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Faculty of Mechanical Technology and Engineering

DEVELOPMENT ON DIGITALIZATION & MODERNIZATION OF PRODUCTION DATA TRACKING AND IMPROVEMENT ON HVAC MANUFACTURING TO INCREASE EFFICIENCY & QUALITY

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Nurul Fatihah Akmar Binti Mohd. Zain

Bachelor of Mechanical Engineering Technology (Refrigerant And Air Conditioning System) with Honours

2024

DEVELOPMENT ON DIGITALIZATION & MODERNIZATION OF PRODUCTION DATA TRACKING AND IMPROVEMENT ON HVAC MANUFACTURING TO INCREASE EFFICIENCY & QUALITY

NURUL FATIHAH AKMAR BINTI MOHD. ZAIN

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Refrigerant And Air Conditioning System) with Honours

Faculty of Mechanical Technology and Engineering

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2024

DECLARATION

I declare that this Choose an item. entitled “Development on Digitalization & Modernization of Production Data Tracking and Improvement on HVAC Manufacturing to Increase Efficiency & Quality” is the result of my own research except as cited in the references. Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis, and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Refrigerant and Air Conditioning System) with Honours.

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DEDICATION

Alhamdulillah, thanks, and praise to the Almighty Allah S.W.T. I dedicate my dissertation work to my family, my supervisor, my lecturers, and all my friends. Expressing gratitude to my parents Mohd. Zain and Juzailina. I also dedicate this dissertation to my friends who have supported me throughout the process. I will always appreciate all they have done, and I will do my best.

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ABSTRACT

In the rapidly evolving landscape of manufacturing, the HVAC industry stands at the crossroads of innovation, where the seamless integration of digital technologies promises to revolutionize production processes. This abstract explores the pivotal role of digitalization and modernization in the context of HVAC manufacturing, specifically focusing on the enhancement of production data tracking for improved efficiency and quality. Moreover, the integration of machine learning algorithms enhances the predictive capabilities of thesystem. By analyzing historical data and identifying patterns, the manufacturing process becomes more adaptive and responsive. Predictive maintenance strategies can be employedto reduce downtime, enhance equipment lifespan, and ultimately contribute to a more cost- effective and sustainable HVAC production environment. In conclusion, the abstract emphasizes the transformative potential of digitalization and modernization in HVACmanufacturing. By strategically implementing advanced technologies, manufacturers can elevate their production processes, boost efficiency, ensure product quality, and position themselves at the forefront of a rapidly evolving industry. This abstract sets the stage for a comprehensive exploration of the methodologies, challenges, and outcomes associated with this crucial transition in HVAC manufacturing. So, the researcher makes some improvement for this company, from manually to digitalization for enter the data. From that, the workers can save their time and the data possibility to have some error, then the data also live.

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ABSTRAK

Dalam landskap pembuatan yang berkembang pesat, industri HVAC berada di persimpangan inovasi, di mana penyepaduan lancar teknologi digital menjanjikan untuk merevolusikan proses pengeluaran. Abstrak ini meneroka peranan penting pendigitalan dan pemodenan dalam konteks pembuatan HVAC, khususnya memfokuskan pada peningkatan penjejakan data pengeluaran untuk kecekapan dan kualiti yang lebih baik. Selain itu, penyepaduan algoritma pembelajaran mesin meningkatkan keupayaan ramalan sistem. Dengan menganalisis data sejarah dan mengenal pasti corak, proses pembuatan menjadi lebih adaptif dan responsif. Strategi penyelenggaraan ramalan boleh digunakan untuk mengurangkan masa henti, meningkatkan jangka hayat peralatan, dan akhirnya menyumbang kepada persekitaran pengeluaran HVAC yang lebih kos efektif dan mampan. Kesimpulannya, abstrak menekankan potensi transformatif pendigitalan dan pemodenan dalam pembuatan HVAC. Dengan melaksanakan teknologi termaju secara strategik, pengeluar boleh meningkatkan proses pengeluaran mereka, meningkatkan kecekapan, memastikan kualiti produk dan meletakkan diri mereka di barisan hadapan dalam industri yang berkembang pesat. Abstrak ini menetapkan peringkat untuk penerokaan menyeluruh metodologi, cabaran dan hasil yang berkaitan dengan peralihan penting dalam pembuatan HVAC ini. Jadi, penyelidik membuat beberapa penambahbaikan untuk syarikat ini, daripada secara manual kepada pendigitalan untuk memasukkan data. Daripada itu, pekerja boleh menjimatkan masa mereka dan kemungkinan data mempunyai beberapa kesilapan, maka data itu juga hidup.

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LIST OF SYMBOLS AND ABBREVIATIONS

HVAC	-	Heating, Ventilation and Air Conditioning
PDCA	-	Plan, Do, Check and Act
CIP	-	Continuous Improvement Process

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CHAPTER 1

INTRODUCTION

1.1 Background

Carrier International (Malaysia) Ltd. was established in 1959 as a distributor for Carrier air-conditioning equipment and components. It was the very first year that Carrier had established a presence in Malaysia. Carrier International Sdn Bhd (CISB) is the new name that was given to the corporation when it converted. Carrier (Malaysia) Sdn Bhd, which is a subsidiary of Carrier International Sdn Bhd, was established in 1960 with the purpose of handling the marketing and maintenance of every model of air conditioners manufactured by Carrier in Malaysia. There is a collective team of trained technicians operating there, and the crew makes up of individuals who have received professional training. Carrier Global Corporation, USA is the owner of 51% of Carrier International Sdn Bhd's share, while Permodalan Nasional Berhad (PNB) is the owner of the remaining 49% of the company's shares.

Air conditioners manufactured by Carrier have been selling and installing in Malaysia for over 60 years at this point. For catering to the requirements of a wide range of clients, including dealers, consultants, property developers, and individual consumers, we provide individualised plans and consulting services. Our customer support staff is committed to providing superior support to our clients. At this point in time, Carrier Malaysia is known as one of the most important suppliers of air conditioning equipment and systems in Malaysia. Carrier can serve families, workplaces, industries, hotels, and shopping arcades

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across the country by using a network of more than 600 dealers and sellers. This dedication to quality, together with our commitment to product innovation and distinction, allows us to provide customers with items that will continue to make their world more comfortable.

They also create and produce HVAC system equipment for residential, commercial, and industrial applications. In this company there are various departments that we have. Production, manufacturing engineering, quality assurance, maintenance facility, finance, logistic, store department and material. For example, production operate machines, for example the staff of production are often to be responsible for operating various types of machines and equipment that used in the manufacturing process. That also can include cutting the tools, varnish, brazing, welding the equipment, bending and other things than that. From this, we can include for inspection. Staff or operators are also concerned more about products quality standards. This includes inspecting products, using measurement tools, and conducting tests to identify defects or any leakage on the equipment.

For, manufacturing engineering they work on new product development, producing prototypes and evaluating mechanical components to ensure their efficiency, reliability, and performance. Other than that, they also design, develop, and make some improvement or inspection of machines, production lines, and specific machinery are examples of mechanical components and systems used in the industry.

This company still uses the old version for entry the data complete. Which is, write the data on the board after scanning the quick response code. This process may take time to complete the data on board. The solution is to make the excel for data entry. From this, we can save our time to write the data on board and no error occurred during entry the data. In a rapidly evolving technological landscape, where automation and digitalization have become the norm, there are still companies that rely on traditional manual methods for updating their production data tracking systems. This unique approach sets these companies

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apart, emphasizing a commitment to time-tested processes and a human touch in an era dominated by digital innovation. Carrier International Sdn Bhd stands as a testament to the enduring value of manual processes in an increasingly automated world. Operates in industry where precision and accuracy in production data tracking are paramount. Despite the widespread adoption of digital solutions in similar industries, other companies or industry has chosen to maintain their reliance on manual methods to capture, record, and analyze crucial production data. So, this company can make improvements from manually to digitalization and modernization process. The researcher believes that at the core of this company can expertise and attention to detail that can only be provided by skilled human operators. This commitment to a manual approach is driven by the belief that experienced hands, guided by a deep understanding of the production process, can offer a level of precision and adaptability that automated systems may struggle to match.

1.2 Problem Statement

In the modern era of industrial, there is a priority for the digitization as well as the modernization of the tracking systems for production data. For now, still use conventional approach of monitoring and manage production data sometimes use manual steps, paper-based documentation, and separate systems, so the result in waste, errors, and lack of time insights. Current methods for tracking and manage production data frequently depend on computers, software and combine with system.

Take time to get the data while using manual data entry. The reliance on manual data entry methods improves the possibility of human error, which in turn increases the probability of production records including incorrect data. Manual tracking uses up valuable

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time and resources, that results in inefficiencies in procedures for operation. From that, maybe the data can be errors while entry or record.

In addition, security, and compliance issues. As we know if still use paper to record the data, maybe some issues can happen. Tracking methods that are manual or based on paper presently a security risk because they are more likely to be misplaced, snatched, or obtained improperly. Without a data monitoring system that is both secure and auditable, compliance with industry standards and norms becomes much more difficult. Other than that, for this company still use the board to write the data complete. Next, problems connected with quality control for example issues with monitoring and tracking production data in line are a contributor to difficulties in maintaining product quality in a consistent manner. It is difficult to identify and correct quality issues that develop during the productionprocess if real-time insights are not available, causing in an increase in waste and rework.

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1.3 Research Objective

The objective of this project is:

a) To update the outcome data through digitalization, ensuring timely access to inform, and enchancing comprehension through visualization.

b) To analyse the real time data tracking that have been collected from the project.

1.4 Scope of Research

The scope of this research are as follows:

- The study focused on excel or another software to solve this problem.
- A study of improvement on HVAC manufacturing to increase efficiency and quality.
- Using excel to make the modernization of data tracking.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

With the goal to compile the data and information that is provided in the subject matter of the study, research that the combination of modernization and digitalization has become a disruptive force in many different areas of the modern industrial environment. Production data monitoring has experienced a paradigm shift in the manufacturing sector due to the use of modern technology, especially in the HVAC (Heating, Ventilation, and Air Conditioning) business. With a focus on improving efficiency and quality, this literature review explores the complex dynamics linked to modernization and digital transformation efforts in HVAC production.

2.2 Definition of Digitalization and Modernization

Digitalization refers to the process of converting analogy information into digital form, which that involves representing information, data, or processes in a digital format. This transformation enables more efficient storage, processing, and transformation of information. Digitalization is a key aspect of the ongoing technologist revolution, influencing various industries and aspects of our daily lives (Goorha, 2018). In a more general sense, modernization refers to the process of improving or changing techniques, procedures, or systems so that they are in line with the most recent guidelines, technology, and fashions. In addition, it is a more general phrase that incorporates a variety of characteristics, such as changes in company culture, technical advancements, and technology. Incorporating modern approaches and solutions is the goal of modernization, which attempts to increase overall performance as well as agility and competitiveness.

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Examples of modernization include the use of agile project management practices, the upgrading of outdated software systems, the adoption of cloud computing, and the reengineering of business processes to improve efficiency (Lyudmyla Chyzhevska, 2021).

2.3 Continuous Improvement

Continuous improvement, referred to as continuous improvement process (CIP) or continuous improvement management, is an activity that is both systematic and ongoing, with the goal of improving goods, services, or processes. The philosophy in question is one that places a value on developing changes that are both steady and long-lasting over the course of time, with the ultimate objective of reaching excellence in terms of quality, efficiency, and customers' satisfaction (Fryer, 2007).

In a great number of companies, the process of change may be difficult to navigate. The core principle of continuous improvement known as kaizen is what makes change a way of life at Toyota. This philosophy is essential to the company's success. inevitably talk about kaizen, we mean that every single person of the team, regardless of where they are located within the organisation, is always looking for ways to improve operations, and that everyone at every level of the organisation is on board with this process of improvement. Additionally, kaizen necessitates the establishment of defined objectives and targets for development, as well as clarity on the goals that are to be accomplished. When it comes to this topic, having a good attitude and putting the emphasis on what ought to be done rather than what can be done is far more important. The Toyota Production System operates on several pillars, one of which is the concept of Kaizen, which is not just a method but also an attitude. Because of Toyota's unceasing pursuit of development, the company guarantees that its consumers will always have access to high-quality goods that make use of the most cutting-edge and dependable technology. Toyota also collaborates with its clients to enhance the quality of

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the services it provides to them to optimise the return on investment that they receive from purchasing Toyota goods (“Toyota Production System,” 2000).

At this company, we also do the kaizen that refer change for the better or continuous improvement. For example, figure 2.1 show the improvement that have been done for line production AHU, we make some improvement from messy trolley to specific lane that can the trolley is in order. Function makes the improvement can say about safety of the workers, more orderly arrangement the trolley and quality about part easier to manage and avoid the damage.

Figure 2. 1 Kaizen Before After

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2.4 Improve Production Tracking

The term "improving production tracking" refers to the practice of increasing the methods and systems that are utilised to monitor and manage the different characteristics of a production process. To do this, it may be necessary to establish tracking systems that are more effective and precise, to make use of technology, and to improve processes to provide improved visibility and supervision over the production lifecycle. An increase in productivity, a decrease in mistakes, and the ability to make accurate decisions based on data that remains accurate and current are the objectives (MassCEC, 2018). The goal is to enhance

productivity, reduce errors, and make informed decisions based on real-time and accurate data. To be able to improve production tracking, key components include efficiency.

It is essential to have efficient production tracking to reduce the amount of time that delays occur and to improve overall operational performance. The following is a list of various strategies that may be used to simplify production tracking processes. For example, employee it is important to provide workers with training on how to use new technology and maintain updated processes. Make that staff are given the opportunity to actively participate in the improvement of production tracking. Companies can greatly improve the efficiency of their production tracking systems by implementing these strategies, which will result in a reduction in delays, an improvement in accuracy, and an increase in total productivity (Edwin & Daud, 2021).

2.4.1 Benefit of Production Tracking

As a strategic tool that helps employers improve their manufacturing processes, production monitoring is becoming increasingly important in today's hectic and competitive business environment, where agility and efficiency are of the highest priority. The production tracking system offers real-time insights into every aspect of the manufacturing process by utilising cutting-edge technology and efficient procedures (Katana, 2010)

2.5 Purpose Tracking Performance

The achievement of a purpose has come out as an important issue in the changing environment of both the commercial world and the area of human development. The need of connecting behaviours with a more profound sense of purpose to achieve meaningful outcomes is being more recognized by both individuals and organizations. When purpose is utilized in an efficient manner, it functions as a directing force, transforming decisions, affecting behaviour, and eventually deciding the level of success achieved (Parker, 2003). If observed in this illumination, the idea of purpose tracking performance emerges as a

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powerful tool that may be utilized to measure and improve one's path toward meaningful life as well as the success of a business. This approach goes beyond the conventional measurements of performance, delving into the fundamental reasons and values that serve as the foundation for actions and achievements. Individuals and organizations may receive useful insights that will allow them to maximize their efforts, cultivate a feeling of fulfilment, and generate sustainable success if they consistently monitor and evaluate the alignment of actions with the overarching goal (Pradhan, 2009).

Taking this approach acknowledges that purpose is not a fixed destination instead a journey that is always growing. To guarantee that activities continue to be coordinated with the overall purpose, it is necessary to engage in continuous self-awareness evaluation, and modification. Purpose tracking performance acts as a compass, pointing in the right direction and assisting in navigating the complex world of both personal development and organizational advancement (Kristan, 2016). During this investigation into the performance of purpose tracking, we will investigate the approaches, tools, and strategies that enable individuals and organizations to not only define their purpose but also to actively observe and evaluate their progress. We hope that by doing so, we will be able to discover a road map that will allow us to achieve not only high performance but also a performance that is deeply founded in purpose. This is a performance that goes above simply performing well to leave an indelible mark on people, teams, and the world.

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2.6 Cost Standard Hour

If it comes to the variable environment of modern business, the effective management of resources is of the highest order to the success of a firm. The idea of "cost standard hour" is a significant statistic that plays an essential part in measuring productivity and reducing costs. It is also an important indicator. This metric provides a significant benchmark, providing organizations with a defined unit of measurement that can be used to evaluate the

effectiveness of labour efforts and the costs that relate to them. At its simplest, a cost standard hour is a measurement of the cost of an hour of work that has been estimated or anticipated beforehand. It provides a standard against which actual performance and the expenses connected with it are evaluated and made comparisons. When organizations create a standard for time and resources necessary to complete activities or manufacture goods and services, they are able to evaluate their performance, discover any deviations, and make decisions that are based on accurate information in order to improve their efficiency and cost-effectiveness skills (Mohammadian, 2012).

To successfully implement cost standard hours, it is necessary to do a thorough examination of several parameters, such as labour rates, overhead expenses, and average levels of predicted productivity. Using this standardized process, companies can establish reasonable expectations regarding the amount of time and resources that are necessary to accomplish results. As a result of this, organizations can plan, budget, and control payments in a more efficient manner, which contributes to enhanced financial management and overall operational excellence.

During this investigation of cost standard hours, we will investigate the relevance of this measure, its applicability across many different industries, as well as the procedures that are utilized to set and maintain these standards (Rahman, 2017). By developing an understanding of cost standard hours and putting them into practice, businesses are given the capacity to coordinate their operational operations with strategic goals. This assists in creating a culture of efficiency and adaptability in a business environment that is always transforming.

2.7 Research Design

Research design is the plan of how researchers will answer research questions and meet research objectives through providing explanation for the selection of data sources,

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data collection methods and data analysis. The research design illustrates how the study will be undertaken by adopting a systematic method to produce a validity and reliability result in each timeline. Research design will show the sources where researcher plan to collect data from, how researcher propose to perform data collection and analyze them, discuss about these issues and constraints that the researcher face while doing research (BCPS Organization, 2015). This research design is very important for the topic research because it guides the researcher in planning and implementing the study to achieve the intended goal. Therefore,the researcher must master the entire process and ensure all the process is clear and should be carefully choosing the suitable data source collection method and data analyze techniques.Basically, there are three types of research design that use on the research which are exploratory, descriptive, and explanatory. Exploratory research is a study undertaken with the objective either to explore areas with little is known or investigate possibilities of undertaking research study (Kumar, Research Design, 2011). The aim of exploratory research is to get background information to define the term, define problem and lastly to establish priority. Moreover, descriptive research was used to collect information that will demonstrate relationships and describe the world as it exists, in which the researcher described a certain phenomenon through being detached from the society of the study based on planned and structured design leaning on interview and observation as a tool (Ronald, 2003). Mentions that explanatory research is the study emphasis to clarify why and how a relationship between two aspects of a phenomenon (Kumar, Research Design, 2011).

For this research, it is regarding the motivation to adopt digitalization and modernization of production data tracking at this company. The research design that was conducted by the researcher is explanatory research. This type of research is suitable to be used by researchers as it helps us to think systematically in each situation, offers ideas for further research and helps to make certain simple decisions.

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2.8 Research Location

The researcher conducted this study entirely at AHU assembly line location. Figure 2.2 show the researcher chooses this location because it has many steps by step for complete one order casing for AHU. Besides that, another line still use manually data, for now, researcher focus on AHU line.

Figure 2. 2 Location AHU Assembly

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2.9 Manufacturing for Efficiency and Quality

When develop items with the lowest feasible overall cost, you will have achieved manufacturing efficiency. Creating as much as you can with the resources you have while simultaneously lowering the amount of time, materials, and energy that you spend is the single most important thing. Productivity and efficiency are not the same thing, even though they are frequently used interchangeably in a variety of different businesses. Manufacturing efficiency is all about raising the efficiency and quality of the work that you perform, in contrast to manufacturing productivity, which is focused on growing the number of things that you provide (Davis, 2022).

The term "manufacturing efficiency," which is also referred to as "manufacturing operational efficiency" by certain individuals, is typically stated as a percentage, with one hundred percent being the highest possible efficiency, which is achieved when superior products are produced at the lowest possible cost. However, most manufacturing companies normally function at a rate of between 60% to 80%. This is due to factors such as faulty products and low-quality raw materials, which bring the statistics down.

This company use manually to write the data every day. Figure 2.3, figure 2.4 and figure 2.5, show the board that the workers update manually data. From that, we can see the worker take time to write the data on board in manually. Other than that, when writing data manually it is possible to have errors. With excel, time for worker to write the data can save and can get the correctly data also data in live. From this, can relate the efficiency and quality.

Figure 2. 3 Status Data in Manually

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Figure 2. 4 Result Data Manually Part 1

Figure 2. 5 Result Data Manually Part 2

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2.10 Data Collection Method

There are two types of data sources, which are known as primary data and secondary data (Cleave, 2003). These two types of data sources are described below. The term "primary data" refers to information that was obtained directly from the research project itself. In most cases, the information was gathered by conducting interviews, carrying out observations, using the case study technique, or completing a questionnaire survey and interview or base on observation. Another form of data source is known as secondary data, and it consists of the earlier data that was compiled and utilized for the purposes of study by a different group of researchers. In most cases, the process of gathering secondary data consisted of looking for publications and journals as well as official statistics and government documents (Bush, 2003). A combination of primary and secondary data is typically employed in research. This is because, to answer research questions and accomplish research objectives, researchers frequently use both types of data.

The researcher also used a combination of data sources, including primary data and secondary data, in this inquiry. The primary data was gathered using the quick response code method, whereas the secondary data was gathered using the internet, and both sets of data have been used to support the overall progress of this investigation.

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2.10.1 Primary Data

For the purposes of this study, it was determined that the survey also from my observations about the quick response code would be sent to all workers at AHU assembly respondents using internet technologies. In this method, researchers observe a situation around factory and record the findings that relate about this case. After that, data will be collected, and analysis of this data will be performed utilizing research methods. The findings from the primary data will be discussed with the findings from the secondary data,

which includes material gleaned from sources such as books, newspaper articles, journal articles, databases, and reports.

2.10.2 Secondary Data

The content or information taken from an existing publication is what is referred to as secondary data. This material may be found in a variety of sources, including books, articles from newspapers and journals, articles from databases, and reports, among other things. As a researcher, also can ask our supervisors at company and university about the information. As well as in the books and journals that can be checked out from the university library. Additionally, one can use the Google scholar website and the Google search engine to look up all relevant statistics and databases.

2.11 Data Analysis Method

The data analysis method in this study is using formula to calculate percentage time increase. Analyzing percentage time increase is a crucial aspect of data analysis that provides valuable insights into changes over a specified period. This method involves examining the difference in time durations or intervals between two distinct points in time or various segments, calculating the percentage increase in time, and interpreting its significance. Whether it pertains to business operations, project timelines, or statistical trends, understanding how to effectively employ this method is essential for informed decision-making and forecasting.

$$\%\text{Change} = \frac{Differet\ Time}{Original\ Time} \times 100$$

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2.12 Summary

In conclusion, the overall research strategy was utilized for the purpose of accomplishing the research goal over the course of this study. The results of the analysis may now be summarized. The subsequent chapter is an analysis of the data, and it will display and discuss in full the data that was gathered from the observation and base on interview from workers.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

The overall study process, procedure, or method employed in this project to fulfil the objectives is referred to as methodology. The methods followed throughout the project are discussed in this chapter. A flow chart is a diagram that depicts or explains a process. The project's overview, flow, and software development are discussed in this chapter.

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3.2 Flow Chart

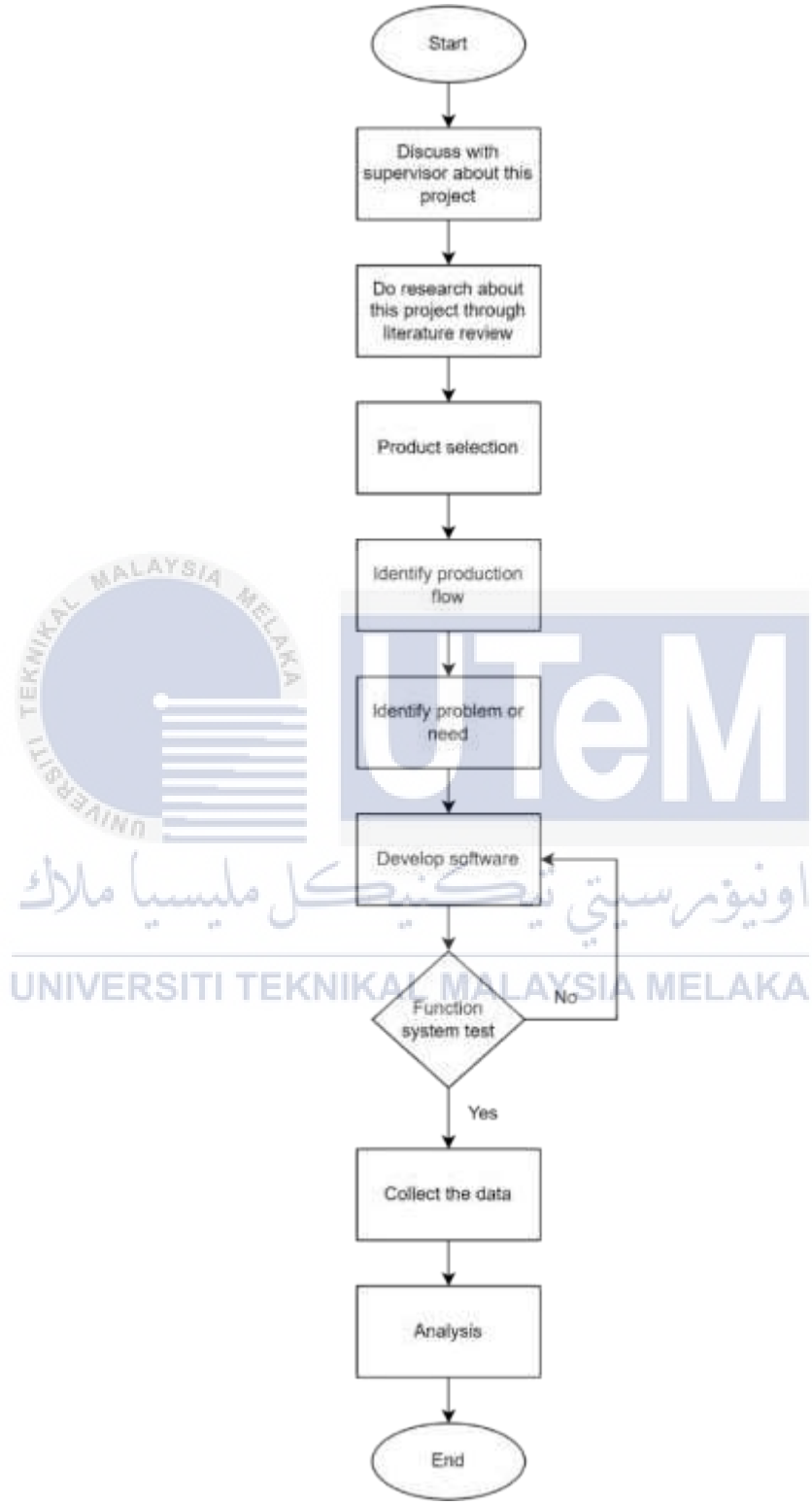

Figure 3. 1 Flow Chart for Methodology

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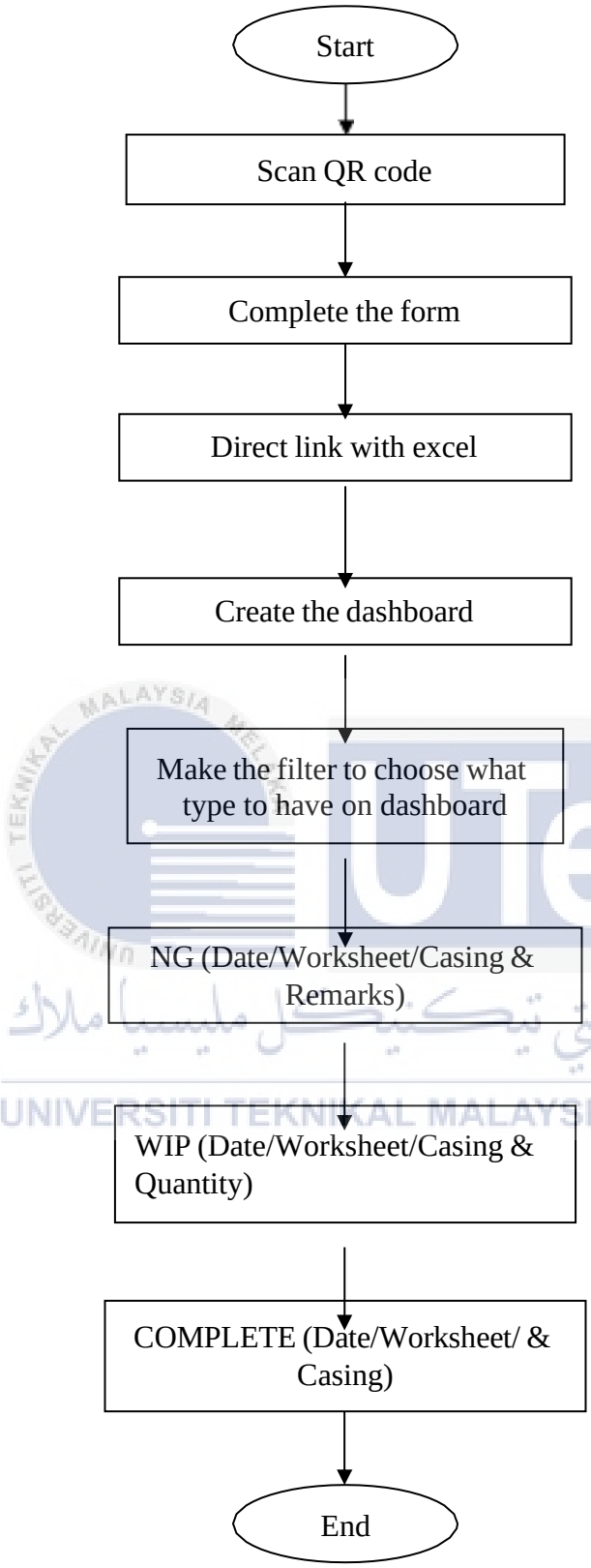

Figure 3. 2 Flow Chart Project

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3.3 Gant Chart

Table 3. 1 Gannt Chart of PSM 1

Gantt Chart for PSM 1															
Task Project	**Plan / Actual**	**Week**													
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
PSM title registration	Plan														
	Actual														
Project briefing with supervisor	Plan														
	Actual														
Research method that uses	Plan														
	Actual														
Introduction (Chapter 1)	Plan														
	Actual														
Literature Review (Chapter 2)	Plan														
	Actual														
Study About the excel	Plan														
	Actual														
Methodology (Chapter 3)	Plan														
	Actual														
Writing full report	Plan														
	Actual														
PSM 1 Presentation and Q&A	Plan														
	Actual														
Full Report PSM 1 submission	Plan														
	Actual														

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Table 3. 2 Gannt Chart of PSM 2

Gantt Chart for PSM 2															
Task Project	**Plan / Actual**	**Week**													
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
PSM 2 Briefing	Plan														
	Actual														
Choose one product to make data entry (AHU casing tracking)	Plan														
	Actual														
Study the flow process	Plan														
	Actual														
Try to use excel (automate)	Plan														
	Actual														
Develop Software	Plan														
	Actual														
System Test Excel	Plan														
	Actual														
Function system test	Plan														
	Actual														
Collect Data Analysis	Plan														
	Actual														
Analysis	Plan														
	Actual														
Writing Full Report	Plan														
	Actual														
Sent Full Report to Supervisor for Checking	Plan														
	Actual														
Submission PSM 2 Report	Plan														
	Actual														
Presentation PSM 2	Plan														
	Actual														

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From week 1 through week 14, the Gantt chart displays the planned and actual progress of the project's tasks. This Gant chart's objective is to assist in time management for the completion of the project while also facilitating the development of a workflow that will improve outcomes.

3.4 PDCA

The PDCA cycle is an improvement cycle that is based on the scientific technique of proposing a change in a process, implementing the change, determining the outcomes, and taking the required action about the changed process. Other than that, PDCA cycle consists of four stages. PDCA stands for plan, do, check, and act or adjust (Pratik & Vivek, 2017).

It is at the planning phase that both the methods and the objectives are set. As part of this process, it is necessary to define what needs to be completed, establish goals, determine resources, and organize the sequence of activities that will be taken to reach the anticipated outcomes. It is the responsibility of the "Do" phase to put into action the strategy that was prepared in the first stage. In this location, the actions that have been planned are carried out. Alterations to the processes, training, and the actual carrying out of the activities that were planned may be required.

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The evaluation of the outcomes of the plan that was put into action is the primary emphasis of the "Check" phase. The evaluation of whether the goals were accomplished, the comparison of the actual results with the ones that were intended, and the collection of data to evaluate the efficiency of the procedures that were put into place are all included in this component. During the "Act" phase, choices are made on how to enhance or optimize the process. These decisions are based on the evaluation that was performed during the "Check" phase. To do this, it may be necessary to make modifications to the plan, adjust the actions that have been carried out, or take corrective actions if the outcomes do not match the

expectations. The PDCA cycle is an iterative process, which means that after the "Act" phase, the process starts again with the "Plan" phase the next time around. The concept behind continuous improvement is that it is a cycle that never ends, and the lessons that arelearnt from each iteration are utilised to refine and improve processes throughout the courseof time. Figure 3.3 show the PDCA cycle.

Figure 3. 3 PDCA Cycle

As a methodical approach to problem-solving, quality improvement, and overall process optimization, the PDCA methodology is widely utilized in a variety of business sectors and organizational contexts. It encourages a culture of learning and adaptation, which enables organizations to successfully respond to changes and challenges in their environment.

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Based on my research about this PDCA, P for plan. The researcher plan to develop excel system to digitalize the existing system, compare with others company. Other than that, with this excel system, all work becomes easy and saves an employee's time. Do or testthe excel and collect the data from the workers through excel only. Also, can educate the workers. Next, for check. Can analyse the data of result and verify that have the improve the process of data tracking using excel. Finally, for act can implement the time of change compare manually and using excel. Also, ensure for everyone to the new standards which is using excel.

3.5 Research Strategy

That research strategy has described the whole plan of research and the way of researcher response to the research observation and interview (Johannesson & Perjons, 2014). Research strategy is essential as the direction and structure of the research can be found by researchers. Research strategy has been classified into case studies, survey, action research, experiments, grounded theory, ethnography, and archival research. In this study, the research strategy used by the researcher is a survey method. The survey strategy is related to the deductive approach used in the research approach. Survey involves collecting large amount of data from a lot of interviewers that allow a specific problem to be viewed comprehensively in details (Thomas, 2001).

The survey research strategy was used by the researcher to collect and obtain data from the interviewers regarding the impact of using time to update the data manually. The researcher used interview and observation research strategy because it can be used to suggest possible reasons for a particular relationship between variables to generalize the results. Researchers believe that research strategy was the most suitable way to measure variables because it given the researcher more control over the research process and sampling used.

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3.6 Quick Response Code

A Quick Response Code, more frequently referred to as a QR code, is a barcode that is two-dimensional and has the capability to store a variety of information. This includes barcodes that may store alphanumeric text, numeric data, binary data, and even hyperlinks. A Japanese firm known as Denso Wave was the first to invent QR codes in 1994. They were initially designed as a method to track automobile parts as they were being manufactured. All the squares in the QR code are black, and they are organised in a grid of white squares. It is possible to scan and interpret these codes in a short amount of time using a QR code

reader, which is often available in mobile devices such as smartphones and other mobile devices. After then, the information that is encoded in the QR code may be decoded and utilised for a variety of reasons, such as accessing a website, saving contact information, making payments, or giving extra information about a product or service (Rongjun, 2019).

Because of their adaptability and ease of use, QR codes have gained a lot of popularity in recent years. In addition to their usage in marketing and advertising, they are also utilised in ticketing, product packaging, and a wide variety of other applications were having access to information quickly is advantages (Furht, 2011). Figure 3.4 example QR code.

Figure 3. 4 Example QR Code

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3.7 Work Instructions (Data Collection)

This operation required one manpower, unless specify step.

i. Open browser and go to Microsoft 365

ii. Login to Microsoft 365

iii. Select form icon on top left Microsoft 365

Figure 3. 5 Select Form Icon

iv. At form, select new form to create new form.

v. Change untitled with form name.

vi. Select + add new and choose type of data recording.

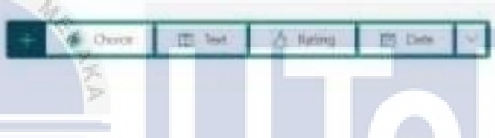

Figure 3. 6 Select + Add New

vii. At form, after setup first question, can add another question (optional) by repeat step 6.

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viii. After setup all the equation, select “Collect Respond” at the top right.

Figure 3. 7 Select “Collect Respond”

ix. To be data can be submitted by everybody. Select “anyone can respond.” Then select QR to generate QR code to be share with others.

Figure 3. 8 Select “Anyone Can Respond”

x. To extract data, go to form page, and select my form. Then select form to analyze.

Figure 3. 9 Extract Data

xi. Select respond button on the left side.

xii. Select open in excel option to extract the data. Then save it.

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3.8 Summary

Improving efficiency and quality is the main goal of the production data tracking and improvement technique for digitalization and modernization in HVAC manufacturing. It entails applying cutting-edge digital tools and technology to optimize data tracking procedures, with a focus on HVAC production in particular. The objective is to use these technologies to improve manufacturing processes, which will increase efficiency and produce better results.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This study includes a conversation regarding the data that is received in Excel after the employee fills in the information that needs to be completed in the Microsoft Form. The discussion is included in this study. In addition to that, this chapter will conduct an analysis of the data concerning the dissimilar amount of time needed to fill out the dashboard with information.

4.2 Software

The software that is being used to construct this project is Excel, which is being used to make improvements in comparison to the prior system. Employees will scan QR to submit the status of the product. After employees have finished filling out the information in the MS form, each piece of data will be immediately imported into Excel. You can select the data based on the category before it is filled in on the dashboard. Every category of data is depicted in the figures that follow. The diagrams below show the ways to get complete data.

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4.2.1 Quick Response Scan

To provide information regarding the product's status, each employee is required to scan a QR code. Work in progress (WIP), non-going (NG), and complete are the three categories that are represented on the QR code that they scan. The QR for each category is depicted in the diagrams that follow.

Figure 4. 1 QR Code for Not Going

4.2.2 Microsoft Form

Upon scanning the QR code, each employee is given a Microsoft form to fill out, which contains information about the product and its status. The information that they will fill out on the Microsoft form includes the date that the product was manufactured, the person who is report about the product, the unit number, the product status, and other relevant details. Below are some figures that illustrate the information that is contained in the Microsoft form and that the employee is responsible for filling out.

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Figure 4. 2 Example Question

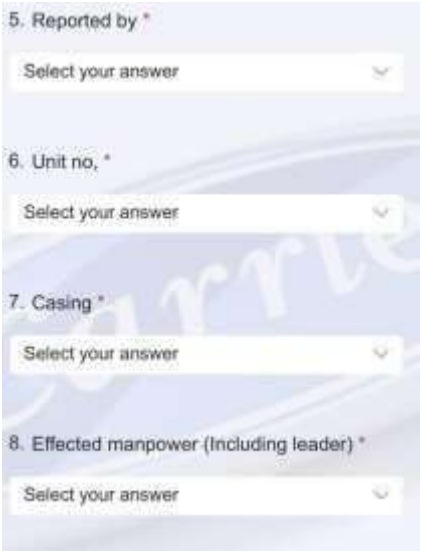

Figure 4. 3 Example Question from Microsoft Team

Figure 4. 4 Example Question from Microsoft Team

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4.2.3 Log

The following categories of product status will be compiled in this section which are, WIP, NG and Complete. The workers can more easily monitor the status of any product that has been updated into excel. Figure 4.5 show the data for log status.

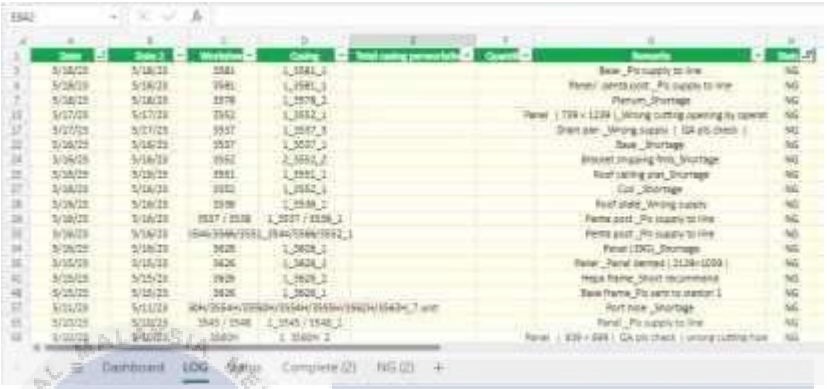

Figure 4. 5 Data Log Status

4.2.4 Status

For status of each product that has been submitted will be included in this section. Ifthe status of a product undergoes any modifications, the personnel will be able to witness live update in this part.

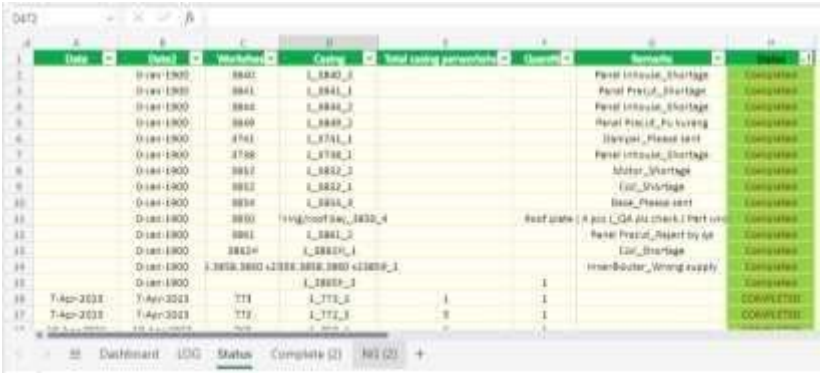

Figure 4. 6 Data for Status

4.2.5 Non-Going (NG)

Each product will be divided into several category of components before it is final after assembled into a product. This will take place before the product is successful installed. On the other hand, if one of the components encounters an issue, such as a defect, the product will not be installed or hold for a while, and its status will be referred to as non-going (NG). If the worksheet has been done, then the workers update the data from non-going to complete. A figure of the data for the non-going status may be found the below.

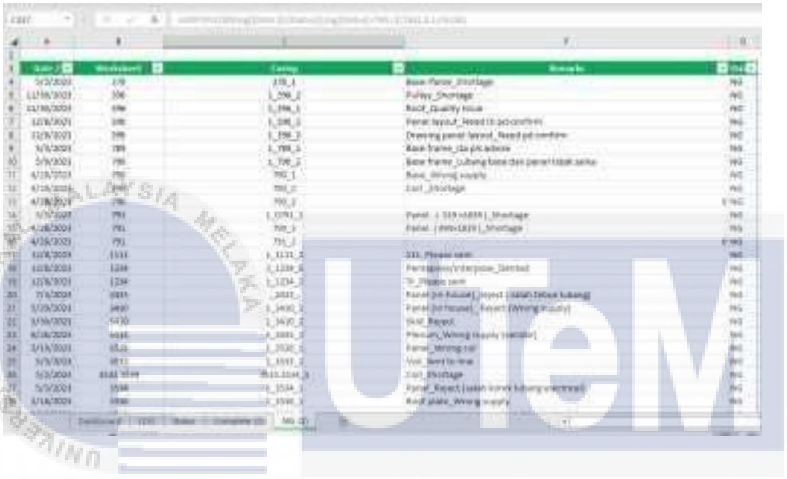

Figure 4. 7 Data for Non-Going (NG)

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4.2.6 Complete

Once the products that have been fully installed are complete. Then the equipment can wrap and pack for to be move out from the factory. So, the data will be put into excel as the complete status.

Figure 4. 8 Data for Complete

4.2.7 Dashboard

In the dashboard, each piece of information from each category will be included. In this area, all the information that the employee has already filled in on the status of the product and other data will be filled in once more in this section. The information that has been filled in from the WIP, NG, and Complete categories is displayed in the figure 4.9 that can be found below. Other than that, this data also in live, the probability of getting lost or error will not happen in this situation. Every day, the date changes automatically. So, the workers no need to update the data in manually.

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Figure 4. 9 Dashboard

4.3 Improvement of Cycle Time

This project has been observed to have a highly positive influence, as evidenced by the findings. With this method, the process of completing all the data that is filled into the dashboard will be completed in a short amount of time. Before entering the information into the dashboard, it is not necessary for each employee to first fill out the information that displays on the board. Alternately, the number of workers in each department may decrease. Additionally, it has the potential to raise the aim for each product line up to finish their products. The goal that you have set to complete the product in the past can be increased even more.

4.4 Analysis Data

For data analysis, Table 4.1 showing the result for time have been taken to complete all the process and the percentage time increase. In this table, it shows the time taken and percentage increase.

Table 4. 1 Result Percentage Increase

	Time taken (minutes)	Percentage of time induction
Manual process	35	82.86 %
Excel	6	

To determine the amount of time required for each procedure, a test was carried out. When the manual procedure is used, as demonstrated in the table that is located above, the amount of time that is required to ensure that all the data is prepared to be entered in the dashboard is quite lengthy. It can take up to 35 minutes. When this procedure has been updated with the use of Excel, things are different once again. The time required to complete

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the work is 6 minutes when the new procedure is utilized. Additionally, this demonstrates that the percentage of time has increased by 82.86%.

4.5 Summary

This chapter describes the methodology's findings as well as the conclusions reached because of them. Other than that, analysis was utilized to evaluate the data acquired through the observation and based on interview. The goal of the project is to modernize and digitalization production data tracking to increase quality and efficiency in HVAC manufacturing. The outcomes demonstrate the important advancements made possible by the integration of modern technologies, which resulted in improved product quality and reduced procedures. The impacts of these findings are explored in detail, with a focus on how the use of digital tools and updated production techniques might boost manufacturing efficiency in the HVAC industry.

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, the project that focuses on the digitalization and modernization of production data monitoring in HVAC manufacturing has shown great potential in producing large improvements in both the efficiency and quality of the products that are manufactured. An ecosystem for manufacturing that is more flexible, responsive, and responsive has been established because of the absorption of cutting-edge technology and the construction of a comprehensive digital framework. The project has been effective in addressing significant issues that are experienced in traditional HVAC manufacturing processes. This was accomplished via the delicate application of advanced data analytics, Internet of Things devices, and machine learning algorithms. Not only have real-time monitoring and analysis made it possible to get granular insights into production, but they have also made it possible to identify chances for optimisation and ongoing improvement.

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Automated technologies, predictive maintenance, and intelligent resource allocation have all contributed to the realisation of efficiency improvements throughout the organisation. Because of these advancements, production lead times and operating expenses have been reduced, which has put the HVAC manufacturing process on a path that will lead to enhanced competitiveness and sustainability. The fact that the project placed such a strong emphasis on quality improvement has resulted in measurable advantages. As a result of the installation of real-time monitoring of production parameters and complex quality control techniques, heating, ventilation, and air conditioning (HVAC) units have been produced that not only meet but also above the requirements set by the industry. In the field of heating,

ventilation, and air conditioning (HVAC) production, the finished products established a new standard for quality by distinguishing themselves via improved dependability and performance.

It is of the utmost Importance to acknowledge that this responsibility is not only a technological advancement; rather, it is a complete rethink of the way that HVAC production is done. The effective incorporation of these digital innovations has been made possible by the concerted efforts of all the stakeholders, from the workers on the manufacturing floor to the management. A culture of creativity and flexibility has been established because of the project, which has ensured the continued success of the improvements that have been made.

5.2 Recommendations

For future improvements, the following are some ways in which the accuracy of the findings might be improved:

i. Considering using this project, can add the time of the worker can finish one project.
ii. Improve the efficiency of predictive maintenance methods by including additional sensors and refining algorithms.
iii. Integration of interconnected systems and the internet of things (IoT) can motivate an easy connection of various systems used in the production process.

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5.3 Project Potential

Based on the findings of this project, it will be possible to significant opportunities exist for the implementation of digitization and modernization in the HVAC manufacturing industry. Improving manufacturing efficiency, lowering mistake rates, and enabling real-time monitoring are all potential benefits of putting in place sophisticated data tracking

systems. Consequently, this results in enhanced quality control and the simplification of associated procedures. With the integration of smart technologies such as Internet of Things devices, important insights may be obtained for the purpose of improving energy usage, performing predictive maintenance, and handling resources in general. By involving cutting-edge technology, the initiative has the potential to improve the HVAC manufacturing business, which would result in better productivity and higher-quality outputs.

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APPENDICES

APPENDIX A

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BORAN□ □EN□E□AHAN □□A□□□ LA□ORAN □RO□E□ □AR□ANA M□DA

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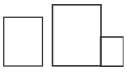

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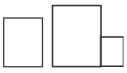

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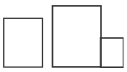

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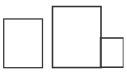

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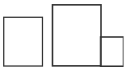

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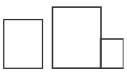

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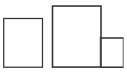

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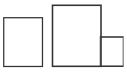

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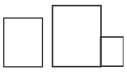

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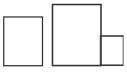

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