidillah & Sari, 2020). Both are predicated on fostering a problem-solving culture in the company. Six Sigma, on the other hand, is concerned with minimising faults and process variability in order to increase process output and quality and fulfil customer expectations. Lean Six Sigma is concerned with minimising or eliminating excessive resource utilisation and errors in order to enhance workflow and provide greater value to consumers.

The six sigma DMAIC (Define, Measure, Analyse, Improve, and Control) methodology can be viewed as a road map for addressing problems and improving products and processes. When the corporate culture and experience level allow, most firms start with the DMAIC approach and then add the DFSS (Design for Six Sigma) also known as DMADV or IDDOV techniques. (Krishnan & Prasath, 2013) Lean Six Sigma is a systematic problem-solving strategy as a statistical and scientific process for developing new strategic systems, products, and services with the goal of significantly lowering customers' stipulated failure rates or improving system inputs. (Linderman et al., 2003)

Lean Six sigma is a quantitative indication of the quality of products, services, and processes as a statistical measurement tool. It displays how far the process deviates from the ideal of zero

defects. The measurement unit in the six sigma technique is "Defects per Unit" (DPU). A fault is something that causes a client to be dissatisfied. The best tool for determining the quality of a process or a product is the DPU. The incidence frequency of flaws is represented by the Sigma coefficients three Sigma, four Sigma, or six Sigma. The lower the Sigma value, the lower the defect chance. (Kasim & Gokhan, 2014)

1.3 Problem Statement

This project addresses the problem which is that the Lean Six Sigma can maximise the profit and difficult to implement. Committing to lean six sigma requires the total cooperation of the company. Due to the tightly defined methods for improved communication, inventory control and measures dealing with customer service, if the entire company is not on board, success is not likely.

For effective performance and perception management in enterprises, vertical and horizontal integration is recommended. Vertical integration refers to the compatibility of an organization's levels from the bottom to the top. In other words, the issue the organisation wishes to manage, as well as essential messages to be developed around it, should be presented by a newly hired office employee or, for example, a chauffeur, with the same zeal, diligence, and content as the corporation's top management. Furthermore, horizontal integration is defined as "ensuring the compatibility and cooperation among communication works supervised by social stakeholders, given their close interdependence." Because Lean Six Sigma is applied to all aspects of the production and planning process, it may create rigidity and bureaucracy that can create delays and stifle creativity. (Bozkanat, 2021)

Sales and profitability are typically measured in most organisations. They do not, however, have operational effectiveness metrics. The outputs of the business are, indeed, sales figures and profitability. The inputs must be subjected to measures to improve profitability and efficiency. There have never been any positive results from regulations imposed on outputs. For maximum performance and efficiency, start with input laws that are compatible with the strategy and maintain vertical and horizontal integration from there. (Kasim & Gokhan, 2014)

Lean Six Sigma measurements appear to focus on process performance; nevertheless, the metrics are not aggregated or associated to corporate wellbeing, according to the Lean Six Sigma strategy. Lean Six Sigma is a performance management system that aims to keep track

of all of a company's internal activities. However, in practise, it appears that developing a process/strategy synergy with Lean Six Sigma is difficult. The effectiveness achieved in process management cannot always or directly be mirrored towards the upper echelons of the company. (Kasim & Gokhan, 2014)

Many papers covered the implementation process in a range of business kinds, according to a previous literature study; however, only a handful of these papers reported empirical research, and all of them were single case studies. (Nonthaleerak & Hendry, 2006)

Since its beginnings, the Lean Six Sigma methodology has been linked with huge corporations. Midsize businesses have gradually begun to profit financially from the scheme. Lean Six Sigma projects have resulted in increased savings and improved growth. SMEs are hesitant about the applicability of Lean Six Sigma due to a lack of expertise and education, as well as some misconceptions about the methodology. Apart from this, SMEs face significant technological, organisational, and financial constraints that prevent them from implementing Lean Six Sigma. (Raghunath & Jayathirtha, 2013)

The use of the DMAIC methodology to improve a dairy farm's feeding system is discussed in this example of an empirical single case study. They came to the conclusion that due to issues like limited resources and data accuracy, the implementation procedure in this small business environment is particularly slow. Healthcare and financial services, as well as non-production internal operations within a manufacturing firm, are two examples of non-manufacturing contexts mentioned in the literature. (Tylutki & Fox, 2002)

For instance, a case study on how to enhance procedures within a Human Resources (HR) function utilising the DMAIC methodology is provided. They validated that Lean Six Sigma may be used in non-manufacturing settings, although there are challenges unique to this setting, such as determining the project scope and working with less concrete metrics. They also emphasised that poor data analysis management might be a major contributor to inefficient Lean Six Sigma results. (Wyper and Harrison, 2000)

1.4 Research Question

1. What are the effective way to increase quality performance in logistic?
2. What are the factors that affect the implementation of Lean Six Sigma in logistic?

1.5 Research Objectives

1. To determine the Lean Six Sigma effectiveness toward performance of logistic.
2. To determine the factors that affect the implementation of Lean Six Sigma in logistic

1.6 Scope of Study

This research is focuses on the effective usage of Lean Six Sigma as one of the technology that be implemented in supply chain and logistic which aims to determine either the Lean Six Sigma are easy to apply to all manufacture or not. The data collection will be collected from manufacturer who have experience in Lean Six Sigma. Research will be conducted through interviews as surveys and other references. Thus, with the results obtained from them, researchers can profile the implementation of Lean Six Sigma and the factors influencing the implementation of Lean Six Sigma in logistic. Research will be conducted through interviews as other references. Thus, with the results obtained from them, researchers can profile the implementation of Lean Six Sigma and the factors influencing the implementation of Lean Six Sigma in supply chain and logistic.

1.7 Limitation of Study

The limitations of the study conducted by the researcher must focus on the huge company because they are so many barrier that have to faces by SME if their implement Lean Six Sigma. Through the limitations of this study, through the results of literature concept, data analysis and conclusions use in the companies that running on Lean Six Sigma.

Furthermore, there is also the assumption needed for the researcher to test the theory in the research. The primary assumption that the researcher comes out with is that all the respondents who involve in this research will provide their answers with fully honest based on their capability of the best understanding together with the adequate knowledge and experience they have on the topic studied to provide the best possible responses. Some of the responses

collected during this research may not exactly represent the responses from the respondents in the actual situation. However, the researcher still assumes that those respondents involved in this research have the correct understanding of the research study. The researcher approaches the right respondents to complete this research

1.8 Significant of Study

The importance of this research is to understand the effective way to increase the quality performance by the companies that implemented Lean Six Sigma in logistic. This research also important because to understand the strategies which can overcome the challenge faced by the company that implemented Lean Six Sigma.

Besides, this research also supported the researcher to understand the role of the Lean Six Sigma in logistic. This study intended to explain the factors influencing the implementation of Lean Six Sigma in logistic as well. This is because the researcher needs better understanding on how Lean Six Sigma can increase the performance in manufacture. In addition, this research was able to identify the relationship between the implemented Lean Six Sigma towards performance of logistic.

1.9 Summary

This chapter had covered the definition of Lean Six Sigma and gave the overview of this research which were the background of study, problem statements, research question, research objective, scope of the study.

In brief, this research is aimed to generate knowledge and details on. In this topic, researcher discuss the research background which brings out the problem of research and the barriers. Researcher also issued two research questions that matched the research objectives. Finally, the researcher chose to conduct interviews with manufacturer that have experience in Lean Six Sigma in different departments to obtain information related to the objectives and research questions that have been issued to produce research writing.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, we will discuss past research studies and debates. All studies related to the performance of logistic in implementing Lean Six Sigma in this chapter. Besides, this chapter will also outline the relationship between the dependent variables and the independent variables.

2.2 Lean Six Sigma Methodology

Six Sigma is a quality improvement tool based on the use of data and statistics. The term "sigma" is the Greek letter σ used for the quantity of Standard Deviation or standard deviation in statistics. Six Sigma's basic principle is product improvement by making improvements to the process so that the process produces the perfect product. In addition, six Sigma is oriented towards long-term performance through quality improvement to reduce errors, with zero failure targets (zero defects) on process capabilities equal to or more than six Sigma in standard deviation measures. Six Sigma is a technique or method of controlling and improving quality dramatically that has been implemented by the Motorola Company from 1987. This method was first developed by William B. Smith, Jr. Dan Mikel J. Harry of Motorola in 1981, when Bob Galvin was CEO of Motorola. (Haekal, 2021) Six sigma is a vision of improving quality towards a 3.4 failure of the unity of millions of opportunities for each transaction, whether it is goods or services, and it is an activity aimed at perfection.

Expenses made to cover the former will aid in the avoidance of losses caused by the latter. At the same time, it's important to remember that quality isn't a goal in and of itself. With Six Sigma, all operations should be focused on increasing the process' capability to meet customer requests while also maintaining process stability, which will lead to improved earnings. Furthermore, this applies to both the external client and the internal procedure. Furthermore, the procedure should be done accurately the first time, with any potential errors discovered and corrected as soon as feasible. Continuous measurement and control of the process provides

information on whether or not the process can satisfy the customer's needs, as well as if and where wastage is occurring. Its premise is that if something isn't measured, its performance can't be assessed. Any process irregularities should be used as a starting point for simplifying it. (Lemke et al., 2021)

2.2.1 DMAIC (Define, Measure, Analyse, Improve, Control) Cycles with Six Sigma.

The Six Sigma DMAIC (Define, Measure, Analyse, Improve, and Control) (Figure 1) methodology can be viewed as a road map for addressing problems and improving products and processes. When the corporate culture and experience level allow, most firms start with the DMAIC approach and then add the DFSS (Design for Six Sigma, also known as DMADV or IDDOV) techniques. (Krishnan & Prasath, 2013) This method allows for the integration of Six Sigma's three major areas: customers, processes, and staff. (Lemke et al., 2021)

Figure 1. DMAIC cycle

Table 1. Sample tools in DMAIC (Define, Measure, Analyse, Improve, and Control).

STEP	TOOLS
Define	CTQ (Critical to Quality), VoC (Voice of Client), SIPOC (Supplier Input, Process, Output, Client), 5W2H (5 Why 2 How)
Measure	Data collection plan, histogram, Pareto chart, C_p (potential process capability), C_{pk} (actual processes capability), DPMO (Defect per Million Opportunities)
Analyze	Ishikawa diagram, 5Why, DoE (Design of Experiments)
Improve	Poka Yoke, FMEA (Failure Mode and Effects Analysis), SMED (Single Minute Exchange of Die), 5S
Control	Control Charts, Shewhart Charts, process audit

While the DMAIC methodology outlined below appears to be linear and well-defined, it should be emphasised that an iterative approach may be required – especially for Black Belts and Green Belts who are unfamiliar with the tools and techniques that make up DMAIC. For example, you may discover that you did not collect enough data to determine the main cause of the problem after analysing your data (the Analyze step). Return to the Measure phase at this time if necessary. Furthermore, prior understanding of the tools and processes is required when deciding which tools are appropriate for each step. Remember that when it comes to efficacy, the proper application of tools is more important than correctness, and you don't have to utilise all of them all of the time. (Krishnan & Prasath, 2013)

2.2.1.1 Define Process

The Define Phase of the Lean Six Sigma improvement process is the first step. The project's executives construct a Project Charter, a high-level vision of the process, and begin to understand the demands of the process's consumers during this phase. This is a vital phase of Lean Six Sigma where your teams define the scope of their activities for themselves and your organization's leadership.

Define Phase: Define the project goals and customer (internal and external) deliverables.	**Tools Used**

Define Customers and Requirements (CTQs) Develop Problem Statement, Goals and Benefits Identify Champion, Process Owner and Team Define Resources Evaluate Key Organizational Support Develop Project Plan and Milestones Develop High Level Process Map	Project Charter Process Flowchart SIPOC Diagram Stakeholder Analysis DMAIC Work Breakdown Structure CTQ Definitions Voice of the Customer Gathering

Table 2: Phases and Tools in Define

2.2.1.2 Measurement Process

Measurement is crucial throughout the project's life cycle, and the team's first focus on data gathering is on two things: defining the process's start point or baseline and looking for indications to determine the process's root cause. Because data collecting requires time and effort, it's a good idea to think about both at the beginning of the project.

Measure Phase: Measure the process to determine current performance; quantify the problem.	**Tools Used**
Define Defect, Opportunity, Unit and Metrics Detailed Process Map of Appropriate Areas Develop Data Collection Plan Validate the Measurement System Collect the Data Begin Developing Y=f(x) Relationship Determine Process Capability and Sigma Baseline	Process Flowchart Data Collection Plan/Example Benchmarking Measurement System Analysis/Gage R&R Voice of the Customer Gathering Process Sigma Calculation

Table 3: Phases and Tools in Measure

2.2.1.3 Analyse Process

The Measure Phase is frequently linked with this phase. The team may be made up of multiple people who will collect different pieces of data or more data when the data is acquired. When the team evaluates the data from the Measure Phase, they may decide to change the data collecting plan to include more information. This process continues as the team examines both the data and the process in order to identify and confirm the fundamental causes of waste and flaws.

Analyze Phase: Analyze and determine the root cause(s) of the defects.	**Tools Used**
Define Performance Objectives Identify Value/Non-Value Added Process Steps Identify Sources of Variation Determine Root Cause(s) Determine Vital Few x's, Y=f(x) Relationship	Histogram Pareto Chart Time Series/Run Chart Scatter Plot Regression Analysis Cause and Effect/Fishbone Diagram 5 Whys Process Map Review and Analysis Statistical Analysis Hypothesis Testing (Continuous and Discrete) Non-Normal Data Analysis

Table 4: Phases and Tools in Analyse

2.2.1.4 Improvement Process

It's time to move on to solution creation once the project teams are comfortable with their data and have established that additional analysis would not add to their understanding of the problem. Although the team is likely to collect improvement suggestions throughout the project, a focused improvement effort might result in unique and beautiful solutions.

Improve Phase: Improve the process by eliminating defects.	**Tools Used**
Perform Design of Experiments Develop Potential Solutions Define Operating Tolerances of Potential System Assess Failure Modes of Potential Solutions Validate Potential Improvement by Pilot Studies Correct/Re-Evaluate Potential Solution	Brainstorming Mistake Proofing Design of Experiments Pugh Matrix QFD/House of Quality Failure Modes and Effect Analysis (FMEA) Simulation Software

Table 5: Phases and Tools in Improve

2.2.1.5 Control Process

This is a scaled-down version of the process management step. Throughout the project's lifecycle, the team has been constructing infrastructure, and during the Control Phase, they begin to document how they wish to pass that structure on to the process's personnel.

Control Phase: Control future process performance.	**Tools Used**
Define and Validate Monitoring and Control System Develop Standards and Procedures Implement Statistical Process Control Determine Process Capability Develop Transfer Plan, Handoff to Process Owner Verify Benefits, Cost Savings/Avoidance, Profit Growth ,Close Project, Finalize Documentation Communicate to Business, Celebrate	Process Sigma Calculation Control Charts (Variable and Attribute) Cost Savings Calculations Control Plan

Table 6: Phases and Tools in Control

2.2.2 Measure of Process in Six Sigma

The key sign in evaluating the process output in the Six Sigma concept is its capacity. The process sigma is a metric that measures the capabilities of a process (or sigma level). Depending on the parameters of the examined data, the approach for identifying and evaluating process capability varies. When dealing with continuous data, such as delivery time or fuel consumption, it's best to look at the frequency graph. Assuming that the process follows a normal distribution, over 90% of measurements of the given measure will lie within a range of plus or minus three standard deviations from the mean (Figure 2). (Lemke et al., 2021)

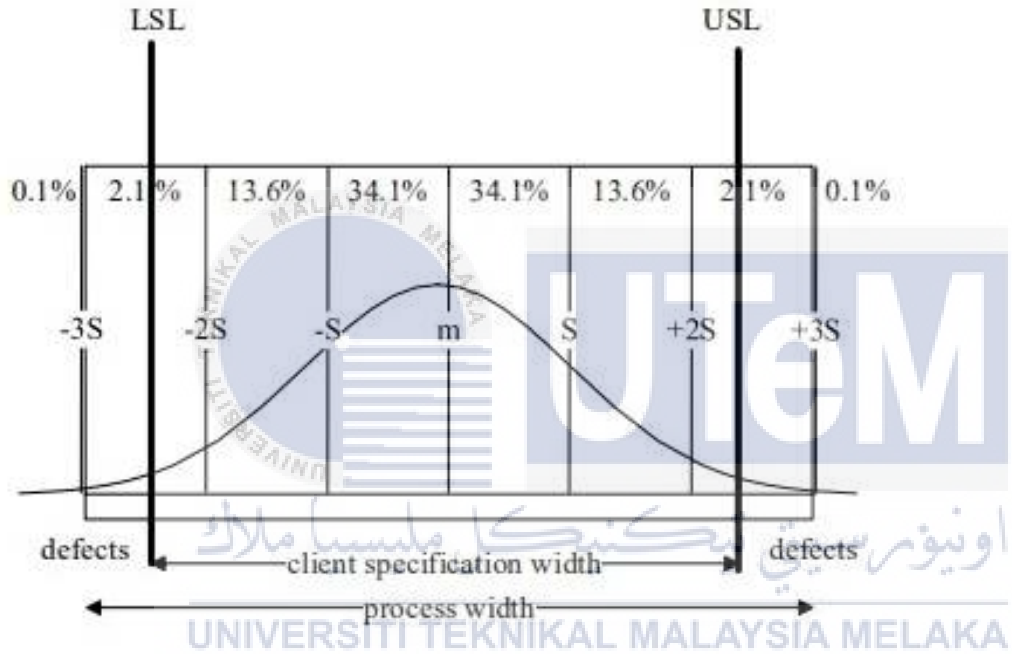


Figure 2. Six Sigma Chart

By plotting the lower and upper customer specification limits (labelled LSL and USL in Figure 3) on the normal distribution curve, the process capabilities may be assessed. For the customer, any values of the measured process output that fall between LSL and USL are regarded acceptable. Defects are defined as values of the process output measure that fall outside the range of the customer specifications. In terms of process capability, a correct process is one in which half of the graph falls within the range of the mean to the customer specifications nearer limit. Furthermore, the graph's mean is the same as the customer specification's mean. A 3-sigma level process is one in which a half of the graph can fit twice within the band from the mean to the nearer customer specification limit, whereas a 6 sigma level process is one in which a half of the graph can fit twice within the band from the mean to the nearer customer

specification limit. A graph like this shows a narrower dispersion, which is more noticeable to customers. It is thought that narrowing a process graph is far more difficult than altering its mean. Visual analysis of graphs is very useful and often applied, as it makes it possible to evaluate the process quite quickly in terms of its purposefulness and coherence. Nevertheless, a process graph analysis should be supported by computation of potential process capability (C_p , Equation (1)) and actual process capability index (C_{pk} Equation (2)). (Czarski & Matusiewicz, 2012)

$$C_p = \frac{USL - LSL}{6\sigma}, \tag{1}$$

$$C_{pk} = min\left[\frac{\mu - LSL}{3S\sigma} ; \frac{USL - \mu}{3S\sigma}\right], \tag{2}$$

Where:
USL - Upper Specification Limit,
LSL - Lower Specification Limit,
σ - Standard Deviation,
μ - Mean Value

The distribution of process capability is assumed to be more or less normal in the process capability study. (Swamy et al., 2014) In the literature on the subject, any process with a value of C_p, < 1 is considered a low capability process. The chart width is greater than the client's specification width. The processes with the C_p ratio falling between 1 and 1.33 are considered to be of medium capability, whereas C_p > 1.33 means a high process capability. The C_{pk} ratio number indicates how close the process mean is to the specification's limitations. Table 2 shows how to interpret the C_{pk} ratio. (Senvar & Toz, 2010)

C_{pk}	Interpretation
$C_{pk} = 0$	the process mean overlaps with one of the specification limits
$C_{pk} > 0$	the process mean is within the specification limits
$C_{pk} < 0$	the process mean is outside the upper or lower specification limit
$C_{pk} < -1$	the whole process is outside the specification limits (the process is off-target)

Table 7. C_{pk} Interpretation.

The combined interpretation of C_p and C_{pk} ratios, on the other hand, can provide a complete picture of the process. It is feasible to derive inferences by overlapping the chart mean with the specification mean by comparing the values of C_p and C_{pk}. (Montgomery, 2009) Table 3 shows how the ratio should be interpreted.

Relationship	Interpretation
$C_p = C_{pk}$	the process mean overlaps with the specification mean (the process is centered)
$C_{pk} < C_p$	the process mean does not overlap with the specification mean (the process is off-center)

Table 8. Relationship between C_p and C_{pk}.

The process sigma level can be found in the process capability table, based on Process Capability Index (C_{pk}) (Hayen, 2008) A six sigma level is achieved by a process described by the equation expressed by formula below.

$$C_p = C_{pk} = 2 \tag{3}$$

The procedure is not only logical, but its graph's mean also falls in the middle of the customer's requirements. It's worth noting at this point that many processes, particularly transaction and service processes, do not follow the normal distribution. Aldowaisan proposed a way for assessing these types of processes. (Aldowaisan, Nourelfath & Hassan 2015)

When the process is reviewed based on discrete facts, such as a damaged shipment, a different approach should be employed. In this situation, the customer is unconcerned with the amount of the damage to the parcel; all that counts is that it was damaged. This is a one-to-one choice. A DPMO (Defects per Million Opportunities) indicator should be calculated in this instance (Equation (4)) (Sujova et al., 2016) and used as the basis for identifying the sigma level in the process capability table. (Hayen, 2008)

$$DPMO = \frac{D}{U \times OPU} \times 1{,}000{,}000 \quad (4)$$

Where:

D—number of defects,

U—number of units,

OPU—number of defects opportunities per unit

An ideal process is the one which generates maximum 3.4 DPMO. (Banuleas & Antony, 2004) This process has a sigma level of 6 in the near term and 4.5 in the long run. (Totolici, n.d.)

2.2.3 KAIZEN

According to Imai (1986), Kaizen is a continuous improvement (CI) approach that involves both management and employees. Kaizen, in its broadest sense, is a strategy that includes concepts, methods, and tools as part of a larger picture of leadership engaging and people culture, all driven by the customer. According to Suzaki (1987), CI is a concept that is extensively used in manufacturing and quality circles. It is based on the premise that there is no end to improving a process, as the name indicates. Wickens (1990) outlines how collaboration helped to create the notion of Kaizen. According to Teian (1992), Kaizen is more than merely a method of development since it represents the daily battles that occur in the workplace and how these problems are conquered. According to Hammer et al. (1993), Kaizen fosters process-oriented thinking since procedures must be addressed before better results can be attained. Womack and Jones (1996) define Kaizen as "lean thinking" and provide a methodical methodology to assisting businesses in systematically reducing waste. According to Imai (1997), there are two types of improvement: Kaizen and innovation. Kaizen refers to minor gains that occur as a consequence of continual efforts. Innovation entails a significant improvement as a result of significant investment in new technology or equipment. (Lina & Ullah, 2019)

Different fields like engineering, manufacturing, management and other supporting processes in the organization can use standard methodology of Kaizen. The practice of Kaizen is illustrated in following figure

Figure 3

Kaizen will assist in teaching people how to complete tasks quickly through trials, which will lead to the identification and reduction/elimination of wastes in the process, and the selected technique may be enhanced. (Lina & Ullah, 2019)

The two most crucial parts of kaizen are gradual and continual improvement, as well as the participation of the whole workforce. Workers must also participate to the development of small but regular modifications by suggesting ways to enhance both the approach and the output. Aside from that, the logical structure of the kaizen concept, the precise relationship among its tools, and concrete measures and sequences implemented on the factory floor are difficult to define because there are many different schools of thought that emphasise different aspects and tools of kaizen in relation to others.(Lina & Ullah, 2019)

2.2.3.1 5 Why Technique

This method allows for a deep conversation regarding the sources of an issue, which is a critical step toward developing remedies based on what various people bring up. The 5 Whys method was developed in the 1930s by Toyota Founder Kiichiro Toyoda's father Sakichi and popularised in the 1970s by the Toyota Production System; it entails looking at every problem and asking "Why?" and "What created this problem?" By asking "Why," you may distinguish between symptoms and causes of a problem. This is crucial since symptoms frequently hide the underlying causes of issues. Figure 2 is an example of using the 5 Why Technique to determine root cause.

Figure 4: 5 Why Technique

2.2.3.2 5S (Workplace Organization)

5S is a method that produces a well-organized workplace with visual controls and order. It's a place where "everything has a place and everything has a place when you need it." The 5S's are five Japanese terms that describe exemplary housekeeping. Roughly translated they are;

• Sort (Seiri)

• Set in order (Seiton)

• Shine (Seiso)

• Standardize (Seiketsu)

• Sustain (Shitsuke)

Figure 5: 5S (Workplace Organization)

Seiri **(Sort)**	Sort through materials, keeping only the essential items needed to complete tasks. (This action involves going through all the contents of a workspace to determine which are needed and which can be removed. Everything that is not used to complete a work process should leave the work area.)
Seiton **(Set in Order)**	Ensure that all items are organized and each item has a designated place. Organize all the items left in the workplace in a logical way so they make tasks easier for workers to complete. This often involves placing items in ergonomic locations where people will not need to bend or make extra movements to reach them.
Seiso **(Shine)**	Proactive efforts to keep workplace areas clean and orderly to ensure purpose-driven work. This means cleaning and maintaining the newly organized workspace. It can involve routine tasks such as mopping, dusting, etc. or performing maintenance on machinery, tools, and other equipment.
Seiketsu (**Standardize**)	Create a set of standards for both organization and processes. In essence, this is where you take the first three S's and make rules for how and when these tasks will be performed. These standards can involve schedules, charts, lists, etc.
Shitsuke (**Sustain**)	Sustain new practices and conduct audits to maintain discipline. This means the previous four S's must be continued over time. This is achieved by developing a sense of self-discipline in employees who will participate in 5S.

2.2.3.3 Elimination of 7 Wastes (Muda)

The simplest definition of waste is "anything that provides no value." Customers will not pay for any activity that does not add value to what they desire, and neither should we. Figure 4 depicts the categorization of seven wastes (Muda).

Figure 6: 7 Wastes (Muda)

Transportation	This type of waste is when you move resources (materials), and the movement doesn't add value to the product. Excessive movement of materials can be costly to your business and cause damage to quality. Often, transportation may force you to pay additionally for time, space, and machinery.
Inventory	Excessive inventory is often the result of a company holding "just in case" inventories. In such cases, companies overstock themselves in order to meet unexpected demand, protect from production delays, low quality, or other problems. However, these excessive inventories often don't meet customer's needs and don't add value. They only increase storage and depreciation costs
Motion	This kind of waste includes movements of employees (or machinery), which are complicated and unnecessary. They can cause injuries, extended production time, and more. In other words, do whatever is necessary to arrange a process where workers need to do as little as possible to finish their job.
Waiting	This is probably the easiest waste you can recognize. Whenever goods or tasks are not moving, the "waiting waste" occurs. It is easily identifiable because lost time is the most obvious thing you can detect. For example, goods waiting to be delivered, equipment waiting to be fixed, or a document waiting for executives' approval.
Over-processing	This type of waste usually reflects on doing work that doesn't bring additional value, or it brings more value than required. Such things can be adding extra features to a given product that nobody will use, but they increase your business costs. For example, if a car manufacturer decides to put a TV screen in the back trunk of a vehicle, probably nobody will use it or find value in it. Even more, it will cost resources, and it will increase the end price of the product for something that customers are not willing to pay for.
Overproduction	Keeping in mind that waste is anything that the customer is unwilling to pay for, it is easy to realize why overproduction is Muda. Producing more means that you exceed customer's demand, which leads to additional costs. Actually, overproduction triggers the other 6 wastes

	to appear. The reason is that excess products or tasks require additional transportation, excessive motion, greater waiting time, and so on. Furthermore, if occasionally a defect appears during overproduction, it means your team will need to rework more units.
Defects	Defects can cause rework, or even worse, they can lead to scrap. Usually, defective work should go back to production again, which costs valuable time. Moreover, in some cases, an extra reworking area is required, which comes with additional exploitation of labour and tools.

2.4 Performance of Logistic

The globalisation of the economy has accelerated due to the logistics sector. The logistics sector has strengthened the connections between industries and accelerated the process of disseminating growth impulses throughout its economic sector and globally.

When it comes to meeting client demands, logistics is defined as "the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from the point of origin to the site of consumption" (Council of Logistics Management). Logistics management is a broad term that includes material handling, packaging, supply chain management, inventory management, warehouse management, and transportation.

The logistics industry benefits from the expansion of transportation infrastructure and boosts economic performance by lowering costs, raising labour productivity, promoting trade, and expanding job possibilities.(Khadim et al., 2021) While inadequate and inefficient transport infrastructure creates barriers to worker mobility, market expansion, and economic progress. Nevertheless, the term logistics is well-known in the literature and has been evaluated using a number of different metrics. A few studies have demonstrated the physical infrastructure investment has a favourable impact on economic growth using it as a stand-in for logistics. Today, logistics is viewed as a comprehensive metric and a multifaceted phenomenon for carrying out tasks related to the level of effectiveness, efficiency, and distinctiveness.

2.5 Summary

Overall, this chapter discusses the past studies related to the research objectives that have been presented. Six sigma gives businesses the tools they need to improve the efficiency of their processes. This improvement in performance and reduction in process variation helps to reduce defects and boost earnings, staff morale, and product or service quality. Therefore, researchers have also submitted past studies related to proposed strategies to help companies engaged in six sigma in addressing the problems faced. The focus is on the manufacturing, pharmaceutical, healthcare, technology or service industries industry in Malaysia.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Saunders et al. (2019) state that research methodology can be defined as a process that should systematically undertake an obvious purpose in a study and determine things in describing, explaining, understanding, criticising and analysing. In this chapter, the researcher will focus and discuss the research method of the study predominantly. First, this chapter explains how the theoretical framework and hypotheses are developed. Then, the researcher explained the research design to answer research questions and achieve research objectives. A descriptive research design was used in this study. Moreover, a qualitative method was selected in this study. Primary and secondary data resources were discussed in the next section.

Similarly, the reasons for the research being carried out in a specific location were also explained. A case study was adopted as a research strategy in this research. Likewise, time horizon and scientific canons were clarified, respectively. The summary of chapter 3 was encompassed. Meanwhile, the research framework of this study will be presented in the last section

3.2 Research Framework and Research Hypothesis

Conceptual Framework

The conceptual framework provides a logical structure in which concepts will be linked, allowing for an overview or visual display of how ideas in a study are interrelated. It is more than just a collection of ideas; it is also a means of identifying and constructing for the reader's worldview of epistemology and ontology, as well as research subjects and techniques authored by scholars. The use of a conceptual framework allows academics to identify and examine concepts in a topic. (Cynthia & Osanloo, 2014)

The aims of this research is to examine the relationship between the six sigma towards performance of logistic technology, which are perceived of DMAIC, DPMO and Kaizen.

Independent variable (IV) is the variable that is being tested to measure its impact on the dependent variable (DV).

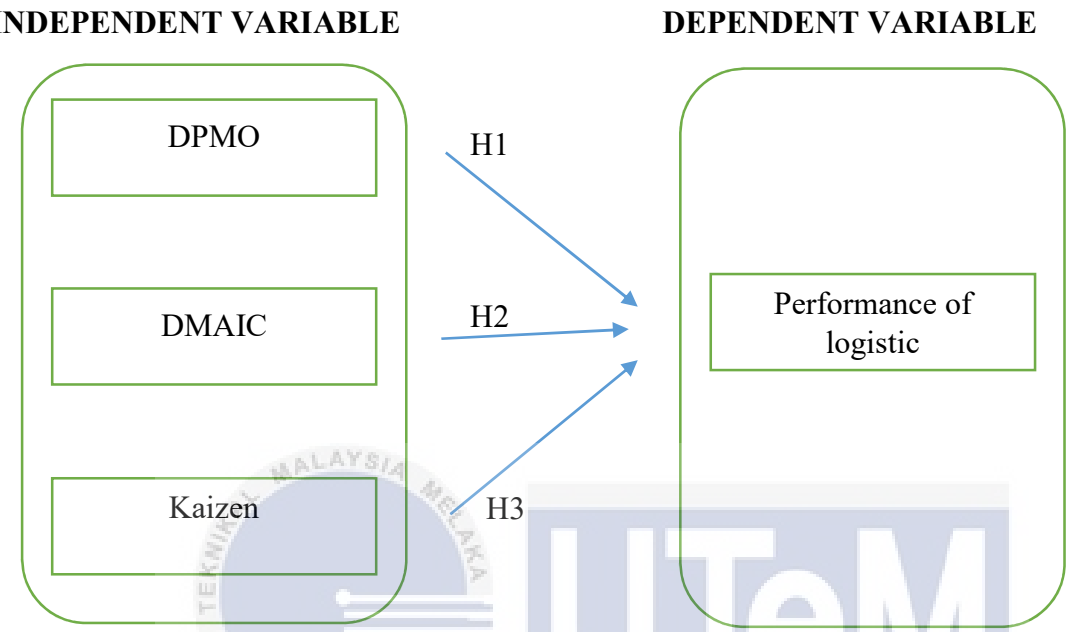


Figure 3.1 Conceptual frameworks for six sigma towards performance of logistic

Hypothesis

The hypothesis is the relationship between the variables that will be tested in this research. This hypothesis would test whether it answer the research questions and achieve the research objectives. As listed below, there are three hypotheses are illustrated based on the studies.

i. **DPMO**

H0: There is no relationship between DPMO and performance of logistic.

H1: There is a significant relationship between DPMO and performance of logistic.

ii. DMAIC

H0: There is no relationship between DMAIC and performance of logistic.

H2: There is a significant relationship between DMAIC and performance of logistic.

iii. Kaizen

H0: There is no relationship between Kaizen and performance of logistic.

H3: There is a significant relationship between Kaizen and performance of logistic.

3.3 General Construction of Research Design

The research design is the researcher's overall strategy for answering the study questions. It is impossible to overstate the significance of research questions. The research design will include a defined purpose drawn from the research questions, as well as a list of the data collection sources employed by the researcher. It also contains a clear display of the researcher's data-gathering sources. It also contains the data collection and analysis methodologies that have been proposed.

3.3.1 Justification of the Study

Descriptive, explanatory, evaluative, and combination studies can all be accomplished with the right research design. Because the study design is depending on the nature of the investigation, the researcher can select one of them. In order to provide correct data, this research included an explanatory investigation. Explanatory study looks into a situation or problem in order to figure out how two factors are linked. The gathering of information in order to describe an event, a person, or a scenario. Include 'who,' 'what,' 'where,' 'when,' and 'how.' Respondents must use the Likert scale to answer the question. Statistical Package for the Social Science (SPSS) software is used to analyse the data. It is a widely used statistical programme that produces results and can be used to predict the association between variables. SPSS aids with the generation of data for graphing statistics, correlation, and other purposes.

3.3.2 Deductive Study

Researchers who take a deductive approach will start with an interesting social theory and then test its implications with data. In other words, they will employ the same methods as inductive research, but in reverse order, advancing from a broad to a more detailed level. Scientific enquiry is most usually connected with deductive research methods. The researcher looks at what others have done, reads existing theories regarding the topic under investigation, and then evaluates the hypotheses that arise from those theories.

3.3.3 Quantitative Study

Quantitative research entails generating numerical data or data that may be turned into useable statistics in order to quantify a problem. It's used to measure attitudes, beliefs, behaviours, and other well-defined factors, as well as to extrapolate results from a broader sample population. In quantitative research, measurable data is used to form facts and identify patterns. Methods for collecting quantitative data are substantially more structured than methods for collecting qualitative data.

In this research, researchers will use quantitative methods to study the relationship between six sigma towards performance logistic. Quantitative research means phenomena by collecting numerical data that are interpreted using specific statistics based on mathematical methods (Almalki, 2016). According to Jusoh et al., (2016), quantitative research examines the relationship between quantitatively calculated variables and evaluated using a variety of statistical and graphical approaches. Quantitative research can be used to test and validate hypotheses as to why the phenomenon occurs and allows researchers to generalize study findings (Mohajan, 2021).

3.3.4 Time Frame of Study

A time frame is an estimate of how long it will take to finish a programme, project, or plan, or make a return on an investment. Longitudinal studies and cross-sectional studies are the two sorts of time spans. Longitudinal studies involve collecting data over a lengthy period of time. This type of research allows the researcher to have some influence over the variables being investigated. The bulk of research projects are chosen for academic courses that require a lot of time to be confined, and cross-sectional studies are the study of certain occurrences at a given time. (Saunders et al., 2017).

Because there is a limited amount of time to complete data analysis and complete this investigation within the time period, the researcher intends to employ a cross-sectional study in this study.

Gant Chart for PSM 1

Task / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Article reading															
The selection of research title															
Construction of research questions and research objectives															
Completion of Chapter 1															
Reading literature review															
Construction of Conceptual Framework															
Completion of Chapter 2															
Drafting Chapter 3															
Completion of Chapter 3															
Amendments															
Compiling															
Slides Preparation															
Report submission															
PSM 1 Presentation															

Gant Chart for PSM 2

Tasks	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Form questionnaire															
Distribute questionnaire															
Data gathering															
Analysis data															
Completed for chapter 4															
Completed for chapter 5															
Report submission															
PSM 2 presentation															

3.4 Research Method

3.4.1 Survey Method

A survey method is a method, tool, or technique for collecting data in research by asking questions to a predetermined set of people. It usually promotes information flow between research participants and the person or organisation conducting the study.

A survey is a data collection instrument that asks respondents to respond to a set of structured questions based on their knowledge and experiences. It's a common data collection method that lets you get information from a specific group of people during your research.

In a survey, several types of questions are asked depending on the study environment and the information you wish to acquire. Many surveys include rating scales and semantic scales, as well as open-ended and closed-ended questions. As a result, they can be used for both qualitative and quantitative research.

3.4.2 Research Instrument

Research instrument refers to various methods through which a researcher obtains data from respondents for his research work. The term "data" refers to all types of information obtained by researchers from study participants. Researchers might employ a variety of measurement tools in their studies, depending on the type of research that will be conducted.

3.4.3 Questionnaire

The questionnaire is the most popular method of gathering research data from study participants. "It simply seeks the opinions of individuals in a sample or population on subjects that are directly connected to the research study's aims". (AINA, 1999)

The questionnaire consists of a series of organised and unstructured questions created by researchers in order to acquire information from respondents. A defective questionnaire is faulty research, and no research is better than its questionnaire. As a result, a questionnaire must be legitimate, dependable, and not fake in order for the data acquired to confirm the research.

3.4.4 Scaling

Questionnaire is distributed to the middle management in electronic manufacturer in Kedah for gathering the primary data in this research. The questionnaire will be in English and self-structure to achieve the research objective. The questionnaire contains closed-ended question which was used to gather the target sample demographic information. The questionnaire will be using 5-point Likert scale. Likert scale which 1 represented "strongly disagree", 2 represented "disagree", 3 represented "neutral", 4 represented "agree" and 5 represented "strongly agree". The questionnaire will be distributed through online by Google form to the targeted respondents and share the questionnaire for people to answer. Table 3.1 below showed the five points Likert scale.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Table 3.1: Likert Scale

3.4.5 Data Analysis

The process of collecting, modelling, and analysing data in order to derive insights that aid decision-making is known as data analysis. Depending on the business and the goal of the research, there are a variety of methodologies and procedures for conducting analysis.

Data analysis is the process by which the researcher employed statistical tools such as the Statistical Package for Social Sciences (SPSS) to evaluate the data obtained from respondents. Furthermore, several sorts of analytic methodologies are used in this study, including descriptive analysis, Pearson's correlation analysis, and multiple regression analysis.

3.4.6 Data Collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. To complete this study, the researcher obtained the data by using primary and secondary data such as questionnaires, journals, sources from the internet, and others.

3.5 Data Collection Methods

Data collection is the process of gathering information from all relevant sources in order to solve the research problem, test the hypothesis (if using a deductive approach), and assess the results. Data collecting methods are classified into two categories: the independent variable and dependent variable.

3.5.1 The independent variable

Within a study, an independent variable is one that the researcher controls or manipulates in some way. A researcher will purposely adjust an independent variable to see if and how the dependent variable changes in response, in order to identify the link between dependent and independent variables.

The explanatory, predicator, right-hand-side, or variable are all terms that can be used to describe the independent variable. These reflect the uses of independent variables, which are designed to explain or predict changes in the dependent variables, similar to dependent variables. Experimenters will generally control independent variables as much as feasible in order to discover their genuine link with dependent variables in study.

For example, a research study might use age as an independent variable, since it influences some potential dependent variables. A researcher cannot assign ages to participants at random, but they can only accept volunteers of specified ages or sort a sample into preferred age groupings.

3.5.2 The dependent variable

A dependent variable is one that is measured in an experiment and represents a result. This variable is not under the direct control of the researchers. Instead, they hope to get insight into the link between factors by studying how the dependent variable responds to various situations.

Although "dependent variable" is the most popular term, response variables, outcome variables, and left-hand-side variables are other prevalent terms. These alternative names help to clarify their function: A dependent variable displays the outcome of a reaction to changes in other variables.

3.5.3 The Control Variable

In a research project, a control variable is anything that is kept constant or constrained. It's a variable that isn't relevant to the study's objectives but is monitored since it could affect the results. Variables can be controlled directly by keeping them constant during a study, or indirectly by using methods such as randomization or statistical control to account for participant characteristics such as age in statistical tests.

3.6 Reliability and Validity

3.6.1 Reliability

Cronbach Alpha (or Alpha coefficient) was developed by Lee Cronbach in 1951 to evaluate the reliability and internal consistency of psychometric instruments. The effectiveness of a test that measures the things to be examined on a frequent basis is referred to as "reliability." The measurements were shown to be free of unstable errors during reliability tests, ensuring robust and consistent findings. Cronbach's Alpha is a test of reliability. The Cronbach's alpha value test is appropriate for "multi-scale items," and it is a great predictor of item consistency (Teixeira, 2019). As a result, the rules for calculating Cronbach's alpha coefficient are listed below.

Alpha Coefficient Range	Strength of Association
< 0.5	Unacceptable
> 0.5	Poor
> 0.6	Questionable
> 0.7	Acceptable
> 0.8	Good
> 0.9	Excellent

Table 3.3: The Rule of Thumb for Cronbach‟s Alpha Coefficient Value

Sources: George and Mallery (2003)

3.6.2 Validity

Validity worries about whether the findings are more or less as they seem to be. Validity is divided into two categories namely internal and external. Internal validity can be provided in survey questionnaires where fixed questions can be statistically proven to have relevance to analytical matters or results. External validity is focused on study results that can be generalized to other settings or groups. By placing the experiments in a natural setting and selecting respondents using simple sampling, the use of external validity can be enhanced. In addition,

construct validity is also a type of validity. Construct validity is used to assess how it should be measured by testing (Mohajan & Haradhan, 2017).

In this research, the researcher collected data through a survey questionnaire and examined the relationship between the dependent variables and the independent variables. The dependent variable is performance of logistic, while the independent variable is six sigma. For the research topic, research questions, and research objectives, quantitative questionnaires need to be constructed. Therefore, the main group related to external validity in this research is the new generation in Malaysia. The researcher must understand the sample size of the population as well as the findings of the study. Researchers should listen to the advice of supervisors to avoid any errors and biases.

3.7 Pilot Study

The pilot testing is a small-scale pre-test which allow the researcher to test the questionnaire before it distributes to the respondents. Pilot testing are useful and important as it can reduce the problem and become a guideline to large study (Zikmund, Babin, Carr, & Griffin, 2013) there will be small quantity of respondents who are apply six sigma to conduct a pilot testing. The researcher will test the questionnaire that related to the research study on the respondent. The result of this pilot testing is importance as it have to identify the problems in the questionnaire in order to make the answer respond are accurate later. There will be changes or modify on the final questionnaire survey when the pilot testing is being tested. Mostly, the researcher will test by spreading questionnaire to a small number of respondents in which it consisted of relevant family members and their colleagues. Researchers used this pilot test as well to test accuracy and reliability questionnaires before distributing them to actual respondents. So, this method will determine whether the questionnaire is clear or not for the respondents to understand well up to it can provide accurate data for the researcher.

3.8 Population and Sampling

3.8.1 Key Respondent

The key respondents in this research are middle management/executive in electronic manufacturer in Kedah. The researcher using sampling method in this research intended to identify why manufacturer use six sigma in the process.

3.8.2 Sample Selection

In general, sample size refers to the number of respondents in a study or observation. According to Delİce, (2001) states that sample size is especially important for data analysis methods that will be used where it requires a large number of respondents. Sampling for this research is convenience sampling which is the simple method to calculate a big data. Researcher used methods from Krejcie and Morgan (1970) to determine the sample size of this research. Sangadah, (2020) mentioned that Krejcie and Morgan (1970) provide tables as shown below to use sample size formulas for larger populations so that studies to determine samples are done easily. Sampling size for this research is 44 respondents and the location of the research will be conducted in Kedah, Malaysia. So, researcher will distribute the questionnaire to the manufacturer who applied the six sigma in their manufacture.

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Figure 2: Krejcie and Morgan (1970) sample size formula

(Source: McNaughton & Cowell, 2018)

3.9 Data Collection Process

In this study, primary and secondary data sources are used. Primary data is information that is accurate and original, and it can be gathered at any time during a study effort. To answer the problem, primary data was obtained. The primary data is obtained by the researcher initially. Questionnaires, surveys, experiments, in-person interviews, and observations are some examples of primary data sources. (Ajayi, 2017) The researcher gathered primary data by distributing questionnaires to a new generation of Malaysian respondents. Respondents were given a collection of questionnaires to complete and mark the correct answers on.

Secondary data records that have been gathered or developed with the assistance of several individuals. Secondary data sources can be evaluated for new or alternative findings, knowledge, or interpretations. (Almalki, 2018). Secondary data, according to Ainsworth (2021), is information gathered by others for various objectives or to address a specific topic of concern. Secondary data sources, journal papers, internal records, books, and official publication websites, according to Ajayi (2018). Secondary data was gathered by the researchers using Google Scholar web sites and library databases such as Emerald Insight and ScienceDirect. To support the goal of this study, researchers used library websites and databases to find pertinent publications, reports, and newspapers. Primary data is more difficult, expensive, and time-consuming to obtain than secondary data. Secondary data analysis, on the other hand, may not be useful in business studies because the data may be obsolete or erroneous.

3.10 Approach and Structure of Data Analysis

According to Saunders et al. (2019), descriptive analysis is a numerical description and comparison of variables that focuses on data scattering and central tendency. Meaning, median, and mode are examples of central tendency measurements, while variance, standard deviation, and population percentage are examples of dispersion measures. To study the information provided by the respondents and translate the raw data into a format that is easier to grasp and interpret, descriptive analysis is required. The demographic background of those who replied can also be described using percentages and frequency distributions. In this study, descriptive analysis is utilised to distinguish between respondents from manufacturer who applied six sigma based on gender, age, occupation, and educational level.

3.11 Summary

This chapter have explained about the methodology used in conducting the research. There are also explain about the research design in detail when we are doing the research. The data collection and data analysis are well introduced in order to obtain the objective of the research. The quantitative and descriptive analysis will be select in conducting this research. The researchers also will conduct questionnaire design, sampling design, and pilot testing in cross-sectional time.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

In this chapter, data had collected through the survey method with google form to target respondents. This chapter is presenting the result that have been done in analysis of data and interpretation of data in more detail which is descriptive analysis, central tendencies measurement, multiple linear regression analysis and Pearson's correlation coefficient analysis and reliability test. In this study, Statistical Packages for Social Science (SPSS) tools will be used to analyse the data that are collected on 84 sets of questionnaires.

4.2 Pilot Test

Pilot test is conducted before the data collection process and distribution of questionnaires to the respondents. Pilot test is a small-scale pre-test on the research in order to collect the data from the target audience which is almost identical and similar to the respondents in. The purpose of conducting pilot test was to ensure all the questions stated in the survey form are understandable by all the respondents with any doubt and problem. Therefore, there are 9 target respondents had been selected to conduct the pilot test in the study.

4.2.1 Validity Test

In this research, validity test had been conducted. 9 items were included in this questionnaire were valid. Therefore, the internal validity can be observed in this pilot test which is to determine the relationship between the independent variable and dependent variable.

4.2.2 Reliability Test

Table 4.1 Reliability Test for Pilot Test

(Source: Data Analysis of SPSS)

RELIABILITY STATISTIC		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.869	.871	9

Table 4.1 indicates the result of reliability test for pilot test in this research. In this research, there are total of 9 items are measured and there are 84 target respondents are involved in the test. Based on the Table 4.1 shown above, the Cronbach Alpha value for the pilot test in this research was 0.869 which is greater than 0.7. Hence, it can conclude that the result of the reliability test on this research were in the strong level of reliability.

Table 4.2 Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
1. I do not have any problems or difficulty when implement DMAIC	33.58	22.415	.555	.604	.861
2. By using DMAIC, I am able to improve the efficiency and effectiveness of supply chain and logistic process	33.24	22.810	.689	.758	.847
3. By using DMAIC, I am able to find issues, then understanding their root causes, creating an improvement plan, and then controlling the implementations	33.26	23.931	.553	.594	.859
4. I do not have any problems or difficulty when	33.42	22.198	.744	.776	.841

implement DPMO					
5. By using DPMO, I am able to minimize the defects in the quality upon completion or delivery of the product	33.14	25.232	.421	.656	.869
6. By using DPMO, I am able to identifying which parts of the process created the most defects and working to improve that component of the process	33.19	23.963	.602	.672	.855
7. I do not have any problems or difficulty when implement Kaizen	33.18	24.148	.588	.781	.856
8. By using Kaizen, I am able to make small changes over a period of time to create improvements within a company	33.50	22.133	.650	.987	.850
9. By using Kaizen, I am able to decreasing	33.49	22.084	.651	.988	.850

waste by eliminating overproduction, improving quality, being more efficient, having less idle time, and reducing unnecessary activities					

4.3 Descriptive Statistic Analysis

In this research, descriptive analysis was conducted in order to provide an easier way to understand. Descriptive analysis also allow researcher to provides a clearly view of summaries with assist of graphic analysis about respondents and measures to ensure better understand. The used of descriptive analysis enable the researcher to analyse the demographic profile such as gender, age, educational level, years of experience and department. In this chapter, demographic background of respondents such as gender, age, o educational level, years of experience and department in this study have been further explained with the used of pie chart.

4.3.1 Response Rate

The questionnaires were distributed by using Google Form to the target respondents. The google form were distribute through email. After 8 weeks of data collection, there are 84 of respondents responded to the questionnaire for this research. All the respondents that have answers the questionnaire are those people who work in semiconductor manufacturing at Kedah.

4.3.1.1 Gender

4.3 Gender

Gender	Frequency	Percentages
Male	35	41.7%
Female	49	58.3%
Total	84	100.0%

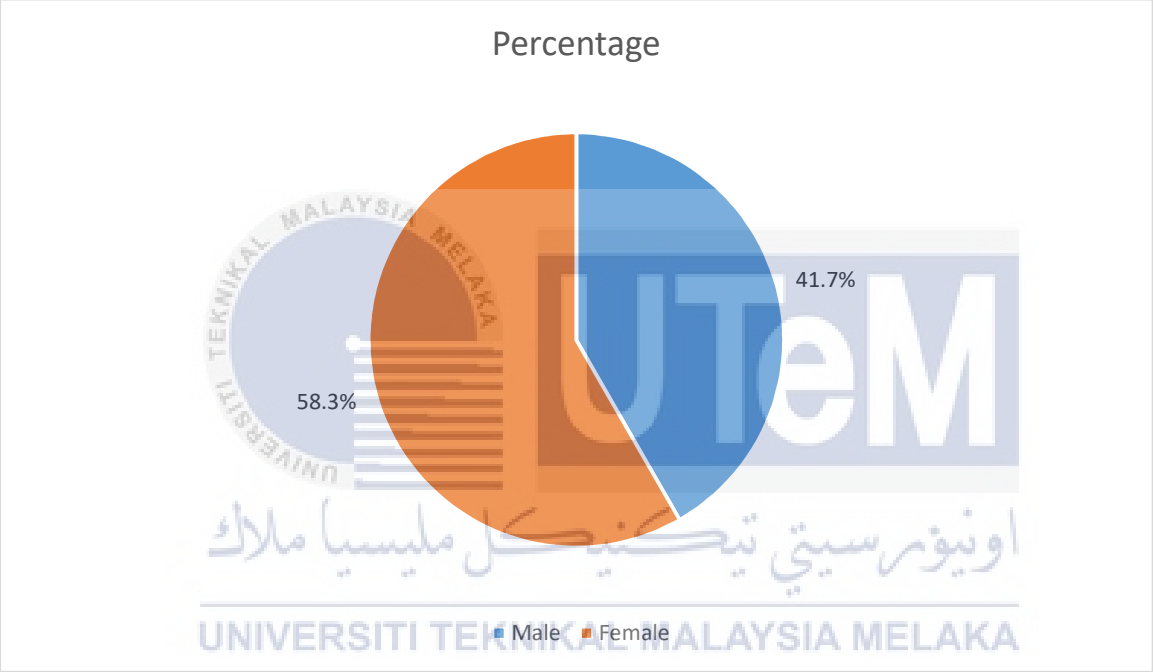


Figure 4.1 Gender of Respondents

Table 4.3 and Figure 4.1 showing the statistical analysis of respondents by gender in this research. It shows that there are 49 respondents which is 58.3% of the data collected in the research are female while there are 35 respondents which is 41.7% of the data collected in the research are male. There is not much difference of gender data collected in this research.

4.3.1.2 Age of Respondent

4.4 Age of Respondents

Age	Frequency	Percentage
20 – 25	20	23.8
26 – 35	48	57.1
36 & above	16	19
Total	84	100.00%

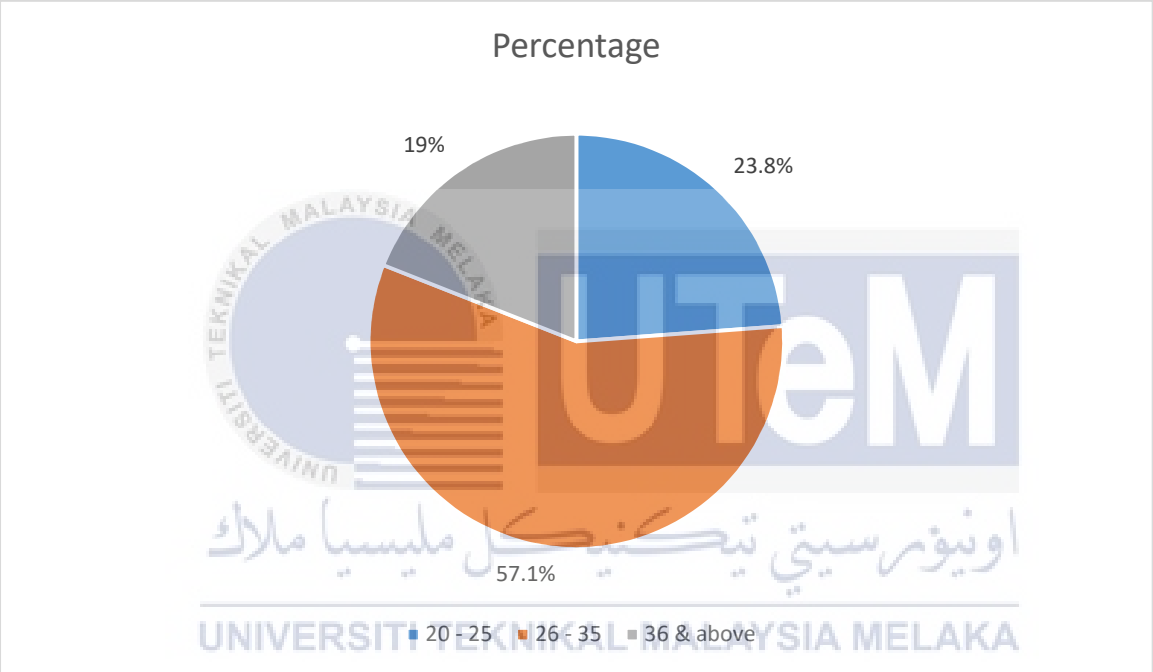


Figure 4.2: Age of Respondents

Table 4.4 and Figure 4.2 are showing ages categories of data collected in this research. In the sample of 84 respondents that are collected, there are 20 respondents or 23.8% of the respondents are falls into the 20-25 years old category. Majority of the respondents are belonged to the 26-36 years old category which have 48 respondents or 57.1% out of 84 respondents. 36 and above years old category are the lowest respondents which have 16 respondents or 19%. This can be explained that in the middle of management in semiconductor manufacturing mostly be using by the middle age generation which is 26 to 35 years old.

4.3.1.3 Educational Level

Table 4.5 Educational Level

Educational Level	Frequency	Percentages
Diploma	32	38.1
Degree	42	50
Master	10	11.9
Total	84	100.00

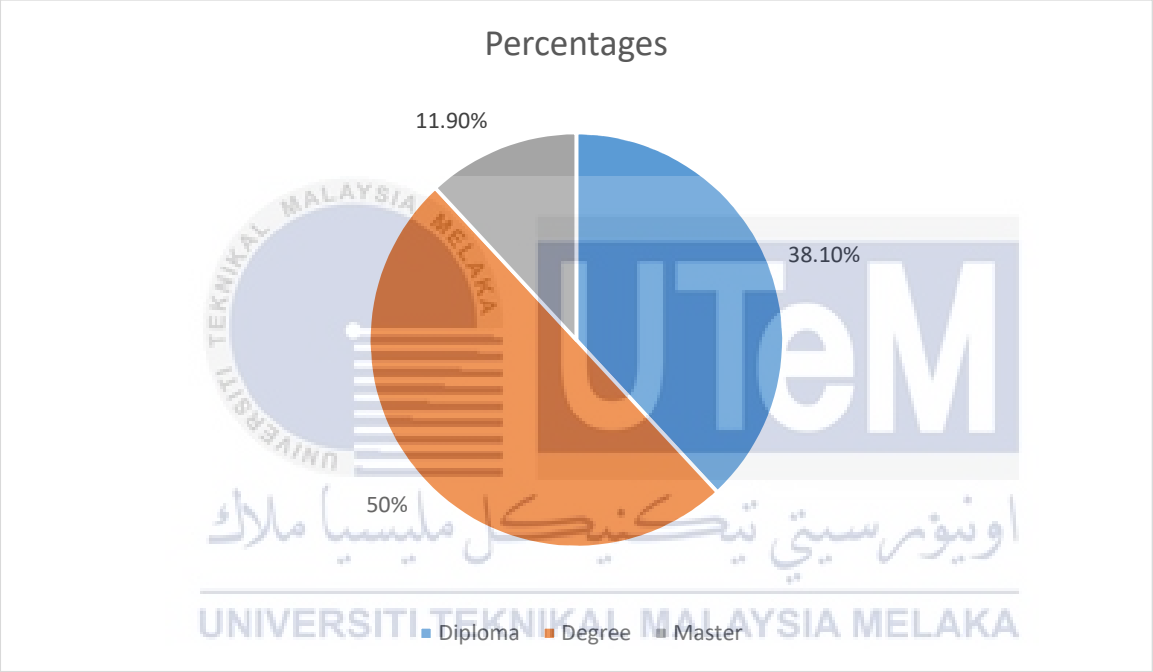


Figure 4.3: Educational level

Table 4.5 and Figure 4.3 are showing the educational level status of the respondents. Majority of the respondents are degree holder which have 42 respondents and 50% out of 84 respondents. There are 32 respondents or 38.1% which is second most category respondents are diploma holder and there are 10 (11.9%) respondents are master level of education.

4.3.1.4 Years of Professional Experience

Table 4.6 Years of Professional Experience

Years	Frequency	Percentages
2 – 5 years	37	44
6 – 10 years	41	48.8
10 – 15 years	6	7.14
More than 15 years	0	0
Total	84	100%

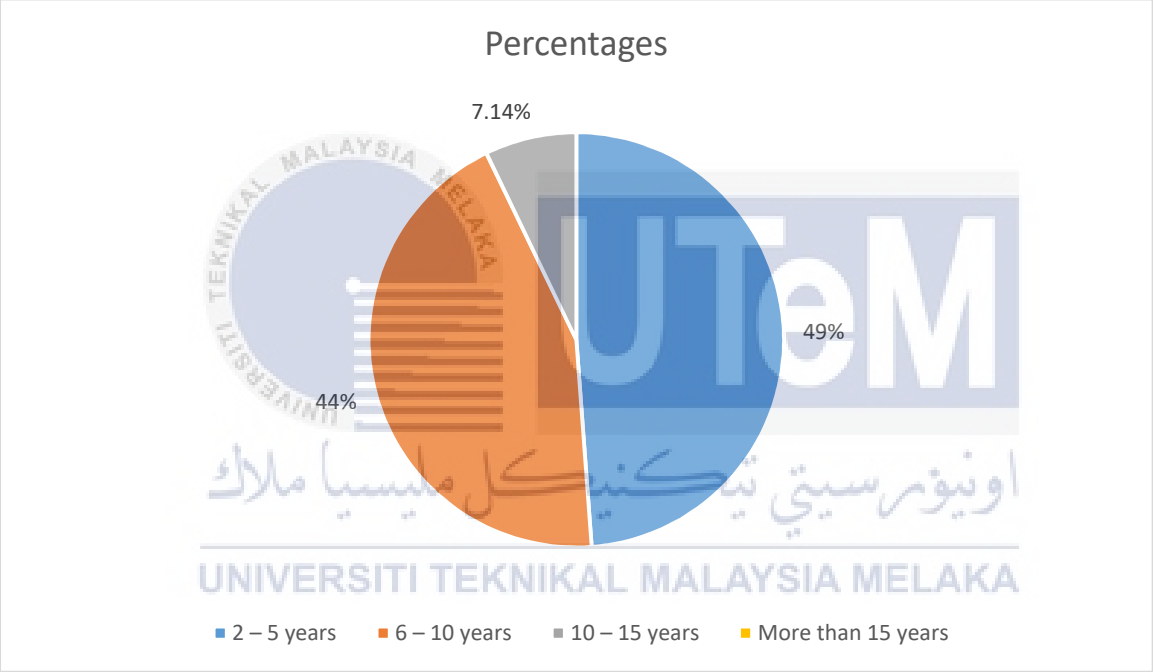


Figure 4.4: Years of Professional Experience

Table 4.6 and Figure 4.4 are showing the years of professional experience of the company. Mostly of the respondent have experience 6 – 10 years which is 41 respondent with 48.8%. While, the percentages for 2 – 5 years is 44% (37 respondent) which is the second highest for years of experience. Lastly, there are six respondent that have experience 10 – 15 years and no respondent that have work for more than 15 years which is 7.14% and 0% respectively.

4.3.1.5 Working Department

Table 4.7 Working Department

Working in Department	Frequency	Percentages
Logistic	29	34.52
Supply Chain	24	28.57
Production	12	14.28
Warehouse	13	15.47
Other	6	7.14
Total	84	100%

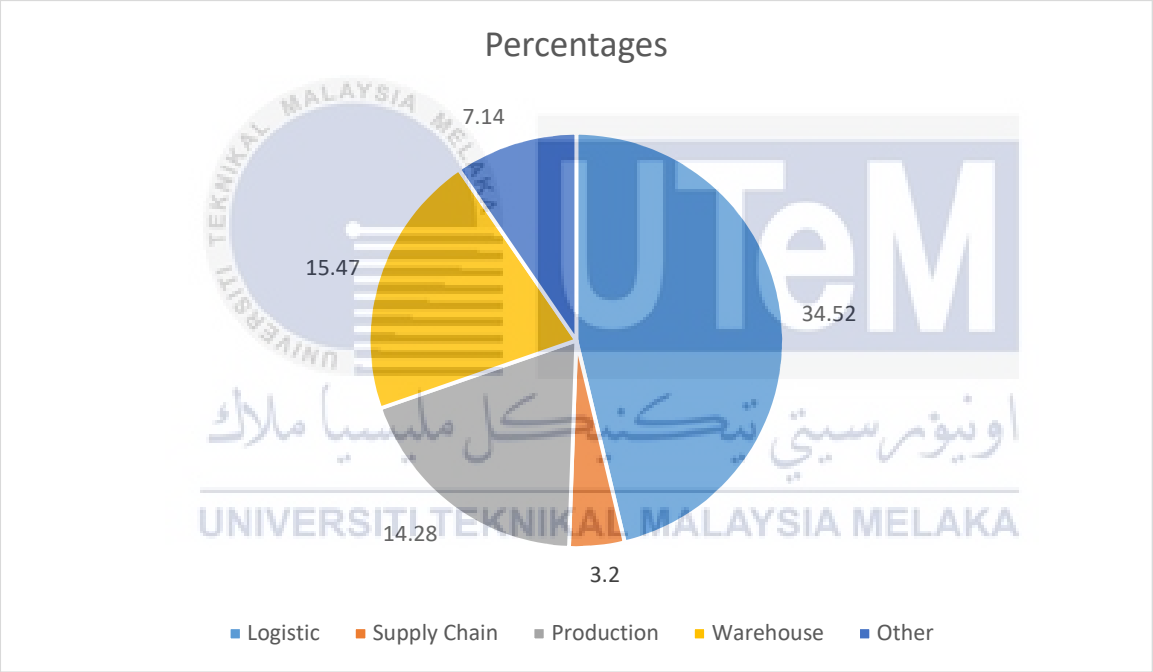
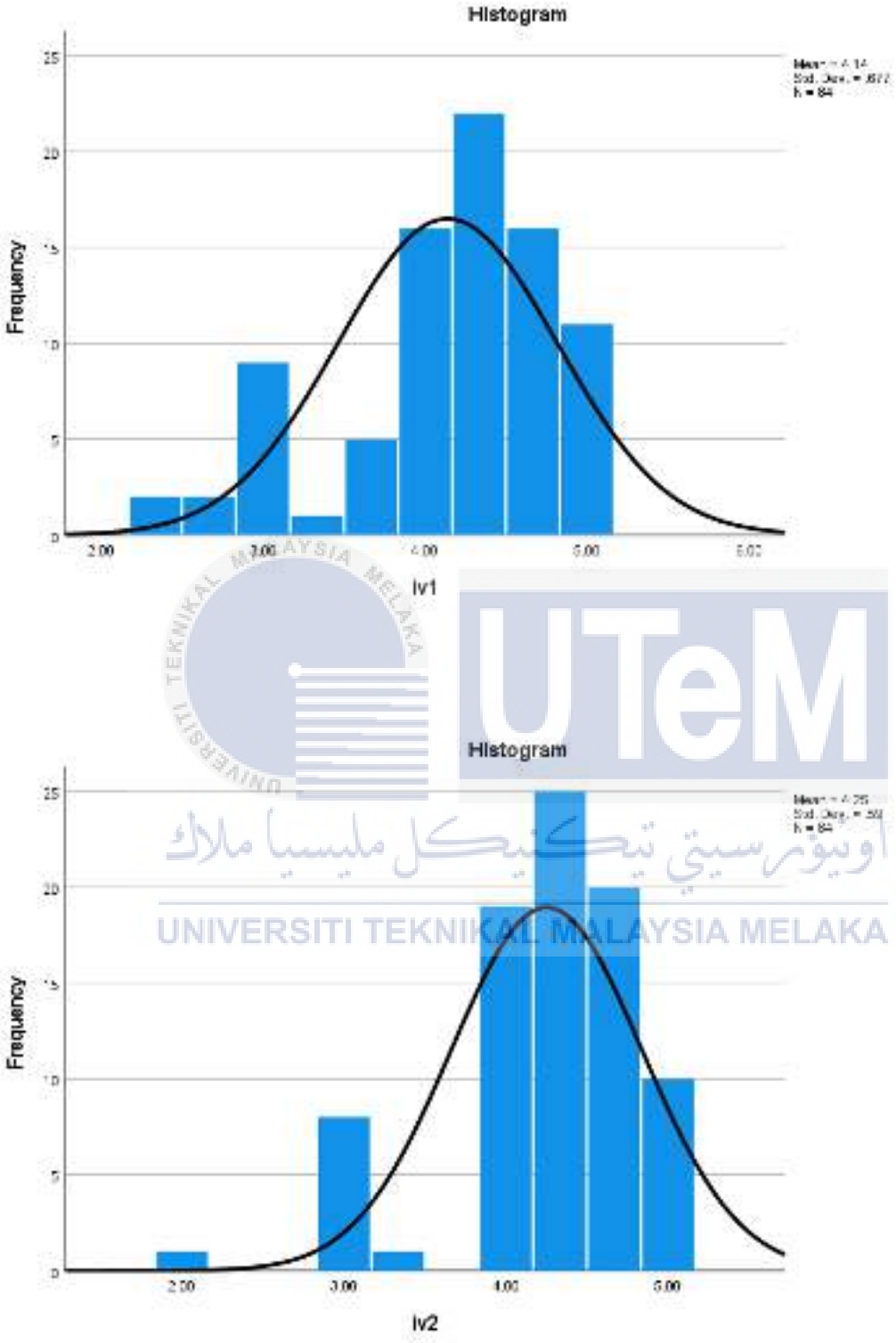
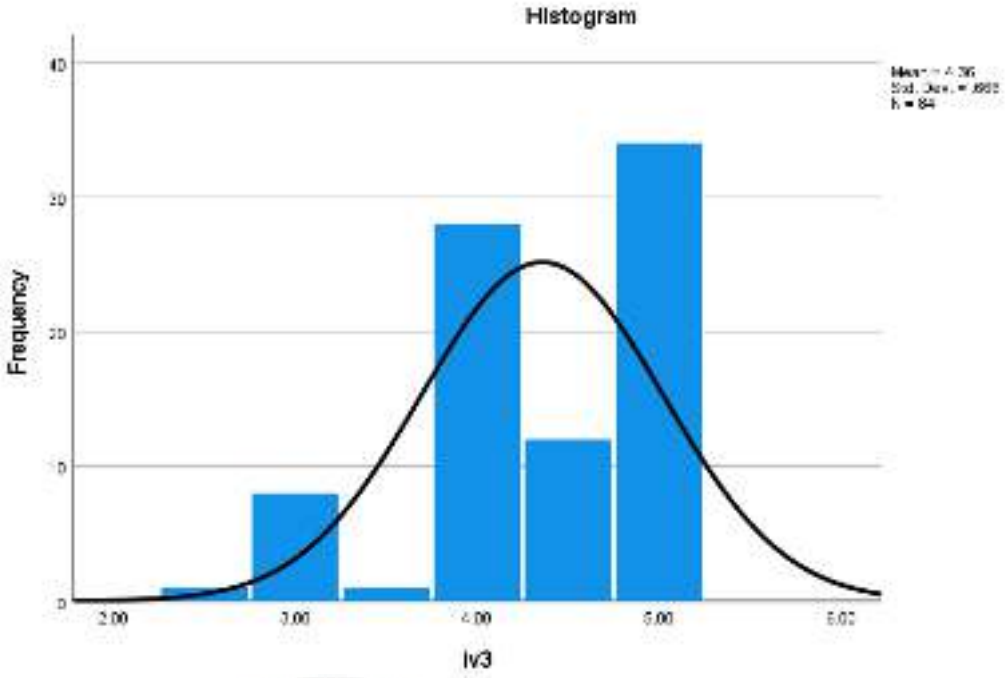


Figure 4.5: Working Department

Table 4.7 and Figure 4.5 are showing the department that respondent work. Most of respondent are working in the logistic department which are 29 respondent or 34.52% of the sample. For supply chain department there are 24 respondent (28.57%) which is the second highest of respondent working in department. For the production and warehouse department, there are 12 respondent and 13 respondent (14.28% and 15.47%) respectively. Lastly, there are six respondent which is 7.14% for other department.

Descriptive Analysis





4.3.2 Mean Score

Table 4.8: Descriptive Statistics of Research Variables

(Source: Data Analysis of SPSS)

	N	Minimum	Maximum	Mean	Std. Deviation
IV1	84	2.33	5.00	4.1389	.67704
IV2	84	2.00	5.00	4.2500	.58968
IV3	84	2.00	5.00	4.1111	.71010
Valid N (list wise)	84				

Table 4.8 shows some descriptive results for the research variables used in this study. The table shows minimum, maximum, mean and standard deviation for the research variables of DPMO, DMAIC and Six Sigma. The results shown below are the summation of all the items belong to each variable from the five-point Likert scale.

4.4 Pearson's Correlation Coefficient Analysis

Pearson Correlation Coefficient (r) is a statistical test which used to determine the relationship exists and the strength of linear relationship between those variables. In this research, there are 3 independent variables which are DPMO, DMAIC and Six Sigma. Pearson Correlation Coefficient was to determine and verify the correlation of the 3 independent variables and one dependent variable which is performance of logistic. The detailed meanings of Pearson's Correlation Coefficient were clearly explained in details in Chapter 3. The Table 4.9 showed the result of Pearson's Correlation between the independent variables and dependent variables

Table 4.9: Pearson's Correlation

(Source: Data Analysis of SPSS)

		IV1	IV2	IV3	DV
IV1	Pearson Correlation	1	.760**	.719**	.819**
	Sig. (2-tailed)		<.001	<.001	<.001
	N	84	84	84	84
IV2	Pearson Correlation	.760**	1	.719**	.729**
	Sig. (2-tailed)	<.001		<.001	<.001
	N	84	84	84	84
IV3	Pearson Correlation	.719**	.719**		.688**
	Sig. (2-tailed)	<.001	<.001	1	<.001
	N	84	84	84	84
DV	Pearson Correlation	.819**	.729**	.688**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	84	84	84	84

The table 4.9 are showing the Pearson's correlation of independents variables towards performance of logistic. The results from the analysis show that the three independence variables are having positively relationship towards the performance of logistic. Table 4.9 shows that correlation value of DPMO and performance of logistic was 0.819 and the level of significance was 0.01 which ($p<0.05$), it means that there has a significant strong relationship between those variables. It is the highest correlation value compared to the other variables.

Besides, the correlation value of DMAIC and Kaizen with performance of logistic were 0.729 and 0.688, the both significance level is same which is 0.01 which ($p<0.05$). This indicated that there is also strong relationship between the independent variables and the dependent variable.

4.5 Multiple Linear Regression Analysis

In order to examine the relationship between implemented Lean Six Sigma towards performance of logistic in semiconductor manufacturing at Kedah, multiple regression analysis was performed. Table 4.10 and Table 4.11 show that the regression coefficient is significant ($F(3, 80) = 63.773$, $p < 0.01$).

4.5.1 Model Summary

Table 4.10 Model Summary

(Source: Data Analysis of SPSS)

Model	R	R Square	Adjusted R Squared	Std. Error of the Estimate
1	$.840^a$	.705	.694	.35147

a. Predictors: (Constant), IV1, IV2, IV3

b. Dependent Variable: DV

4.5.2 Anova Test

Table 4.11 Anova

(Source: Data Analysis of SPSS)

Model		Sum of Squared	df	Mean Square	F	Sig.
1	Regression	23.634	3	7.878	63.773	$< .001^b$
	Residual	9.883	80	.124		
	Total	33.517	83			

a. Predictors: (Constant), IV1, IV2, IV3

b. Dependent Variable: DV

Based on the ANOVA table, the result showed the F-test value was 63.773 with significant level 0.01 which <0.05, therefore we can conclude that there is a significant relationship between DPMO, DMAIC and Kaizen towards performance of logistic. In addition, the null hypothesis is rejected because the significant level of regression model did not exceed 0.05.

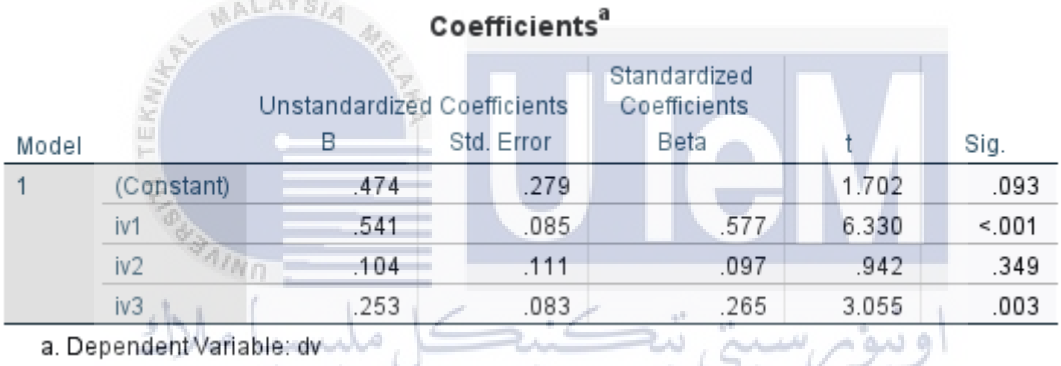
4.5.3 Regression Coefficient

Table 4.12: Regression Coefficient

(Source: Data Analysis of SPSS)

Model		Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.474	.279		1.702	.093
	Iv1	.541	.085	.577	6.330	<.001
	Iv2	.104	.111	.097	.942	.349
	Iv3	.253	.083	.265	3.055	.003

a. Dependent Variable: dv



Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.474	.279		1.702	.093
	iv1	.541	.085	.577	6.330	<.001
	iv2	.104	.111	.097	.942	.349
	iv3	.253	.083	.265	3.055	.003

a. Dependent Variable: dv

The table 4.12 showed that the estimated coefficient was beta (constant) was 0.474 with a significant level of 0.093. The beta of DPMO was 0.541 with 0.01 significance level, beta of DMAIC was 0.104 with 0.349 significance level, beta of Kaizen was 0.253 with 0.003 significant levels. Based on the table of regression coefficient, the equation of multiple regressions was:

Relationship between implemented Six Sigma towards performance of logistic = 0.474 + 0.541 + 0.104 + 0.253

In this table, DPMO, DMAIC and Kaizen variables had positively relationship with the performance of logistic. It shows that the DPMO variable was the major factor that are affecting the performance of logistic with 0.541 point while the second major factor are Kaizen variable which have 0.253 point.

4.6 Hypothesis Testing

The three hypotheses will be tested and discuss based on the result from the multiple regression coefficient.

i. DPMO

H0: There is no relationship between DPMO and performance of logistic.

H1: There is a significant relationship between DPMO and performance of logistic.

The table 4.12 shows that the regression results of DPMO towards performance of logistic. The p value of DPMO is 0.001 < 0.05.

Thus, the null hypothesis is rejected and alternative hypothesis is accepted. Hence it can conclude that there is significant relationship between the DPMO and performance of logistic.

ii. DMAIC

H0: There is no relationship between DMAIC and performance of logistic.

H2: There is a significant relationship between DMAIC and performance of logistic.

The table 4.12 shows that the regression results of DMAIC towards the performance of logistic. The p value of DMAIC is 0.349 > 0.05.

Thus, the null hypothesis is accepted and alternative hypothesis is rejected. Hence it can conclude that there no significant relationship between the DMAIC and performance of logistic.

iii. Kaizen

H0: There is no relationship between Kaizen and performance of logistic.

H3: There is a significant relationship between Kaizen and performance of logistic.

The table 4.12 shows that the regression results of Kaizen towards the performance of logistic. The p value of Six Sigma is 0.003 < 0.05.

Thus, the null hypothesis is rejected and alternative hypothesis is accepted. Hence it can conclude that there is significant relationship between the Lean Six Sigma and performance of logistic.

4.7 Summary

In conclusion, the survey questionnaires and data collection from 84 respondents have been done in this study. This chapter had collected all the data through google form and the data had analysed by using SPSS. There are several types of analysis have been carried out which included descriptive analysis, reliability analysis, ANOVA analysis, Pearson Correlation analysis, and Multiple Regression analysis. The correlation and the significance of hypotheses has been tested in this chapter.

CHAPTER 5

DISCUSSION, IMPLICATION AND CONCLUSION

5.1 Introduction

In this chapter, the researcher will review and analyse the result and finding into a summary of review in statistical analysis that are obtained from the previous chapter. Discussion of major finding in this research and the study implication would be including in this chapter. The research questions and research objectives that have been stated in Chapter 1 will be discussed. The study limitation of this research is clearly defined and stated. In addition, there have some propose recommendation for future study and research. Lastly, conclusion will be made for the whole research.

5.2 Summary of Result

Table 5.1 Demographic Information

Information	Frequency with highest value	Percentages
Gender	Female	58.3%
Age	26 – 35	57.1%
Educational Level	Degree	50%
Years of Professional Experience	6 – 10 years	48.8%
Working Department	Logistic	34.52%

Table 5.2 Hypothesis

	Hypothesis	Coefficient	Result	Supported Literature
H1	DPMO	0.541	Significant relationship	(Haekal, 2021)
H2	DMAIC	0.104	No significant relationship	(Lemke et al., 2021)
H3	Kaizen	0.253	Significant relationship	(Lina & Ullah, 2019)

5.3 Discussion

5.3.1 Specific Objective: To investigate the relationship between implemented Lean Six Sigma towards performance of logistic.

There are total of three independence variables and one dependent variable in this research. The three independent variables are DPMO, DMAIC and Kaizen. The dependent variable is performance of logistic. According to the results stated in Chapter 4, the findings are:

The p-value of DPMO to performance of logistic is 0.01<0.05. Hence, it can conclude that there is significant relationship between DPMO and performance under 0.05 significance level. According to (Haekal, 2021), DPMO does significantly affect performance of logistic in the research.

The p-value of DMAIC to performance of logistic is 0.349>0.05. Hence, it can conclude that there is no significant relationship between DMAIC and performance of logistic under 0.05 significance level. Lemke et al. (2021) had talked about DMAIC that no relationship towards the performance of logistic.

The p-value of Kaizen to performance of logistic is 0.003<0.05. Hence, it can conclude that there is significant relationship between Six Sigma and performance of logistic under 0.05 significance level. According to findings Lina & Ullah (2019) , it stated that Kaizen is directly related with performance of logistic.

5.3.2. Specific Objective: To identify the most significance factors in affecting performance of logistic.

In the research, there are three factors that are performance of logistic and the results are being analysed by using multiple regression to identify the strength of each independent variable with the dependent variable which is performance logistic. The results had told us that the strength of each independent variable towards performance of logistic.

Pearson's Coefficient results had shown that all the independent variables are have the relationship with the dependent variables. While Multiple Regression Analysis had been using to analyse the most significance factor.

Firstly, this research had concluded that DPMO variables are the major factors that are positively affecting the performance of logistic as the coefficient of DPMO towards performance of logistic are highest which 0.541 Beta is. Therefore, the most significance factors in performance of logistic is DPMO factor.

Lean Six Sigma is a quality improvement tool based on the use of data and statistics. The term "sigma" is the Greek letter σ used for the quantity of Standard Deviation or standard deviation in statistics. Lean Six Sigma's basic principle is product improvement by making improvements to the process so that the process produces the perfect product. In addition, Lean Six Sigma is oriented towards long-term performance through quality improvement to reduce errors, with zero failure targets (zero defects) on process capabilities equal to or more than Lean Six Sigma in standard deviation measures.

According to Haekal (2021), DPMO is oriented towards long-term performance through quality improvement to reduce errors, with zero failure targets (zero defects) on process capabilities equal to or more than Lean Six Sigma in standard deviation measures. It is the most independent variable that related in performance of logistic. Therefore, we can conclude that DPMO are the tools that the most company used to boost supply chain and logistic performance by lowering costs and raising labour productivity.

5.4 Implication of the Study

This research had been using the Theoretical Framework by Haekal, Lemke et al, Bozkanat Lina and Ullah which these three factors that are effect the performance of logistic. In this research one of the factors that stated by Haekal, Lemke et al, Bozkanat, Lina and Ullah can be change from DMAIC to DPU (Defect per Unit). This is because the findings of the results for DMAIC are no significant correlation towards the performance of logistic. This can be considered for the future researchers as they can include both of the factors into independent variables.

The findings of the research are important as it can help the manufacturing manager to have a guideline or basic understanding of the performance of logistic and wants for efficiency. The findings can be used on performance development when a manager want to improve performance of logistic as is different with the current way to develop more efficiency.

5.5 Contribution of Study

This research is aimed to contribute the knowledge and provide the information and understanding about the performance of logistic. This research had introduced the factors that are affecting performance of logistic. The factors such as DPMO and Kaizen had been proven that they are one of the factors that are affecting performance of logistic.

The research is able to provide and benefit to the future researcher and manufacturing manager as a guideline. Besides, this research can identify the value and the perspective of a performance when they want to implement tools to improve performance in logistic.

Besides, the customers also will be satisfying as there will be more business owner who understand their needs and wants so that the customers will purchase from them. It will improve the quality of the e-commerce business.

5.6 Limitation of Study

In this research, there were some limitations during the process which is respondent limitation, cooperation of respondents and strength of the independent variable toward dependent variable.

First, the limitation was the respondent limitation, the survey and questionnaire only able to send through email. The respondents are hard to find and they not reply the email that have been send. Hence, respondents are cover in middle executive in supply chain logistic department. Not only that, some respondent might not take the survey seriously and simple answer it without considers of the question. This maybe can cause the result to be different and not accurate.

The strength of the independent variable which is the factor toward dependent variable might be weak. There might be some other factors which be placed as independent variables that are affecting the dependent variables which is performance of logistic.

5.7 Recommendation

In this research, there are some limitations caused the result of this research is not completed and accurate. Hence, there are some recommendations can be given to the future researchers who wanted to carried similar research in future. First, the researcher who going to conduct the similar research in future can looking for variety of manufacturing and not specific in semiconductor only. The data collected can be more accurate and be can reference based on the type of manufacturing.

Besides, the future researcher can gather data by doing interview session as the data collected from interview will be more details and precise. The interview can provide a better understand of question to the respondents so that they will take it seriously and answer with some explanation.

Lastly, there are still a lot of factors can be taken as independent variables in affecting the dependent variables. The researchers can consider of more other factors in the research and determine the relationship between implemented Lean Six Sigma towards performance of logistic. Therefore, future researcher can inspect and investigate more variables that are regarding to this research.

5.8 Conclusion

The research had been completed and it had focus on the Six Sigma that are affecting performance of logistic. From the result and findings analysis, there are two hypotheses that are accepted in the research. The two independents' variables DPMO and Six Sigma factor that are affecting the performance of logistic. The DPMO factors had the strongest bond in affecting the performance of logistic among all the variables while the DMAIC had the weakest bond in affecting the performance of logistic. Besides, there are also some limitations in conducting this research. Hence, there are some recommendations suggested for the future researcher so that the results and finding can be better and accurate in the future research.

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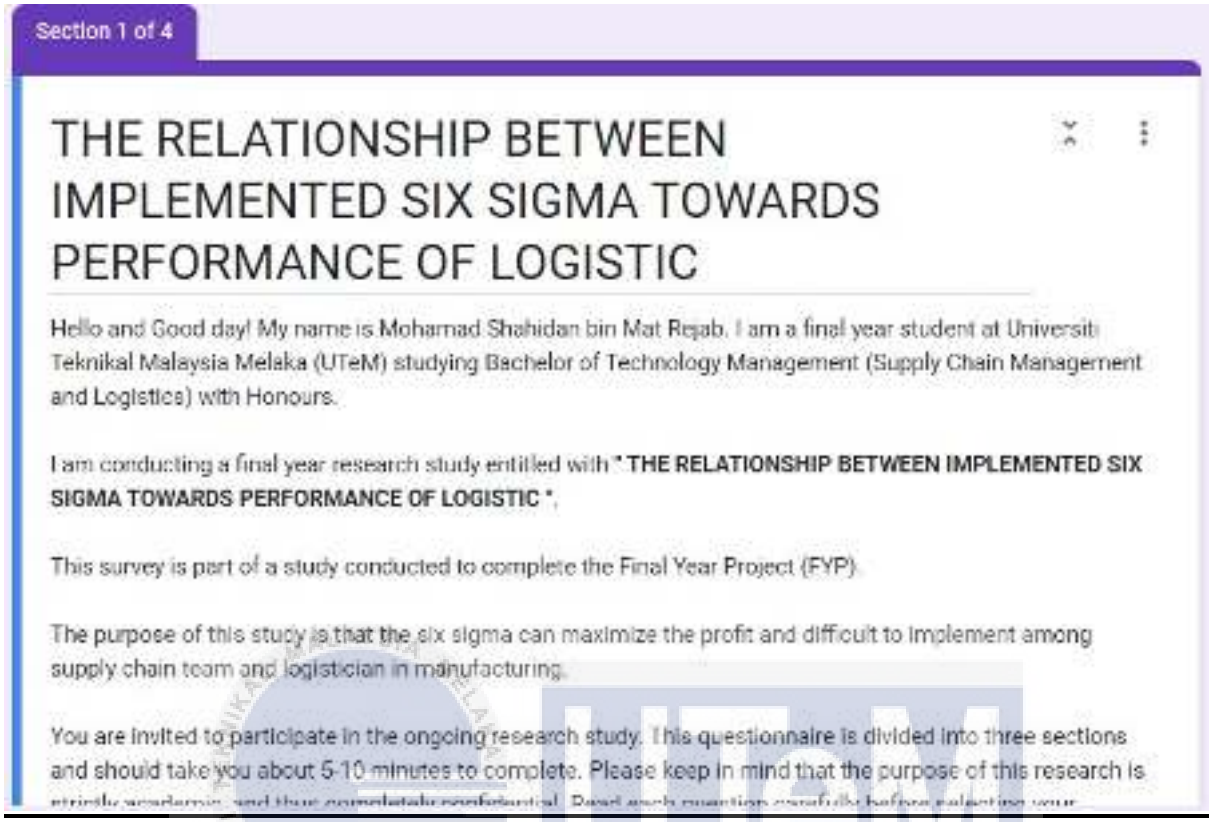
Ubaidillah, A., & Sari, I. A. (2020). *TiBuana Journal of applied Industrial Engineering-University of PGRI Adi Buana p- ISSN 2622-2027 DOI : https://doi.org/10.36456/tibuana.3.01.2193.1-7 e- ISSN 2622-2035 QUALITY ANALYSIS OF GOODS DELIVERY SERVICE USING SIX SIGMA APPROACH IN PT . KAMADJAJA L*. *03*(2), 58–71.

APPENDIX



Section 1 of 4

THE RELATIONSHIP BETWEEN IMPLEMENTED SIX SIGMA TOWARDS PERFORMANCE OF LOGISTIC

Hello and Good day! My name is Mohamad Shahidan bin Mat Rejab. I am a final year student at Universiti Teknikal Malaysia Melaka (UTeM) studying Bachelor of Technology Management (Supply Chain Management and Logistics) with Honours.

I am conducting a final year research study entitled with " **THE RELATIONSHIP BETWEEN IMPLEMENTED SIX SIGMA TOWARDS PERFORMANCE OF LOGISTIC** ".

This survey is part of a study conducted to complete the Final Year Project (FYP)

The purpose of this study is that the six sigma can maximize the profit and difficult to implement among supply chain team and logistician in manufacturing.

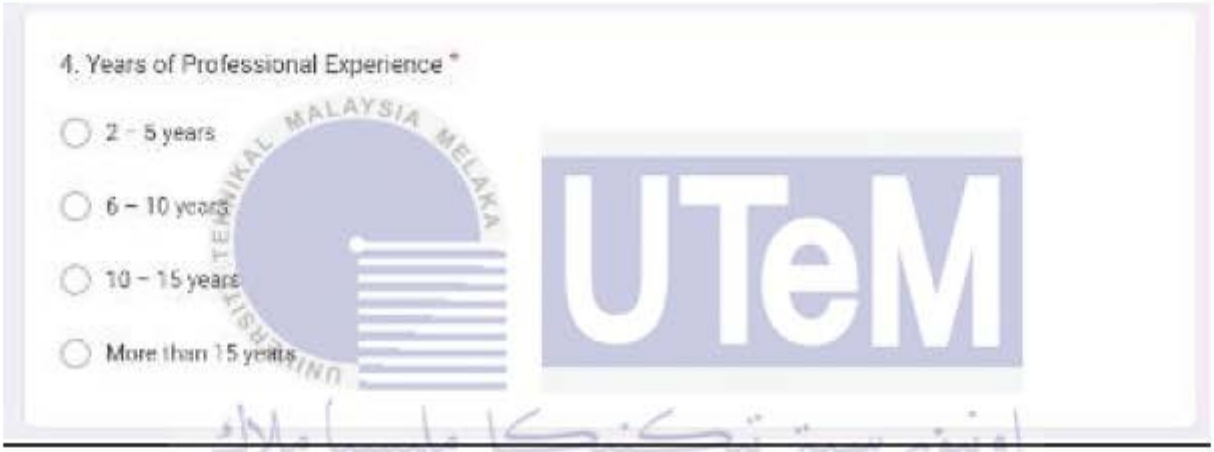
You are invited to participate in the ongoing research study. This questionnaire is divided into three sections and should take you about 5-10 minutes to complete. Please keep in mind that the purpose of this research is

1. Gender *

- Male
- Female

2. Age *

- 20 - 25
- 25 - 35
- 35 & above



6. Do you know about six sigma? *

- ◯ Yes
- ◯ No

7. Do you implement six sigma in your organization? *

- ◯ Yes
- ◯ No

Section 3 of 4

SECTION B: IMPLEMENTATION OF DPMO AND SIX SIGMA IN SEMICONDUCTOR MANUFACTURING AT KEDAH

In this section respondents are asked to indicate the extent to which they agree or disagree with each statement regarding the performance of logistic in semiconductor manufacturing at Kedah. The following questions are about how your organisation has been implementing DPMO (Six Sigma metric used in quality management that stands for defects per million opportunities) and DMAIC (Define, measure, analyse, improve, and control) in logistic management practices. In general kindly identify your agreement on the following practices by using 5-point Likert Scale response framework.

Please tick one (/) number per line to show either you agree or disagree with the following statement.

(1) – Strongly disagree

(2)– Disagree

(3)– Neutral

(4)– Agree

(5)– Strongly agree

1. I do not have any problems or difficulty when implement DMAIC

1	2	3	4	5
○	○	○	○	○

2. By using DMAIC, I am able to improve the efficiency and effectiveness of supply chain and logistic process

1	2	3	4	5
○	○	○	○	○

3. By using DMAIC, I am able to find issues, then understanding their root causes, creating an improvement plan, and then controlling the implementations

1	2	3	4	5
○	○	○	○	○

4. I do not have any problems or difficulty when implement DPMO

1	2	3	4	5
○	○	○	○	○

5. By using DPMO, I am able to minimize the defects in the quality upon completion or delivery of the product

1	2	3	4	5
○	○	○	○	○

6. By using DPMO, I am able to identifying which parts of the process created the most defects and working to improve that component of the process

1	2	3	4	5
○	○	○	○	○

7. I do not have any problems or difficulty when implement Kaizen

1	2	3	4	5
○	○	○	○	○

8. By using Kaizen, I am able to make small changes over a period of time to create improvements within a company

1	2	3	4	5
○	○	○	○	○


Section 4 of 4

SECTION C: THE PERFORMANCE OF LOGISTIC IN SEMICONDUCTOR MANUFACTURING AT KEDAH

In this section respondents are asked to indicate the extent to which they agree or disagree with each statement regarding the performance of logistic in semiconductor manufacturing at Kedah after using Six Sigma using 5-point Likert Scale response framework.

Please tick one (/) number per line to show either you agree or disagree with the following statement.

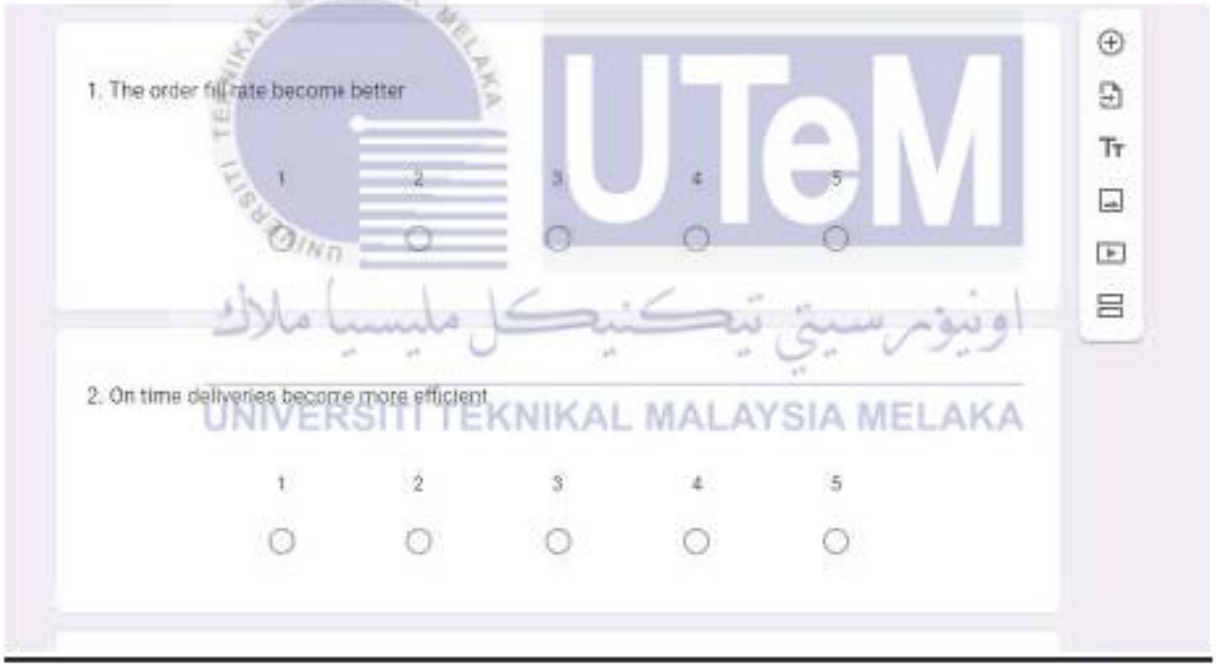
(1) - Strongly disagree

(2) - Disagree

(3)– Neutral

(4)– Agree

(5)– Strongly agree


1. The order fill rate become better

1 2 3 4 5

2. On time deliveries become more efficient

1 2 3 4 5

3. Customer response time extremely better

1 2 3 4 5

4. The percentage of shipping errors is decreasing

1 2 3 4 5

5. The time it takes to create a product and deliver it to a consumer become more efficient

1 2 3 4 5

6. Business does deliver on its commitment and does meet customer expectations in terms of the product or services

1 2 3 4 5