Exploring The Industrial Revolution 4.0 and Data Analytics Among Malaysian Manufacturing Companies: A Qualitative Approach

by

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EXPLORING THE INDUSTRIAL REVOLUTION 4.0 AND DATA ANALYTICS AMONG MALAYSIAN MANUFACTURING COMPANIES: A QUALITATIVE APPROACH

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ABSTRAK

Pembuatan Malaysia kini mengalami tempoh pertumbuhan. Kemajuan teknologi berlaku pada kelajuan yang pantas, mewujudkan beberapa peluang bagi pengeluar untuk mengatasi pesaing mereka. Revolusi Industri 4.0, adalah fasa terbaharu Revolusi Perindustrian yang mendapat perhatian kerana sumbangannya terhadap pembuatan seperti kecekapan, kualiti, kelajuan, kualiti, mengurangkan kos dan pengeluaran yang diperibadikan. Tujuan penyelidikan ini adalah untuk menyiasat dan mengenal pasti kesan ketara Revolusi Industri 4.0 dan Analitik Data dari perspektif pembuatan Malaysia. Oleh kerana terdapat sangat sedikit penyelidikan dan rujukan terdahulu yang berkaitan dengan tema yang muncul daripada Revolusi Industri 4.0 dan Analitik Data, oleh itu kajian ini akan memfokuskan kepada pendekatan kualitatif. Kajian ini mengkaji data daripada empat syarikat pembuatan yang mengikuti inisiatif Revolusi Industri 4.0. Data dikumpul melalui temu bual maya mendalam. Penyelidikan ini menggunakan prosedur analisis 5 langkah Yin untuk menganalisis data. Berdasarkan penemuan, penyelidikan ini telah menyaksikan Faktor Kejayaan Kritikal (FK) yang telah digunakan pada Revolusi Industri 4.0 dan Analitik Data ke arah mencapai prestasi organisasi. Penyelidikan ini juga telah menerangkan tema yang muncul di bawah Revolusi Industri 4.0 dan Analitik Data. Daripada sembilan teknologi digital yang telah diterangkan oleh Boston Consulting Group (BCG), penyelidikan ini telah menyaksikan semua teknologi kecuali realiti Diperkukuh. Untuk tujuan itu, kajian lanjutan dapat mengisi kekosongan kajian ini.

Exploring The Industrial Revolution 4.0 and Data Analytics Among Malaysian Manufacturing Companies: A Qualitative Approach

ABSTRACT

Malaysian Manufacturing are now experiencing a period of growth. Technological advancement is occurring at a rapid speed, creating several chances for manufactures to outsmart their competitors. Industry Revolution 4.0 is the latest trend of phase that has gain attention due to its contribution toward manufactures such as efficiency, quality, speed, quality, reduce cost and personalised production. The purpose of this research is to investigate and identify the significant impact of Industrial Revolution 4.0 and Data Analytics from the Malaysian manufacturing perspective. Due to little prior research and reference pertaining to the themes that emerged from Industrial Revolution 4.0 and Data Analytics, hence this research will be focusing on a qualitative approach. This study examines data from four manufacturing companies pursuing Industry 4.0 initiatives. The data was collected through in-dept virtual interviews. This research employed Yin 5 step analytics procedures to analyse the data. Based on the finding, this research has witnessed the Critical Success Factors (CSF's) that has deployed on Industrial Revolution 4.0 and Data Analytics towards achieving organization performance. This research has also described the emerged themes under Industrial Revolution 4.0 and Data Analytics. Out of nine digital technologies that have been described by Boston Consulting Group (BCG), this research has witnessed all the technologies except for Augmented reality. For the purpose of that, further research can fill the gap of this study.

CHAPTER 1: INTRODUCTION

1.0 Overview

The first chapter of this research project opens with a background of the study and further describes the terms and evolution of Industrial Revolution 4.0. This is followed by the problem statement, research questions, research objectives, research gaps, the significance of the study, scope, and limitation.

1.1 Background of Study

There is no doubt that technology has advanced and change the direction of a business and the marketplace. Looking back where products were developed for instant meals, buildings, or even clothing were manufactured with the aid of animals or by hand. Eventually, thanks to technology, previously we have witnessed those inaccessible products and possibilities became available where it has enhanced business to a new height. Without a question, the growth of the industrial revolution has modified the way manufacturers operate.

The first industrial revolution began when agricultural cultures transitioned to industrial and urban society began to employ steam and water-powered machinery that replaced manual labor. In 1800, the first industrial revolution began with mechanization and mechanical power generation. It was mostly used in the textile industry to replace hand-operated operations with the first production process. The second industrial revolution began in the early twentieth century when the globe began to embrace steel and the use of electricity in the industry. electricity was replaced with coal as the principal source of energy. Manufacturing facilities have arisen as a result of several ideas such as industrial plan design, supply chain, and mechanized operation Rubmann et al. (2015)

and Erol and Sihn (2016). In 1968, the industrial revolution of 3.0 began, which was marked by the advent of microelectronics digitalization and automation technologies. Since the introduction of the transistor and integrated circuit chips which are implanted in machines operating electrically powered machinery was more completely automated machines have been produced.

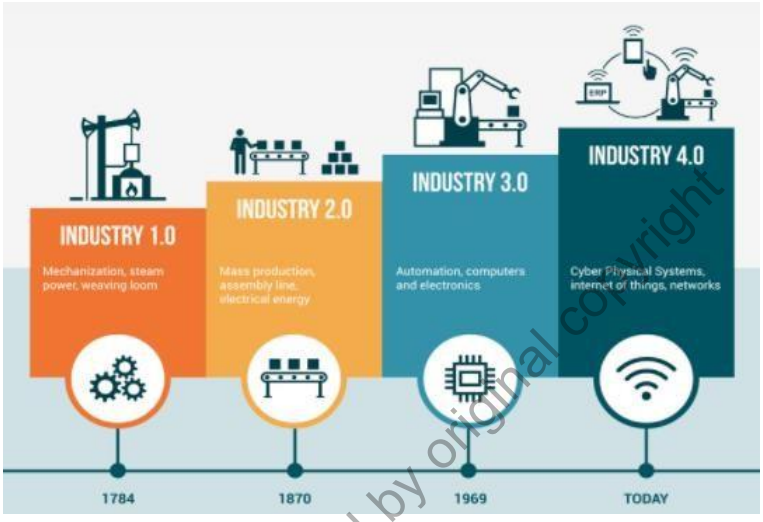

Figure 1.1: Evolution of Industrial Revolution 4.0

According to Lee et al. (2014), the industrial revolution 4.0 ties up together some major technological innovations with astonishing new capabilities in digital technology for instant, Big Data, Argument Reality, and Cyber-Physical Systems (CPS), all of which are composed to transform manufacturing sectors and optimize energy resources usage. The Boston Consulting Group (BCG) has identified and published nine technology pillars that could construct the Industrial Revolution 4.0 which is Big Data and Analytic, Automation Robots, 3D Simulation, Universal System Integration, Industrial Internet of Things (IoT), Cyber Security, Cloud Computing, Additive Manufacturing and Augmented Reality.

Malaysia's government approved the industrial revolution policy in 2018. Malaysia is pursuing Industrial Revolution 4.0 to boost productivity, initially focusing on the manufacturing sector but with plans to expand toward other industries in the future. This effort was launched in response to Malaysia's economic progress being hampered by low productivity across all industries. Lately, Ex-Prime Minister Tun Dr. Mahathir Mohamad at the beginning of 2019 stated that Malaysia risks losing out with untapped talent in Industrial Revolution 4.0 (February 2019, The Star Newspaper). Since then, Malaysia is currently seeking new and inventive methods to increase its market and generate higher-quality goods. The Southeast Asian country's manufacturing industry has been dramatically modernized in recent years. Liao et al. (2017), shared that the government perspective where South Korea, China, Japan, Taiwan, and Singapore have invested billions of amounts for the development of cutting-edge technologies to lead the next generation of manufacturing. Malaysia’s manufacturing companies is an important economic sector, providing roughly 22% of GDP in the previous five years, according to Malaysia’s National Policy on Industrial Revolution 4.0. To date, its growth has had the effect of stimulating jobs, attracting investment, and creating business opportunities in downstream activities and related service sectors. Therefore, the manufacturing sector is expected to remain resilient and is on track to achieve the targeted annual GDP growth rate of 5.1% under the 11th Malaysia Plan (RMK-11).

1.3 Problem Statement

Industrial Revolution 4.0, which refers to a new era, has recently become a popular trend throughout the world. According to Saucedo-Martínez (2018), Industrial Revolution 4.0 is viewed as a phenomenon of the far future from its inception in 2011, but at the beginning of 2016, it has gained more relevance and usefulness for manufacturing sectors and other sectors. Lately, Gartner forecast that worldwide information technology spending is projected to total 4.2 trillion USD in 2021, implying that reliance on Industry 4.0 technology will be greater than ever. Similarly, as has been predicted by McKinsey in 2018, 90% of manufacturers saw Industrial Revolution 4.0 as an opportunity rather than a danger. Cloud Computing, big data, and the Internet of Things are among the new business drivers, and they, together with other digitally-based technologies, have a significant influence on today's organizational performance (Tohanean et al., 2018). According to Ching et al. (2020), Industrial Revolution 4.0 has accelerated in recent years, with various nations, including the United States, the United Kingdom, Germany, Japan, Singapore, China, and South Korea implementing it.

Therefore, this paper will investigate and identify the significant impact of Industrial Revolution 4.0 and Data Analytics from Malaysia's manufacturing perspective. According to the prior study by Tay et al. (2021), they conducted a qualitative approach to discuss the current practice and challenges of Malaysian manufacturing firms in the implementation of Industrial Revolution 4.0. Based on the investigation determined that data management and integration, as well as personnel re-education, were the respondents' primary operational challenges. Furthermore, Hajar and Hadi (2018) conducted a study investigating the adaptation of industrial 4.0 in manufacturing companies. Based on their study, they outline three challenges faced by companies in

adopting Industrial Revolution 4.0 which is to capture and make sense of machine-generated data and turn it into valuable information, security issues and interpretation of Internet of Things generated data requires companies to use relevant analytical technologies such as big data analytics and cloud computing technologies. Aside from that, Zaher et al. (2019) did a study to close the knowledge gap and raise awareness about Big Data Analytics. Based on the research, they addressed problems such as complexity, security, risk, privacy, and ethical concern in data collection, technology, organizational, and human resources all of which might impact the organization's adoption of Big Data.

According to Muller et al. (2017) there is a shortage of literature in this study area of a well-founded instrument for qualitative research. Because there has been very little prior research and references pertaining to the themes that emerged from Industrial Revolution 4.0 and Data Analytics, therefore this research will be focusing on a qualitative research approach. To distinguish this research from others, this research tends to employ Yin's (2011), five-phase cycle data research design. This will consider the methodological gap for this research. Hence, this research narrows down to identify the Critical Success Factors (CSF's) on the substantial influence of Industrial Revolution 4.0 and Data Analytics among Malaysian manufacturing companies.

1.4 Research Question

The research questions are related to the area of study that this paper is going to discuss. The question is related to the significant impact of Industrial 4.0 and Data Analytics from Malaysia's manufacturing perspective. As a result, the research question is as follows,

i. What are the Critical Success Factors (CSF's) for industrial 4.0 based on Malaysian manufacturing companies?
ii. What are the Critical Success Factors (CSF's) for Data Analytics based on Malaysian manufacturing companies?

1.5 Research Objective

The purpose of this study is to investigate and identify the significant impact of Industrial Revolution 4.0 and Data Analytics from Malaysia's manufacturing perspective. To achieve this purpose, the following objective has been formulated.

i. To identify the Critical Success Factors (CSF's) for Industrial Revolution 4.0 based on Malaysian manufacturing companies.
ii. To research the Critical Success Factors (CSF's) for Data Analytics based on Malaysian manufacturing companies.

1.6 Significance of The Study

This study investigates and identifies the significant impact of Industrial Revolution 4.0 and Data Analytics from Malaysia's manufacturing perspective. Also, this study aims at exposing and acting source of knowledge for all university students to communicate with manufacturing industry experience. Industrial Revolution 4.0 is a driver for manufacturing companies to adopt the new line of the process. Apart from that this study also contributes challenges that are related to industrialization which could aid in improving organization performance. In Malaysia, manufacturing companies are still working in terms of developing strategies, investing in digital technologies, providing training, and working with digital technologies. Other than that, they are also currently seeking new and inventive methods to increase their market and generate higher-quality goods. Hence this research tends, to examine what is Critical Success Factors (CSF's) have developed by Malaysian manufacturing companies which are in line with Industrial Revolution 4.0 to achieve organizational performance. Whereas, when it comes to data analytics, manufacturing companies must use it in collecting, storing, managing, and analyzing it effectively. This digital technology helps to improve the response in making decisions and solving problems. Therefore, this research tends to take the responsibility to examine the Critical Success Factors (CSF's) on Data Analytics that has developed by Malaysia manufacturing companies. The finding of this research will propose the dimension of implementation on Data Analytics in manufacturing companies for an instant the significant, areas of implementation, types of tools, and challenges faced. Thus, from this study, managerial and manufacturing companies will gain insight into the contribution of Industrial Revolution 4.0 towards organization performance, and at the

same time, they will be aware of the current challenges faced by manufacturers in this era.

Rather than that, this research expands the methodology in analyzing the variable in this study. Since much research has been conducted on the quantitative method, this study tends to conduct qualitative research in analyzing the collected data. This research uses Yin five-stage cycle to analyze the collected data. There is very little prior research that has tested Yin's five-stage cycle research design when it comes to the context of Industrial 4.0. In analyzing the collected data this research tends to develop themes that are related to this field. This might be a contributor to the upcoming research.

1.7 Scope and Limitations

The purpose of this research is to see how successful the implementation and impact of Industrial Revolution 4.0 and Data Analytics in Malaysian manufacturing companies. The level to which manufacturing is adopting digital technology is also investigated in this research. The status of manufacturing organizations concerning Industrial Revolution 40, whether they are in the observation, initial or adaption stage, and maturity stage was also addressed in this study. This research also discusses the hurdles and how they overcome them when it comes to digital technology adaption. Furthermore, when it comes to data analytics, this research aims to determine how data analytics is utilized in manufacturing organizations and the problem associated with applying it.

Moreover, the number of respondents in this study is a restriction. The data for this study was gathered from four respondents who work as quality department managers. This might also be considered the limitation for this research paper. Aside from that, a

few literature reviews were undertaken in the Yin five-stage cycle. When it comes in implementing this research approach in these studies, it has become a challenge. Furthermore, when it comes in identifying the Critical Success Factors (CSF's) of an organization in boosting it organization performance there are 14 factors has to be considered according to prior research. Nevertheless, this research paper narrows down the focus on one Critical Success Factors (CSF's) which is the significant impact of Industrial Revolution 4.0 and Data Analytics in boosting organization performance. Therefore, upcoming research can fulfil all 14 Critical Success Factors (CSF's). Hence, this will be one of the limitations of this research paper.

1.8 Summary

The scope and purpose of this work are mostly explained in this first chapter. The background of this study, problem statement, research questions, research aims, research gap, and limitation of this study have all been thoroughly addressed to offer a clear grasp of the material that will be discussed in this article in this field of study. The content in this chapter will be significant for the following four chapters.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This part focuses on the variables that are related to this study. To recap, this research tends to investigate and identify the significant impact of Industrial 4.0 and Data Analytics from Malaysia's manufacturing perspective. In today's manufacturing industry, achieving organizational performance is a difficulty. Whereas the drivers for achieving organizational success are the deployment of the Fourth Industrial Revolution and a significant focus on data analytics. In this part, we will look at prior literature perception about this subject of research

2.2 Organization Performance

The degree of accomplishment attained in a certain profession or task that must be completed is referred to as performance. Thus, organizational performance refers to how successfully a company meets its market and financial objective according to Chaves et al., (2017). On the contrary, it can be also referred to as the degree of achievement of corporate objective after a certain time, as well as the amount of company success according to Erdem et al., (2013). According to Elnihewi et al., (2014), good performance measures the strategic plans and objective or organizations, compares the company to its rivals, by measuring its success, motivates employees, create an early warning system towards errors, and contributes a crucial role in management's decision-making, thus organizational performance is also important for determining the efficiency and effectiveness of business activities. Meral and Bunyamin (2021), conducted research in determining the effect of industry 4.0 technology components on the organizational performance of businesses. The researchers conducted quantitative research by proposing

a questionnaire for 1677 respondents who are working in production companies in Turkey. Based on the finding, the implementation of industry 4.0 technologies increases organization performance criteria such as profitability, sales, production amount, production amount per capita, capacity utilization rate, production speed, product quality and can lead to significant reductions in production cost. Nevertheless, according to its finding's businesses are faces challenges in lack of qualified employees and costs associated with research and training. According to Rosmanin et al., (2020), they conducted a study on analyzing the readiness of automotive manufacturing firms on industrial 4.0 towards quality performance. The researcher conducted quantitative research by proposing a questionnaire towards 96 respondents from the top and middle management from all departments in the DRB-HICOM company. Based on the finding, all related constructs have a significant yet strong relationship between industry 4.0 and quality performance. According to the result obtained, maintenance has a high-level priority in the company characteristic and RFID systems are important to their company for achieving good quality performance. According to Dragos Tohanean et al., (2018), they conducted a study on the relationship between the concept of organizational performance and digitalization in Industry 4.0. the research conducted quantitative research combined with a case study on BMW AG. Based on the findings, it shows that digitalization improves the performance of today's organization and in the case of the German company, leads to providing safer products for customers and achieving better results. As been mentioned by Kong et al., (2020), even implementation of industry 4.0 is widespread around the world, but Malaysia still has not widely adopted this technology yet. In this era, Industrial Revolution 4.0 and Data Analytics are important factors that will boost the organization's performance. Various studies have proven that the pillar of

a successful organization is based on the implementation of industry 4.0 technologies. Therefore, this study tends to explore what are the strategies and initiative that is in line with Industrial Revolution 4.0 and Data Analytics has Malaysia manufacturers developed. When the development of Industrial 4.0 has been introduced globally, there were no procedures to guide manufacturing companies to develop their vision toward the implementation of these technologies. For the purpose of that, it is significant to conduct this research among Malaysian manufacturing companies. This will measure the capabilities of Malaysian manufacturing companies in adapting these digital technologies. At the same, these technologies aim to increase the capabilities of manufacturing companies in terms of enhancing productivity and efficiency among employees, better flexibility and agility as well as increasing profitability. This will may help manufacturing companies in moving to an automated process, expand their market, and at the same time gain competitive advantages. This research paper tends to examine the Critical Success Factors (CSFs) that manufacturing company has employed concerning Industrial Revolution 4.0 and Data Analytics to boost organizational performance.

2.3 Industrial Revolution 4.0

A German project coined the phrase “Industry 4.0” to represent a fully automated manufacturing process in which information flows between robots controlled by human, minimizing the necessity of human contact. Industry 4.0 is frequently used in conjunction with the Cyber-Physical System (CPS) production model, which entails the integration of data and knowledge. According to Lu (2017), the fundamental ideas of (CPS) are to meet production's flexible and dynamic requirements, as well as to improve the product's effectiveness and efficiency. The Boston Consulting Group (BCG) has identified and

published nine technology pillars that could construct industrial 4.0 which is Big Data and Analytic, Automation Robots, 3D Simulation, Universal System Integration, Industrial Internet of Things (IoT), Cyber Security, Cloud Computing, Additive Manufacturing and Augmented Reality. According to Wilkesmann (2018), highlight that most manufacturers of Industry 4.0 are still in the early stages of development. At the same time, according to Hubert and Nadarajah (2019), stated that Malaysia manufacturing is likely to remain largely at the mass production and automation levels of Industry 2.0 and 3.0. On the other, much research has been contributed concerning this field. Tay et al., (2021), conducted research on the current practices and challenges of Malaysian manufacturing firms in the implementation. The research employed a qualitative grounded theory method based on seven engineering manufacturing firms. Based on the finding, the majority of respondents cite knowledge-driven, technology, capital, education, and the workforce as major challenges. The findings also indicate that the Malaysian manufacturing industry is still in the early stage of transition from existing manufacturing mostly industry 3.0. Bavaani et al., (2021), conducted research on examining the Industrial Revolution 4.0 adoption behavior by utilizing Technology Acceptance Model. The researcher employed a qualitative approach where questionnaires are sent to a bigger sample size on the Electrical & Electronic industry and Small Medium enterprises in Malaysia. Based on the finding, the author claims that the enthusiasm for the Industrial Revolution 4.0 adoption among E&E and SMEs appears to be minimal. Simon and Devika (2019), conducted research on proposing a conceptual framework on identifying the relationship between Industry 4.0 and key technologies and productivity in Malaysian manufacturing firms. The researcher concludes that profound research is still lacking concerning the extent of a positive or negative relationship between

productivity and industry 4.0 technologies. Concerning the prior studies, this research takes this opportunity to investigate the adoption of Industrial Revolution 4.0 in Malaysian manufacturing companies. Unlike prior research, this research focuses on the involvement of Industrial Revolution 4.0 among manufacturing companies and the contribution towards the implementation. At the same time, this research aims to develop the emerged themes relating to Industrial Revolution 4.0. Therefore, it is significant to investigate to what extent Malaysian manufacturing companies have implemented these digital technologies.

2.4 Data Analytics

Big data has a significant influence on companies in the fourth industrial revolution, this is because the revolution in the network, platforms, people, and digital technology has altered the drivers of organization innovation and competitiveness. Manyika et al., (2011), claim that big data refers to large datasets that are not able to be captured, stored, managed, and analyzed by typical software tools. Vassakis et al., (2018), these data set are massive, not just in terms of quantity, but also in terms of variety and complexity (structured, semi-structured and unstructured data). According to Gantz (2011), unstructured data is growing faster than structured and has captured the 90% of all the data. The analysis of large data sets in enterprises, the term of big data analytics is associated with data science, business intelligence, and business analytics. When it comes to the context of Industrial 4.0, it aspires to achieve personalization and resource efficiency through shared facilities in an integrated global industrial system for on-demand manufacturing aided by data analytics in a smart and autonomous system. Prior studies have examined data analytics from various angles. Popovic et al., (2016), conducted an investigation of the impact of big data analytics on operation management

in the manufacturing sector. The researcher employed an interpretive qualitative approach which is a comparative case study of three manufacturing companies with varying levels of big data analytics usage. Based on the finding, big data analytics supports performance aspects in relation to their planning, manufacturing process, and quality assurance. Patrick et al., (2019), conducted research on understanding how factors relating to a firm's data analytic research combined with contextual elements to high firm performance. The researcher employed a mix-method approach that build on both quantitative and qualitative methods. The research uses the fsQCA research method on a sample of 175 Greek firms and fuzzy-set qualitative comparative analysis with three firms. Based on the findings, one of the main issues faced by many organizations that adopt big data analytics is that they are failing to realize performance gains. Other than that, many businesses particularly bigger and more fragmented ones, construct hurdles to collaboration with analytics departments due to negative psychology and fear of losing authority. This causes significant issues because most analytics programs need data and subject expertise from personnel from several departments. Surajit et al., (2020), conducted a study to examine the effect of institutional pressures intangible resources, and workforce skills for big data analytic powered artificial intelligence adoption and to understand the impact of data analytic powered artificial intelligence on sustainable manufacturing practices and circular economy capabilities. Based on the finding, there is a positive relationship between data analytic powered artificial intelligence adoption and sustainable manufacturing practices, and circular economy capabilities. This research examines the implementation of data analytics in Malaysian manufacturing companies. In this era, the involvement of data analytics in manufacturing is crucial. Since the manufacturing environment is dynamic where they have to deal with a big bunch of data the use of data

analytics is crucial in various dimensions. Unlike prior research, this research highlights the significance, tools, area implementation, and obstacles faced by Malaysian manufacturing companies. At the same time, this research aims to develop the emerging themes relating to data analytics. This will prove the capabilities of Malaysia manufacturing companies in dealing with real-time data analytics.

2.5 Summary

In this chapter, the researcher has given a clear explanation regarding the variables based on prior research. The researcher believed that those explanations of dependent variable and independent variable can provide very good understanding and depth knowledge for the following chapters.

CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of this chapter is to discuss the design of this research methodology. In this chapter, the research design, population and sampling, methods used for data collection, and data analysis procedures. This research aims to indicate how the research was conducted through the study period.

3.2 Research Design

This research follows the qualitative approach because the central goal is to discover or explore a given phenomenon. According to Durodola et al., (2017), qualitative research allows for a more in-depth examination and comprehension of how group or individuals view social or human problems. The qualitative research tradition allows the use of inductive reasoning to synthesize textual or narrative data. The method of this research focuses on textual data. Malagan-Maldonado (2014), mentions that qualitative research is subjective since it exposes a researcher to a variety of realities about a specific event, which may be interpreted in a variety of ways depending on individual viewpoints. The qualitative research platform allows for five approaches which are case study, phenomenology, narrative, ethnography, and grounded theory. In this research, a descriptive case study approach is employed to address the research questions. According to Yin (2009), a case study is an in-depth investigation of a social phenomenon rooted inside actual life difficulties, particularly when the phenomenon and the setting in which it happens are intertwined. According to Cronin (2014), said that case study research follows a methodical approach, especially when acquiring in-depth data. Other than that, Janis et al., (2020) suggested that case study research gives a solid grasp of a phenomenon

that originates from complications associated with interpersonal behaviors in a broad social context. Yin (2009), illustrated that a case study is effective in exploratory and descriptive forms and it is beneficial in the study of current events because significant variables cannot be manipulated as easily as they can in a controlled setting. Yin (2009), also mentions that a case study can provide a greater collection of data by allowing the researcher to personally watch and interview people associated with the event or phenomena of interest.

3.3 Population and Sampling

In this research, the participant was selected via a purposive sampling method. According to Saunders, Lewis, and Thornhill (2012), Purposive sampling is also known as judgment selective or subjective sampling. This method is a sampling approach in which the researcher chooses individuals of the population to participate in the study based on his or her judgment. According to Yin (2011), mention that the goal or purpose of this approach is to have those that will yield the most relevant and plentiful data, given to your topic of study. For this study, the participant was chosen from a Malaysian manufacturing company. Instead of randomly selecting participants for this study, the participant was chosen based on their experience working in the quality department. According to Black, (2010), researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money.

According to Yin (2014), the minimum number of instances to be researched in a case study to find similar and dissimilar patterns in data is four to six participants. This research interviewed four participants who work in the quality department of a Malaysian manufacturing company. The location company Raymond, Participant 1 and

Shathiananthan, Participant 4 was from different parts of Selangor, namely Shah Alam and Subang. Whereas Selva Ganesha, Participant 3 company is located in Bayan Lepas, Penang and Gopinathan Subramaniam company is located in Sungai Petani, Kedah.

Table 3.3: Respondent Profile

Participant Name	Company Name	Industry	Department	Working Experience	Length of interview
Raymond Anthony	Renesas International Operation Sdn.Bhd	Electrical & Electronic	Supplier Quality Department	7 Years	34 mins 43 sec
Gopinathan Subramaniam	LYSA Technology Sdn.Bhd	Electrical and Electronic	Quality Assurance Department	4 Years	21 mins 08 sec
Selva Ganesha A/L K.Tawadisen	Osram Opto Semiconductor Sdn. Bhd	Electrical and Electronic	Quality Engineering Department	6 Years	16 mins 25 sec
Shathiananthan Sambayah	NIPPON PAINT (M) SDN. BHD	Chemicals and Chemical Products	Technical Quality Control Department.	4 Years	19 mins 03 sec

3.4 Data Collection Methods

In this research, the data collection method used is the in-depth virtual interview. The interview is a commonly used technique in qualitative research. Cannell and Khan (1968) defined the interview as 'a two-person conversation initiated by the interviewer for the specific purpose of gaining relevant information. It focuses on the content specified by the research objectives and direct verbal interaction between the researcher and the information. Yin (2011), interviews can take many different forms, but for the purpose or argument, all of them can be divided into two types which are structured

interviews and qualitative interviews. This research paper adopted qualitative interview. According to Yin (2011), a qualitative interview is open-ended question where it will be more significant that closed-ended question. A structured interview directly follows the researcher words usage, phrases and thus meaning, whereas qualitative interview seek to understand participant "on their own terms and how they make sense of their own lives, experiences, and cognitive process". Therefore, this paper would like to encourages participants to use their own term rather than those chosen by the researcher. The interview was conducted via Google Meet. Each interview that was conducted was recorded. The recorded attachment was used to transcribe the opinion of the participant. Manual codding was employed to conduct the data analysis procedure.

3.5 Data Analysis Procedure

The role of a researcher is to observe, collect and deliver accurate textual data or information regarding the nature of the study. While the interview session is conducted, taking advantage of unexpected chances to collect data by being responsive to participant replies and providing questions that will elicit answers that will improve the study's findings. The five-step data analysis procedure is present in Figure 3.1 below proposed by Yin (2011).

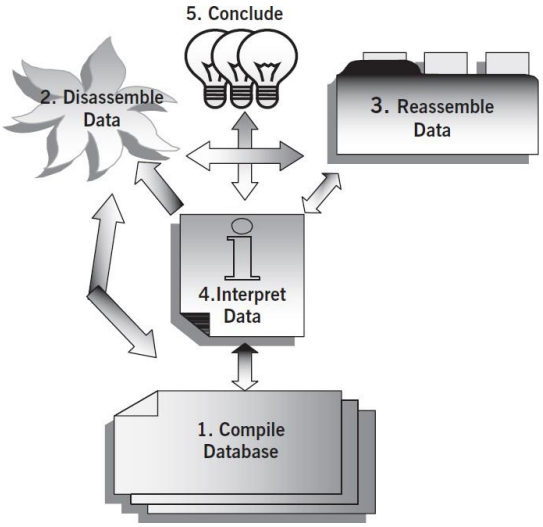

Figure 3.1: Five steps procedure for qualitative data analysis

The first stage of the five-stage analytic approach proposed by Yin (2011) is compiling data. the primary goal of this step is to categorize and arrange the notes or data obtained from the field activities. Aside from that, the researcher must repetitively read the transcript and become acquainted with the topic. Based on this research, the data was collected from the recorded interviews. Based on the recorded video, each content and opinion that was answered by the participant will be scripted. Once the transcript is done, it is necessary to read it several times to become acquainted with each of the participant's responses.

The second stage is data disassembling. The goal at this stage is to split down the gathered data into smaller fragments by identifying them with codes or leveling them. The researcher must identify particular actions, opinions, and explanations and assign them level 1 or code them to categorize the fragment. If there is a comparable item, the researcher must classify it as level 2 and place it in a bigger category. As part of the trial-and-error process, this step might be recursive between the prior two stages. Based on

this research once the script is familiarized, the next stage is breaking down the phrase into smaller fragments or keywords.

Reassembling is the third stage. The goal of this stage is to find a believable and fascinating pattern. The researcher must include the usage of substantive themes to arrange the fragment items and build a new formation that is distinct from the original text. To accomplish this, Yin (2011) has introduced three sorts of arrays which us hierarchy, creating matrices, and cooperating with other arrays. Next, to see whether there is any difference in participant reaction and experience, Yin (2011) advocated three procedures which are constant comparison, negative instant, and rival thinking. In addition, there is a necessity in the searching procedure to mix and match the code question till it satisfies the researcher.

The fourth stage is interpreting data, the goal of this step is to analyze the data derived from reassembling data and data arrays in accordance with the research question and research purpose. The reassemble data must be scanned from a larger viewpoint until it is narrowed down to a close agreement with the study purpose. The final stage is concluding. In this stage, the researcher wraps up the whole process.

3.6 Validity

The term "Validity" refers to how suitable the method, data, and process selection are in connection to research. Another often-used criterion is reliability. However, this criterion is more commonly utilized in quantitative research Yin (2011). Because qualitative and quantitative studies are so distinct, some writers suggest that they should be assessed differently Yin (2011). Lincoln and Guba (1989), stated in the case of

qualitative investigations, more acceptable criteria include credibility, transferability, dependability, and confirmability.

3.6.1 Credibility

Internal validity is characterized as a similar criterion to credibility, both address the appropriateness of observation and the author's interpretation. In a qualitative study, the researcher must address the fact that the study is being done in a social situation, which adds the dimension of individual interpretation of subject ideas. First is prolonged engagement with the subject. The researcher has spent 20 to 30 minutes interviewing the participants. Apart from that, prolonged engagement with data. The researcher has taken days to understand and transcribe the data. In other words, the researcher did not read the answer script once and come up with some themes. The research took hours to spend time with the transcripts to understand the phenomena of each participant. Secondly, is persistent observation with the subject. With this in mind, the researcher implemented respondent validation were in a situation of uncertainty. During the data analysis, if there were any unclear responses, the research texted the participant to get clarification to avoid misinterpretation. The third is member checking. Lincoln and Guba (1989), asserted that this is the most important form of credibility. For the purpose of that, once the research competed for the finding, the researcher sends a copy to the subject via email to review the findings. By doing this, the researcher might get a deeper insight into how the participant perceives the interpretation. The fourth is reflexive journaling, to support each decision in the findings, the researcher cited by reflexing prior research. By having a reflexive journal, it will help the researcher to evaluate the perception in reference to the phenomena in an asynchronous way.

3.6.2 Transferability

Transferability is a criterion that is related to external validity in that both address the application of research to another similar subject. External validity, on the other hand, strives to provide a generalizable outcome. An issue emerges in qualitative research because, due to the study's limited sample size, it is insufficient to make broad conclusions. However, Bryman and Bell (2015), transferability highlights the process of giving enough background information for the reader to judge in which circumstance the study findings might be useful. In presenting the data the situation and background of the companies and the participant were presented. The researcher also presented the data collection method that was employed. Apart from that, the research also describes the data number and the length of the data collection sessions.

3.6.3 Dependability

This criterion is related to reliability. To obtain the highest level of dependability, the researcher should take on the role of an auditor, which involves keeping documentation at all phases of the research process, Bryman and Bell (2015). For this research, the document is stored in a folder. The document includes participant selection, interview transcript, recorded interview, and data analysis procedures. The researcher design that is proposed in this study may be considered a prototype model. This will help readers to the extent of this proper research practice.

3.6.4 Confirmability

As a researcher, this paper was not conducted with biasness. According to Bryman and Bell (2015), argue that it is hard to be entirely impartial owing to the subjective nature of doing research in a social situation. This researcher admitted that it was difficult to not