UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF BURGER'S PATTY FORMING MACHINE FOR SMALL MEDIUM ENTERPRISE (SME)

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY WITH HONOURS

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Faculty of Mechanical Technology and Engineering

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A thesis submitted
in fulfillment of the requirements for the degree of
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DEDICATION

My heartfelt gratitude and warmest regards go to my family and friends, especially my loving parents, Muhammad Danish Bin Abdullah and Intan Kartina Binti Tawil. Their unwavering encouragement and support have been invaluable throughout this project, and I am deeply grateful for their belief in me. I would also like to express my sincere appreciation to my supervisor lecturer, Mohd Khairul Nizam Bin Suhaimin. His guidance, expertise, and valuable insights have been instrumental in shaping this thesis paper. I am thankful for his unwavering commitment to my academic and personal growth, as well as his genuine concern for my well-being. Furthermore, I extend my gratitude to my family, instructors, and coursemates who have played a significant role in my journey. Their willingness to share their knowledge, provide guidance, and offer words of advice have been invaluable. I am truly fortunate to have such a supportive network of individuals who have contributed to my learning and development. Finally, I dedicate this dissertation to the pursuit of knowledge, growth, and personal development. May this work serve as a testament to the power of education and the collective efforts of those who strive to make a difference in the world

ABSTRACT

The main focus of this project is to design and develop a patty forming machine specifically tailored for Small Medium Enterprises (SMEs) operating in the burger industry. The objective is to address the specific challenges faced by these SMEs during the patty forming process and provide them with a solution that is both efficient and versatile. The project encompasses various stages, including conceptual design, fabrication, and rigorous testing of the machines.To begin, an analysis of the current practices and challenges within the burger business is conducted, underscoring the need for an improved patty forming machine. Design criteria are then established, taking into account essential factors such as efficiency, consistency, versatility, precision, adaptability, and hygiene. The SolidWorks software is utilized to create detailed designs, incorporating key features such as a cylinder container for meat loading, a patty mold for shaping the patties, and a motor-driven blade for mixing and moving the meat.The fabrication process involves the meticulous assembly of the machine's various components. Tools like measuring tape, L-shaped rulers, and drilling machines are employed to ensure accurate assembly and precise placement of these components. Subsequently, the functionality of the machine is thoroughly tested through a series of trials, evaluating its efficiency, consistency, and ease of use.The findings of the project demonstrate that the designed patty forming machine effectively addresses the challenges faced by SMEs, offering significant improvements in efficiency, consistency, and versatility. The machine allows for the production of patties in various sizes, shapes, and thicknesses, thereby catering to different customer preferences. Furthermore, it proves to be reliable, durable, and easy to maintain, ensuring seamless operations for SMEs. In addition, the machine adheres to stringent hygiene and safety standards, contributing to the overall quality and safety of the burger production process.Overall, this research project makes a valuable contribution to the advancement of patty forming technology for SMEs in the burger industry. The developed machine offers a practical and cost-effective solution that enhances productivity, product quality, and operational efficiency. It serves as a valuable tool for SMEs to overcome challenges, expand their capabilities, and thrive in a highly competitive market.

ABSTRAK

Fokus utama projek ini adalah untuk mereka bentuk dan membangunkan mesin membentuk patty yang disesuaikan khusus untuk Perusahaan Kecil Sederhana (PKS) yang beroperasi dalam industri burger. Objektifnya adalah untuk menangani cabaran khusus yang dihadapi oleh PKS ini semasa proses pembentukan daging burger dan memberikan mereka penyelesaian yang cekap dan serba boleh. Projek ini merangkumi pelbagai peringkat, termasuk reka bentuk konsep, fabrikasi, dan ujian mesin yang ketat. Sebagai permulaan, analisis amalan dan cabaran semasa dalam perniagaan burger dijalankan, menekankan keperluan untuk mesin membentuk daging burger yang lebih baik. Kriteria reka bentuk kemudiannya diwujudkan, dengan mengambil kira faktor penting seperti kecekapan, konsistensi, serba boleh, ketepatan, kebolehsuaian, dan kebersihan. Perisian SolidWorks digunakan untuk mencipta reka bentuk terperinci, menggabungkan ciri-ciri utama seperti bekas silinder untuk pemuatan daging, acuan daging untuk membentuk seperti daging burger, dan bilah dipacu motor untuk mencampur dan menggerakkan daging. Proses fabrikasi melibatkan pemasangan yang teliti daripada pelbagai komponen mesin. Alat seperti pita pengukur, pembaris berbentuk L dan mesin gerudi digunakan untuk memastikan pemasangan yang tepat dan penempatan tepat bagi komponen ini. Selepas itu, fungsi mesin diuji secara menyeluruh melalui satu siri ujian, menilai kecekapan, ketekalan dan kemudahan penggunaannya. Penemuan projek menunjukkan bahawa mesin membentuk daging burger yang direka dengan berkesan menangani cabaran yang dihadapi oleh PKS, menawarkan peningkatan yang ketara. dalam kecekapan, konsistensi, dan serba boleh. Mesin ini membolehkan pengeluaran daging burger dalam pelbagai saiz, bentuk dan ketebalan, dengan itu memenuhi pilihan pelanggan yang berbeza. Tambahan pula, ia terbukti boleh dipercayai, tahan lama dan mudah diselenggara, memastikan operasi lancar untuk PKS. Di samping itu, mesin itu mematuhi piawaian kebersihan dan keselamatan yang ketat, menyumbang kepada kualiti dan keselamatan keseluruhan proses pengeluaran burger. Secara keseluruhannya, projek penyelidikan ini memberi sumbangan berharga kepada kemajuan teknologi membentuk daging burger untuk PKS dalam industri burger. Mesin yang dibangunkan menawarkan penyelesaian praktikal dan kos efektif yang meningkatkan produktiviti, kualiti produk dan kecekapan operasi. Ia berfungsi sebagai alat yang berharga untuk PKS untuk mengatasi cabaran, mengembangkan keupayaan mereka, dan berkembang maju dalam pasaran yang sangat kompetitif.

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CHAPTER 1

INTRODUCTION

1.1 Background

Fast food, particularly burgers, has gained significant popularity worldwide due to its convenience, affordability, and wide range of options. Eating fast food, and dining out more generally, incorporates aesthetic, social, and economic dimensions (see Warde et al., 2020). The fast food industry is characterized by a high growth rate that leads to a very competitive market. In recent years, the major food consumption trend in urban parts of developing countries is that more consumers are eating increasingly more meals outside of their homes and most of the growth in away-from-home eating has been in the fast food sector (Kaynak et al., 2006). A driving factor to the growth rate is that a larger share of meals is eaten outside the home. According to Nordic Service Partners (2015) the burger restaurants are one of the most successful parts of the QSR industry (Quick Service Restaurants). The burger, a quintessential fast food item, consists of a patty sandwiched between two buns, often accompanied by various toppings and condiments. The patty itself is a key component, typically made from ground meat, such as beef, chicken, or vegetarian alternatives.

Small and Medium Enterprises (SMEs) play a crucial role in the fast food industry, contributing to job creation, economic growth, and culinary diversity. Small and medium-sized enterprises (SMEs) contribute significantly to the economic development of most countries (Ismail, 2022). However, SMEs face several challenges in the patty forming process, including cost, space constraints, maintenance, adaptability, product quality, operator training, limited production capacity, and cleaning and sanitization concerns. .

According to Malaysian Investment Development Authority (2012), the sector is dominated by small and medium enterprises (SMEs). Despite their major percentages in comparison to large scale enterprises, they are inefficient to produce consistent volume of outputs and also have difficulties to comply with food safety and hygiene standard (PEMANDU, 2010). 1. This condition should not be overlooked regardless of SMEs' low volume of production because, notably, they are the major number of establishments (>90%) in the food industry for many countries (Baregheh et al., 2012; Hasnan & Ramli, 2020).

In response to these challenges, the project of "Design and Development of Burger's Patty Forming Machine for Small Medium Enterprise (SME)" aims to address the specific needs of SMEs in the patty forming process. This project seeks to develop an innovative and efficient patty forming machine that caters to the unique requirements of SMEs, such as affordability, space optimization, ease of maintenance, adaptability to different patty sizes, consistent product quality, operator-friendly interface, increased production capacity, and improved hygiene standards.

By focusing on the design and development of a specialized patty forming machine, this project aims to enhance the operational efficiency, productivity, and competitiveness of SMEs in the fast food industry. Through thorough research, analysis, and collaboration with industry stakeholders, this project seeks to provide practical solutions that empower SMEs to overcome the existing challenges and thrive in a competitive market.

1.2 Problem Statement

In Small And Medium-Sized Businesses (SMEs) involved in burger production, the use of patty forming machines presents several challenges that hinder their operations. One

major concern is the cost associated with acquiring a high-quality machine, as SMEs often face financial limitations. The investment required for such machinery can strain their resources and hinder their ability to make efficient purchases.

Additionally, SMEs often operate in limited physical spaces, and accommodating a patty forming machine within their production area can be problematic. The machines may require additional space for operation and maintenance, which may not be readily available. This space constraint limits their production capacity and restricts their ability to scale up their operations to meet growing demand.

Maintenance and repairs pose another challenge for SMEs. Patty forming machines require regular upkeep and occasional repairs, but SMEs may lack the necessary resources or technical expertise to handle these tasks effectively. This can lead to production disruptions and additional expenses for repairs, impacting their overall efficiency and profitability.

Moreover, SMEs may encounter difficulties in adapting their patty forming machines to different patty sizes and shapes. Some machines have limited adjustability, restricting the variety of patties that can be produced. This lack of flexibility affects their ability to cater to diverse customer preferences and limits their menu options.

Inconsistency in patty quality and shape is another issue faced by SMEs. Some patty forming machines may result in uneven patty thickness or inconsistent weight, negatively impacting the overall taste, texture, and presentation of the burgers. This inconsistency can lead to customer dissatisfaction and harm the reputation of the SMEs.

Furthermore, operating patty forming machines requires specialized skills and training, which SMEs may struggle to find in their workforce. The lack of trained employees can impede the optimal utilization of the machine, hindering productivity and efficiency.

Limited production capacity is a common challenge for SMEs using patty forming machines. Some machines have limitations in terms of the number of patties they can produce, making it difficult for SMEs to meet peak demand or expand their production when necessary. This limitation may lead to delays in output and missed business opportunities.

Finally, maintaining proper hygiene and cleanliness is crucial in the food industry. However, certain patty forming machines may have design features that make cleaning and sanitization challenging. The difficulty in ensuring thorough cleanliness increases the risk of contamination and foodborne illnesses, posing significant concerns for SMEs.

Addressing these challenges requires innovative solutions, strategic planning, and access to resources and support. By developing efficient and user-friendly patty forming machines that overcome these limitations, SMEs can enhance their operational efficiency, productivity, and competitiveness in the fast food market.sizes and shapes is a further difficulty confronted by SMEs. To accommodate diverse consumer preferences and menu options, it is necessary to produce patties of varying sizes and shapes. Unfortunately, the adjustability of certain patty-forming machinery is limited, limiting the variety of patties that can be produced.

1.3 Research Question

The research question aims to investigate the current machines used for burger patty forming in small and medium-sized enterprises (SMEs). The focus is on evaluating the performance of these machines in terms of efficiency, consistency, versatility, and ease of use. By answering this research question, we can gain insights into the strengths and weaknesses of the existing machines and identify areas for improvement. This information will help in developing a better understanding of the challenges faced by SMEs in the burger industry and lay the foundation for the subsequent objectives of conceptual design, fabrication, and prototyping of an improved burger patty forming machine tailored to their specific needs.

1. What are the existing machines used for burger patty forming in small and medium-sized enterprises (SMEs), and how do they perform in terms of efficiency, consistency, versatility, and ease of use?
2. What are the key design considerations and features required for a new and improved burger patty forming machine that is specifically tailored to meet the needs and challenges faced by Small and Medium-Sized Enterprises (SMEs) in the burger industry?
3. How can the selected design of the burger patty forming machine be effectively analyzed to ensure a thorough evaluation of its functionality, efficiency, and performance?

1.4 Research Objective

The objectives of this research report are as follows:

1. To identify and evaluate the current machines used for burger patty forming in Small and Medium-Sized Enterprises (SMEs).
2. To conduct a conceptual design of a new and improved burger patty forming machine specifically tailored for SMEs.
3. Perform a SolidWorks design analysis to scrutinize and evaluate the proposed burger patty forming machine.

1.5 Scope

The scope of the project includes the following :

- Burger patty forming for Small Medium Enterprise owner
- Focus on conceptual design stage.
- Design concept based on House Of Quality Method.
- Software such as Solid works and Simulation were used during the study.
- Fabrication based on the selected design.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review for our project aims to explore and analyze key aspects related to the burger business, the patty forming process, and the patty forming machine. In the subtopic of the burger business (2.2) delve into the current trends, market dynamics, and challenges faced by small and medium enterprises (SMEs) operating in the burger industry. Understanding the business landscape will provide valuable insights into the specific context in which the patty forming process and machine operate. Moving on to the patty forming process (2.3) the examination of various steps involved in forming patties, including ingredient preparation, portioning, shaping, and cooking. By reviewing existing literature, this project aim to identify the specific challenges and limitations encountered in this process. Finally, in the subtopic of the patty forming machine (2.4), exploration of different types, functionalities, and design considerations of patty forming machines available in the market. This literature review will serve as a foundation for understanding the current state of the burger business, the intricacies of the patty forming process, and the existing technologies and approaches in patty forming machine design.

2.2 Burger Business

A business that specializes in the preparation, assembly, and sale of burgers is also known as a "burger business." A grilled or fried ground meat patty, typically made from beef, is sandwiched between two slices of bread or a bun with a variety of toppings and sauces, and is a popular and widely consumed food item. Burger restaurants offer a variety

of burger options, including various patty sizes, meat selections (such as beef, chicken, or vegetarian alternatives), and a variety of toppings and sauces, to cater to a broad range of customer preferences. In an effort to satisfy consumers' desires for a quick, flavorful, and filling burger meal, these establishments frequently offer casual dining or delivery service. The patty formation procedure is essential for ensuring uniformity, efficiency, and quality control when making burgers, as it provides businesses with a practical and standardized method for creating patties that meet customer expectations.

2.2.1 History/ Current Market

The burger business has a rich history and has evolved significantly over time. Burger consumption dates back centuries, with various cultures having their own versions of ground meat patties. However, the modern burger as we know it today gained popularity in the early 20th century. The creation of the burger bun and the introduction of fast food chains played a significant role in popularizing burgers and establishing them as a staple in the fast-food industry.

In the mid-20th century, fast-food chains like McDonald's revolutionized the burger business with their standardized processes and assembly-line production. This led to the mass production of burgers, making them affordable and easily accessible to a wider audience. Fast-food chains started to dominate the market, offering consistent quality, quick service, and a limited menu of burger options.

In recent years, there has been a shift towards gourmet and artisanal burgers. Consumers have become more conscious of the quality of ingredients, flavors, and customization options. This trend has given rise to burger joints and restaurants that focus

on creating unique and high-quality burgers using premium ingredients, diverse toppings, and innovative flavor combinations. This segment of the burger business caters to consumers seeking a more upscale and personalized dining experience.

Furthermore, there has been a growing demand for healthier burger options. With increasing health concerns and dietary preferences, burger businesses have introduced alternatives to traditional beef patties, such as turkey, chicken, fish, and plant-based options like veggie burgers and Beyond Meat. These alternatives provide options for consumers looking for lower-calorie, lower-fat, or vegetarian/vegan burger choices.

The burger business has also embraced technology and digitalization. Online ordering platforms, mobile apps, and delivery services have made it easier for customers to access their favorite burgers from the comfort of their homes. This integration of technology has become crucial for burger businesses to stay competitive in the modern market.

Overall, the burger business has a diverse landscape, ranging from fast-food chains to gourmet burger joints, and from traditional beef burgers to healthier and alternative options. Understanding the current practices and history of the burger business is essential for entrepreneurs and industry professionals to navigate the market, identify opportunities, and meet the evolving preferences of burger consumers. As shown in Figure 2.1 is the McDonald's first restaurant.

Figure 2.1 : McDonald's first restaurant

2.2.2 Process of Burger's Making

Burger products are simple mixtures of ground meats, including the traditional burger consisting of pure beef only without any extender or binder and with low fat content. The name burger is used for all kinds of simple mixtures of ground meat and animal fats (beef, pork, poultry meat, fish, or mixes of several) (Heinz G & Hautzinger P, 2007) .The process of making burgers in the burger business typically involves several key steps. Here is a general overview of the burger-making process:

1. Meat Selection: High-quality ground beef is commonly used for making burgers. The meat is often chosen for its fat content, which contributes to flavor and juiciness. Some establishments also offer alternative meat options, such as turkey, chicken, or vegetarian patties.

2. Patty Formation: The selected meat is seasoned with salt, pepper, and other spices to enhance flavor. The seasoned meat is then shaped into patties of desired size and

thickness. This can be done by hand or by using a patty forming machine for efficiency and consistency.

3. Cooking: The patties are cooked on a grill, griddle, or stovetop. The cooking method may involve direct heat, such as grilling over an open flame, or indirect heat, such as using a flat-top griddle. The patties are flipped once or twice during cooking to ensure even cooking on both sides.

4. Bun Preparation: While the patties are cooking, the burger buns are prepared. The buns are typically sliced in half horizontally and toasted or lightly grilled to add texture and enhance flavor. Some establishments may also apply condiments like butter or special sauces to the bun surfaces.

5. Toppings and Condiments: Once the patties and buns are ready, the burgers are assembled with a variety of toppings and condiments. Common toppings include lettuce, tomato, onion, pickles, and cheese. Additional options may include bacon, mushrooms, avocado, or fried eggs. Condiments like ketchup, mustard, mayonnaise, and special sauces are also added based on customer preferences.
6. Assembly: The burger is assembled by placing the cooked patty on the bottom half of the bun and layering the desired toppings and condiments on top. The top half of the bun is then placed on the assembled ingredients.

7. Serving: The finished burgers are typically served on plates or wrapped in paper or foil for takeout orders. They are often accompanied by side dishes such as french fries, onion rings, coleslaw, or a salad.

The burger-making process can vary based on regional preferences, specific recipes, and the culinary style of each establishment. Different burger businesses may have their own unique variations and techniques to create signature burgers that appeal to their customers.

2.3 Patty Forming Process

The process of moulding ground beef into homogeneous patties for use in making burgers and other foods is referred to as "patty forming." The preparation of ground meat, which is often a combination of beef or other meats along with seasonings and additions, is the first step in this procedure. After being put into a patty-forming machine, the ground beef is compressed and shaped into the proper size, thickness, and shape for patties. The created patties are then normally stored and transported refrigerated or frozen before being cooked and added to burgers.

Figure 2.2 : Example of current used patty former product

2.3.1 Current Practice

The current practice of patty forming in the burger business involves the use of patty forming machines. These machines are designed specifically to shape ground meat into uniform patties, streamlining the production process and ensuring consistent results. Here is an overview of the current practice of the patty forming process:

1. Preparation of Ground Meat: The process begins with the preparation of the ground meat. Ground beef is the most commonly used meat, although other types of meat or plant-based alternatives can also be used. The ground meat is typically seasoned with salt, pepper, and other spices to enhance flavor.

2. Loading the Machine: The prepared ground meat is loaded into the hopper or feeding system of the patty forming machine. The machine may have different feeding mechanisms, such as augers or belts, to transfer the ground meat to the forming section.

3. Forming the Patties: As the ground meat is fed into the forming section of the machine, it undergoes compression and shaping to form uniform patties. The forming section consists of a mold or die that shapes the meat into the desired patty size and thickness. The machine applies pressure to compress the meat and shape it into a consistent patty.

4. Patty Release: Once the patties are formed, they are released from the machine onto a conveyor belt or tray. The machine may have mechanisms, such as pneumatic or mechanical systems, to ensure the smooth release of the patties without damaging their shape.

5. Stacking and Packaging: The formed patties are stacked and may be arranged in layers with separators to prevent sticking. They are then packaged for storage, transportation, or immediate use. Packaging options include plastic bags, vacuum-sealed packages, or trays with plastic wrap.

6. Storage and Distribution: The packaged patties are stored in refrigerated or frozen conditions to maintain freshness and extend shelf life. They are distributed to restaurants, fast food chains, supermarkets, or other food establishments for use in burger production.

2.3.2 Issues SMEs Owner

The patty forming process in Small and Medium Enterprises (SMEs) is fraught with various challenges that can impact their operations and hinder their success. Extensive research, including studies by Saleh & Ndubisi (2006), Samad (2007), Abu Bakar et al. (2006), and others, has identified these challenges. They include the high cost of equipment, space constraints, maintenance and repair difficulties, limited adaptability of machines, inconsistent patty quality, skill requirements, production capacity limitations, and cleaning and sanitization concerns.

SMEs face financial burdens when procuring patty forming machines, and limited physical spaces make it challenging to accommodate and maintain such equipment. The lack of resources, technical expertise, and dedicated maintenance staff leads to difficulties in carrying out maintenance and repairs. Additionally, limited machine adaptability restricts

the variety of patties that can be produced, and inconsistent patty quality affects taste and presentation. SMEs also struggle to find skilled operators and may face limitations in production capacity during peak demand periods. Furthermore, ensuring proper cleaning and sanitization is a challenge due to design characteristics of some patty forming machines.

Addressing these challenges requires innovative solutions, strategic planning, and access to resources and support. By overcoming these obstacles, SMEs can enhance their efficiency, productivity, and competitiveness in the patty forming process.

2.3.3 Criteria of Gourment Forming Patties

In the development of the patty forming machine for small and medium enterprises (SMEs), several key evaluation criteria were identified to ensure an efficient and effective solution. These criteria include efficiency, consistency, versatility, precision, adaptability, easy maintenance, durability and reliability, hygiene and safety, operator-friendliness, and cost-effectiveness.

Efficiency is crucial in optimizing production rates and minimizing manual intervention, while consistency ensures uniformity in patty shape, size, and weight. Versatility allows for customization and menu flexibility, while precision enables precise control over patty characteristics. Adaptability ensures compatibility with various types of ground meat, while easy maintenance and cleaning contribute to smooth operations and minimal downtime. Durability and reliability are essential for continuous production, and hygiene and safety prioritize food safety and compliance.

The patty forming machine should also be operator-friendly, requiring minimal training and skill level for efficient and safe operation. Lastly, cost-effectiveness considers the balance between upfront and operating costs, as well as long-term value.

By considering these evaluation criteria, the design and development of the patty forming machine can meet the specific needs and challenges faced by SMEs, ultimately enhancing their productivity, product quality, and overall business performance.

2.4 Patty Forming Machine

A patty-forming machine is a specialized piece of machinery used to shape ground beef into uniform patties for burger production. This device automates the creation of beef patties, thereby accelerating production and ensuring uniformity in terms of size, shape, and thickness. It typically includes a hopper or feed system to hold the ground beef, a shaping mechanism to compress and shape the meat into patties, and a conveyor or discharge system to collect the patties. Patty-forming machines provide accurate and efficient patty production while reducing labor needs and maintaining product quality. They are designed specifically to meet the needs of the food industry. They are necessary for increasing production, standardizing product specifications, and satisfying customer demands for uniform and well-formed burger patties.

2.4.1 Design Criteria for Patty Forming Machine

Designing a patty forming machine involves considering various criteria to meet the specific requirements of the business. Efficiency is crucial, as the machine should optimize patty production by minimizing time and resource wastage. Accuracy and consistency are also important, ensuring that the machine produces patties with uniform shape, size, and

weight, maintaining quality standards. Versatility is another key criterion, enabling the machine to accommodate different patty sizes, shapes, and thicknesses to cater to diverse menu offerings and customer preferences.

Durability and reliability are vital aspects of machine design. The machine should be built with sturdy materials to withstand continuous production and designed for consistent operation to minimize downtime. Hygiene and sanitation are paramount in food processing. Therefore, the machine should have a hygienic design with smooth surfaces and easy-to-clean components to prevent cross-contamination and comply with food safety standards.

Operator-friendliness and safety are significant considerations. The machine should have user-friendly controls, ergonomic features, and safety mechanisms to ensure efficient and safe operation. Maintenance and serviceability are also important, with accessible parts and clear procedures for routine maintenance and repairs to minimize disruptions in production.

Compliance with industry standards and regulations is essential to ensure electrical safety, food safety, and sanitation requirements are met. The machine should undergo proper testing and certification. Lastly, cost-effectiveness is a critical criterion, balancing upfront costs, operating expenses, and long-term value. The machine should provide a reasonable return on investment through increased productivity, reduced waste, and improved product quality.

By considering these design criteria, the patty forming machine can be tailored to the specific needs of the business, enhancing production efficiency, maintaining product quality, and adhering to industry standards.

2.4.2 Material Selection

Designing a patty forming machine involves considering various criteria to meet the specific requirements of the business. Efficiency is crucial, as the machine should optimize patty production by minimizing time and resource wastage. Accuracy and consistency are also important, ensuring that the machine produces patties with uniform shape, size, and weight, maintaining quality standards. Versatility is another key criterion, enabling the machine to accommodate different patty sizes, shapes, and thicknesses to cater to diverse menu offerings and customer preferences.

Durability and reliability are vital aspects of machine design. The machine should be built with sturdy materials to withstand continuous production and designed for consistent operation to minimize downtime. Hygiene and sanitation are paramount in food processing. Therefore, the machine should have a hygienic design with smooth surfaces and easy-to-clean components to prevent cross-contamination and comply with food safety standards.

Operator-friendliness and safety are significant considerations. The machine should have user-friendly controls, ergonomic features, and safety mechanisms to ensure efficient and safe operation. Maintenance and serviceability are also important, with accessible parts and clear procedures for routine maintenance and repairs to minimize disruptions in production.

Compliance with industry standards and regulations is essential to ensure electrical safety, food safety, and sanitation requirements are met. The machine should undergo proper testing and certification. Lastly, cost-effectiveness is a critical criterion, balancing upfront costs, operating expenses, and long-term value. The machine should provide a reasonable return on investment through increased productivity, reduced waste, and improved product quality.

By considering these design criteria, the patty forming machine can be tailored to the specific needs of the business, enhancing production efficiency, maintaining product quality, and adhering to industry standards.Material Selection

The failure to effectively control the flow of materials and operators within the patty forming process can have significant consequences, not only on operational efficiency but also on sanitation practices. Strano et al. (2012) and Benyagoub and Ayat (2014) highlight the potential impact of such failure.

Patty forming machines, which play a crucial role in the patty forming process, are typically constructed using a combination of different materials. These materials are carefully selected to meet specific requirements, including strength, durability, and adherence to food-grade standards. Here is an expanded discussion on the common materials used in the construction of patty forming machines:

1. Stainless Steel: Stainless steel is a highly favored material in the food processing industry due to its exceptional corrosion resistance and hygienic properties. It is easy to clean, resistant to staining, and does not react with food. Different grades of

stainless steel, such as 304 and 316, are chosen based on the machine's specific needs and the desired level of corrosion resistance.

2. Aluminum: Aluminum is widely used in the construction of patty forming machines due to its lightweight nature, durability, and excellent thermal conductivity. It is often employed for components that require efficient heat transfer, such as heating elements or surfaces in direct contact with the patty mix. Aluminum is also corrosion-resistant and can be easily cleaned.

3. Food-Grade Plastic: Certain parts of the patty forming machine, such as covers, guards, and knobs, are commonly made from food-grade plastics. These plastics are carefully selected for their non-toxic properties, resistance to chemicals, and ability to be molded into complex shapes. Food-grade plastics ensure that the machine remains safe for food contact.

4. Food-Grade Rubber or Silicone: Seals, gaskets, and O-rings in the patty forming machine are often made from food-grade rubber or silicone materials. These materials provide a secure and hygienic seal, exhibit high-temperature resistance, and ensure that the formed patties remain free from contamination.

5. Food-Grade Belts and Conveyors: In certain patty forming machines, belts or conveyors are utilized for the transfer of the patty mix or formed patties. These belts are typically made from food-grade materials, such as polyurethane or polyethylene. These materials possess qualities such as durability, ease of cleaning, and compliance with food safety regulations.

6. High-Grade Engineering Plastics: Some components of the patty forming machine that require specific mechanical properties, such as gears, cams, or sliding surfaces, may be made from high-grade engineering plastics. These plastics exhibit excellent wear resistance, low friction characteristics, and dimensional stability under the operating conditions of the machine.

7. Other Materials: Depending on the particular design and functionality of the patty forming machine, additional materials such as brass, copper, or non-stick coatings may be employed in specific parts to enhance performance or facilitate ease of operation.

8. It is important to emphasize that the selection of materials for a patty forming machine should conform to relevant food safety regulations and industry standards. Manufacturers and designers have a responsibility to ensure that all materials in contact with food are safe, easy to clean, and suitable for their intended purpose within the machine. By prioritizing appropriate material selection, the patty forming machine can maintain optimal performance, adhere to food safety guidelines, and contribute to the overall success of the patty forming process.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The methodology section of the report encompasses several key elements to ensure the effective fulfillment of the research's objectives of the project. These processes include project planning, process flow, and Gantt charts, which provide a detailed outline of the project's timeline and tasks. By following a rigorous methodology, the research study strives to develop a comprehensive understanding of the issues faced by SMEs in the patty forming process and to propose effective solutions. The methodology provides a structured framework for data collection, analysis, and evaluation, enabling the researchers to generate meaningful insights and recommendations.

3.2 Overview of Project

The overview of project provides a visual representation of the manufacturing procedure through a flowchart, ensuring a systematic and easy-to-understand approach. Figure 3.1 outlines the step-by-step process required for the successful execution of the project and attainment of the research objectives. The flowchart serves as a roadmap, highlighting the major phases and activities of the project. By following the flowchart, the project team can ensure that each step is carried out accurately, promoting a smooth progression towards the desired outcomes.

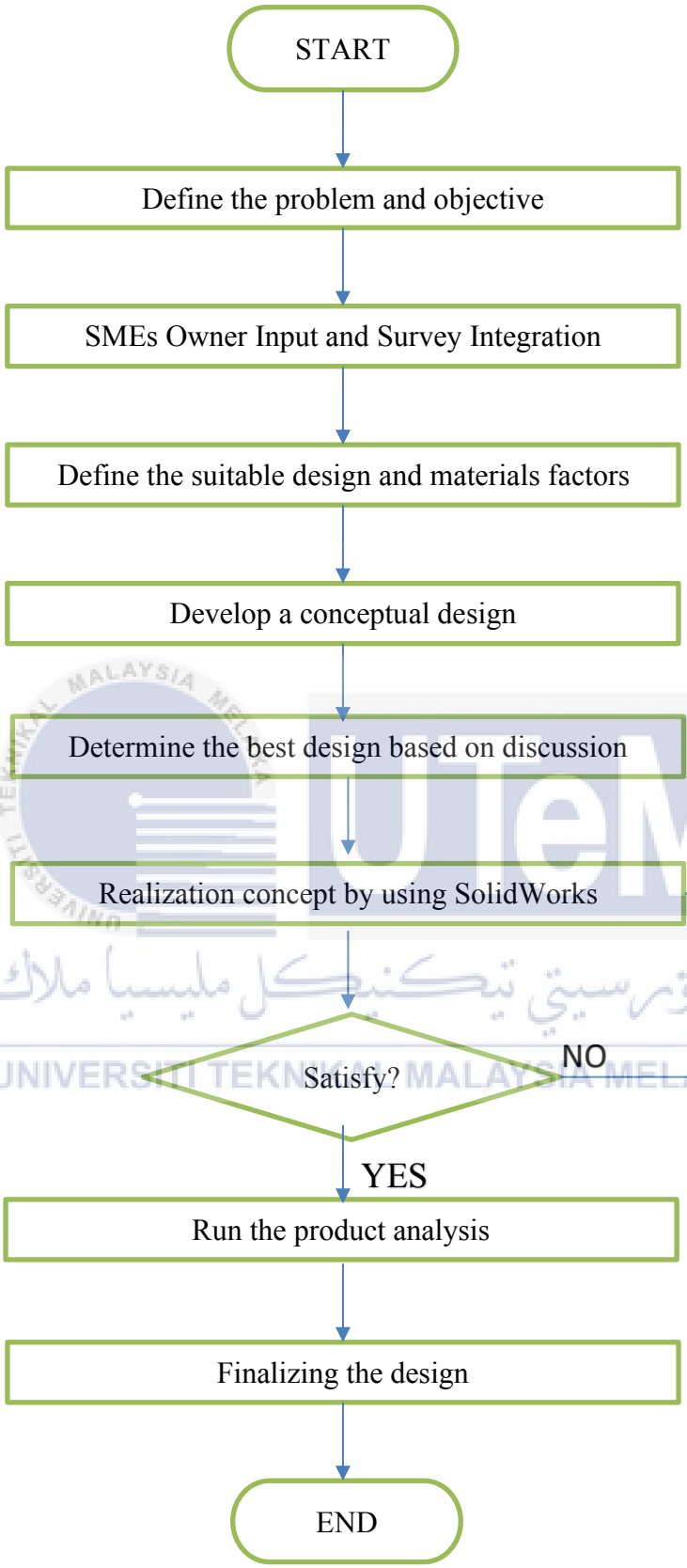

Figure 3.1 : Flow Chart of the Project

3.3 Brainstorming

The brainstorming in this project encompasses the formulation of the problem faced by Small and Medium Enterprises (SMEs) and the development of conceptual designs to address these challenges. The brainstorming process serves as a foundation for further development and refinement of design concepts in the subsequent stages of the project.

3.3.1 Criteria Survey Of The Use Of Burger Patty Forming Machine

The objective of the survey is to gather data about the needs and preferences of Small and Medium Enterprises (SME) owners and a vendors, specifically focusing on a Patty Forming Machine. The survey aims to comprehend both the demand for the product among SMEs and the criteria that hold significance for SME owners when selecting a product that aligns with SMEs expectations.

i. **Content Relevance**

The survey content is intricately designed to address multifaceted aspects crucial for understanding the demands and preferences of Small and Medium Enterprises (SMEs) and burger vendors in relation to a Patty Forming Machine. It delves into nuanced topics such as the prevalent usage of frozen versus homemade patties, interest levels in the product, financial constraints affecting purchasing decisions, considerations for available space in establishments, maintenance expectations, the desired consistency of the end product, and the overarching expectations of SME owners. This meticulous design ensures that the survey encapsulates a comprehensive range of factors influencing the adoption and satisfaction with patty forming machines within the SME sector.

ii. **Conducted Using Microsoft Form**

The survey's deployment on the Microsoft Form platform reflects a deliberate choice, leveraging its intuitive interface and streamlined features for efficient data collection. The incorporation of Quick Response (QR) codes further enhances accessibility for respondents. To facilitate easy access for respondents, Quick Response (QR) codes have been generated as follows :

Figure 3.2 : Quick Response (QR) codes

By allowing effortless scanning with smartphones, the QR codes direct participants directly to the survey. This contemporary approach aligns with modern data collection practices, facilitating easy engagement, particularly for SME owners and burger vendors utilizing mobile devices.

iii. **Endorsement Date**

The official endorsement on September 4, 2023, acts as a pivotal timestamp, signifying the formal commencement of data collection. This date serves as a transparent starting point for analyzing the acquired data in subsequent phases of the project.

The official endorsement of the survey on September 4, 2023, serves as a crucial timestamp marking the initiation of data collection. This date signifies the formal commencement of the survey process, providing transparency and a clear starting point for analyzing the gathered data in subsequent project phases.

iv. **Target Audience**

The survey strategically encompasses a diverse audience, including both burger vendors and SME proprietors actively engaged in the burger production industry. This inclusive strategy ensures a holistic perspective, capturing insights from various facets of the burger production and distribution landscape.

v. **Overall Impact to the Project**

The survey's outcomes play a pivotal role in steering the project's course by providing invaluable insights into the specific needs and expectations of SMEs and burger vendors. These insights influence subsequent phases of design and development, acting as a guiding force for decisions aligned with the authentic demands of the target audience. Ultimately, the survey contributes to the creation of a patty forming machine tailored to the unique requirements of SMEs in the dynamic burger production sector.

By incorporating these elements, the survey aims to capture comprehensive data in decision-making process and contribute to the creation of a patty forming machine tailored to the unique requirements of SMEs.

3.3.2 House of Quality

The House of Quality (HOQ) provides a systematic and structured approach to evaluate and prioritize design options based on customer requirements and technical specifications. By using the HOQ, a matrix of maps is created between customer requirements against design features, allowing for a comprehensive assessment of design alternatives. Through the application, the design selection process ultimately leading to the development of a patty forming machine that is tailored to the requirements of SMEs in the burger production industry. The data is shown in Figure 3.2 below.

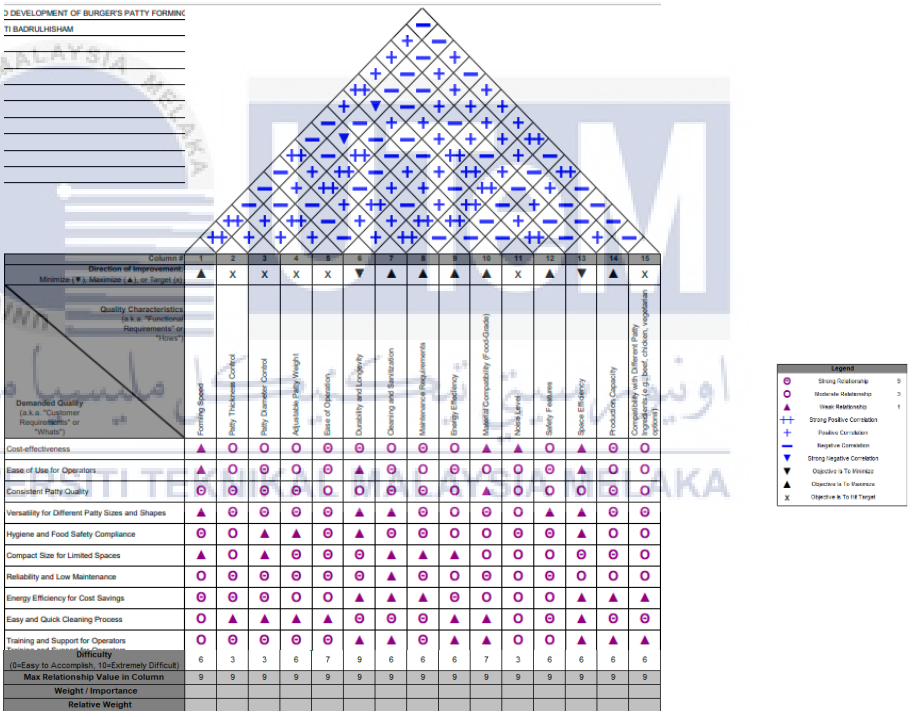

Figure 3.3 : HOQ of the project

3.3.3 Survey-Informed Conceptual Design

During the conceptual design phase of the project, an active engagement in brainstorming sessions, sketching exercises, and conceptualization endeavors has been undertaken. The primary goal is to formulate innovative design solutions for the patty

forming machine. The strategic significance of this phase lies in shaping a practical and effective solution that enhances key aspects, including cost-efficiency, adaptability, patty quality, ease of maintenance, and overall productivity, with a specific focus on meeting the requirements of Small and Medium-sized Enterprises (SMEs) involved in the patty forming process. The outcomes of these design efforts are comprehensively documented and presented as below.

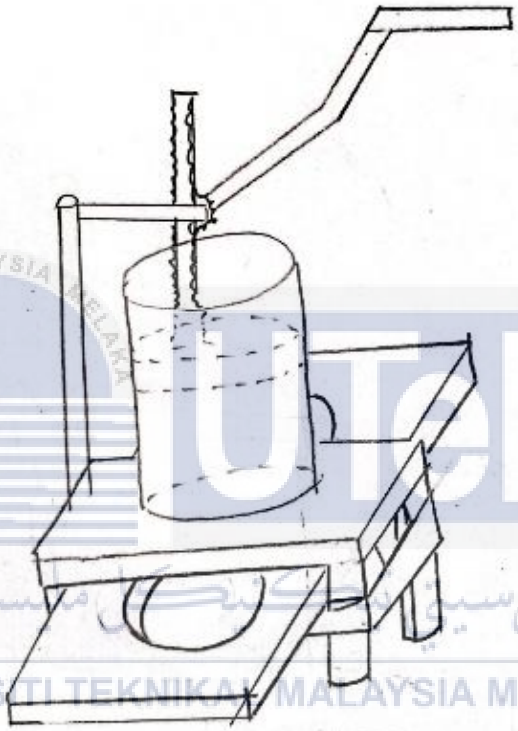

Figure 3.4 : Concept Design 1

A manual process that utilizes human power to convert hand power into mechanical energy through the use of gears. It is designed to be small and lightweight, making it easy to carry and transport. The design is capable of handling a limited amount of meat, typically a few kilograms. It has the capacity to form two patties simultaneously, increasing efficiency in the patty forming process.

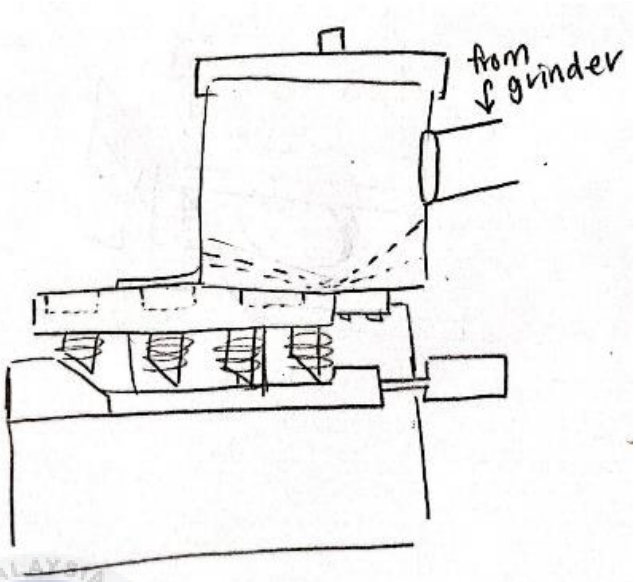

Figure 3.5 : Concept Design 2

A streamlined automated patty forming process with adjustable height for customized patty thickness. Easy disassembly enables thorough cleaning, ensuring hygiene. Unlimited meat handling directly from a grinding machine enhances efficiency. Simultaneous production of five patties enhances productivity. Versatile design accommodates different patty sizes and shapes, catering to diverse consumer preferences.

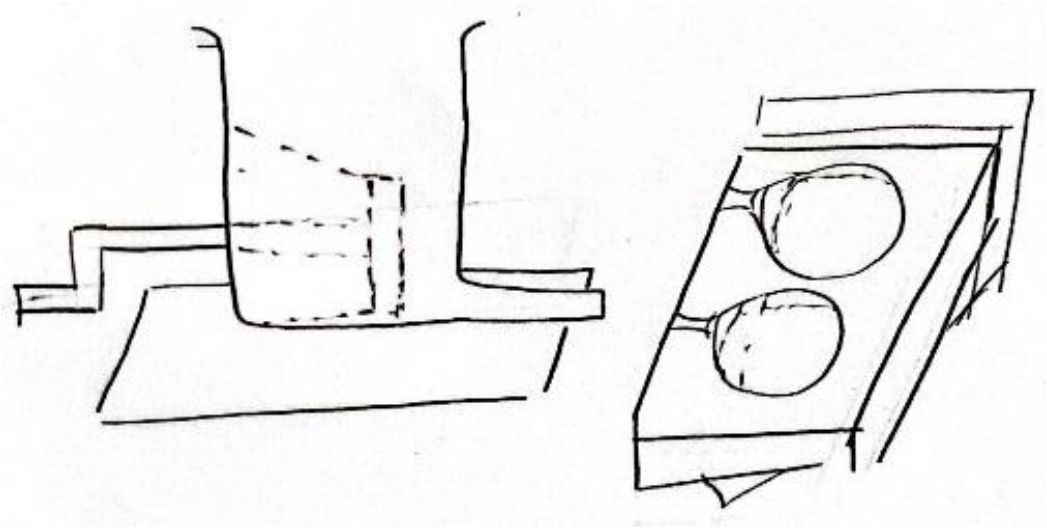

Figure 3.6 : Concept Design 3

A manual process that involves two equipment units. The design is not intended to be disassembled and is designed to handle a limited amount of meat in kilograms during the patty forming process. However, it has the capability to produce an unlimited amount of patties. The design allows for flexibility in creating different sizes and shapes of patties, which can be achieved by using different boards or molds.

3.4 Optimal Design Choice and Decision Process

3.4.1 Evaluation

This evaluation process is designed to assess the effectiveness, feasibility, and suitability of each design option from the perspective of Small and Medium-sized Enterprises (SMEs). By systematically comparing design solutions against predefined criteria, including cost-effectiveness, efficiency, functionality, and compliance with standards, the evaluation aims to pinpoint the most suitable design solution for SMEs.

Incorporating the SMEs' viewpoint ensures that the chosen design aligns with their specific needs and preferences. This data is evaluated using the Pugh Method, as illustrated below.

Table 3.1 : Pugh method

Criteria	Weight	Design		
		1	2	3
Cost-effectiveness	10	1	1	1
Space efficiency	5	1	-1	0
Adaptability	4	1	1	1
Ease of Maintenance	8	1	1	-1
Consistent patty quality	8	1	1	0
User-friendly operation	6	1	1	1
Production capacity	8	0	1	-1
Hygiene and sanitation	8	-1	1	-1
Energy efficiency	6	1	1	0
Totals	63	39	58	-4

This systematic and comprehensive evaluation guarantees the selected design solution not only meets industry standards but also fulfills the desired objectives and user requirements from an SMEs standpoint, contributing to the development of a successful and efficient patty forming machine. Based on the Table 3.2, it is evident that Design 2 achieves the highest score and aligns well with the demands and requirements expressed by SMEs, outperforming both Design 1 and Design 3.

3.5 Summary of Chapter

The methodology focuses on the key phases essential for improving the patty forming process for Small and Medium Enterprises (SMEs). The chapter commences with an introduction, emphasizing the significance of a robust methodology, encompassing project planning, process flow, and Gantt charts. A visual representation of the project's manufacturing procedure is presented through a detailed flowchart (Figure 3.1), acting as a roadmap for systematic project execution.

Brainstorming emerges as a pivotal phase, involving the identification of challenges faced by SMEs and the development of conceptual designs. The criteria survey conducted with SMEs provides crucial insights into their preferences and needs, guiding subsequent design considerations. The House of Quality (HOQ) is introduced to systematically evaluate and prioritize design options based on customer requirements.

The optimal design choice and decision-making process are detailed, employing the Pugh Method for a comprehensive evaluation. Design 2 emerges as the most suitable option, aligning well with SME demands and requirements. In summary, Chapter 3 sets the foundation for subsequent chapters by providing a thorough overview of the methodology, project phases, and the decision-making process essential for enhancing the patty forming process for SMEs.

CHAPTER 4

RESULT & DISCUSSION

4.1 Introduction

In order to address the challenges faced by SMEs and assess the capability of the designed product, various designing and analysis activities were conducted. These activities aimed to evaluate the efficacy of the designed patty forming machine in addressing the specific problems encountered by SMEs in the burger production process. Through a systematic approach, the study incorporated designing techniques and analysis methods to ensure that the resulting product is well-suited to the needs of SMEs.

4.2 Survey Result Of The Use Of Burger Patty Forming Machine

The survey results on the utilization of current patty forming machines are presented in three distinct sections. Participants are assured of the confidentiality and academic use of the survey responses, with gratitude expressed for participants honesty and cooperation. The gathered data is expected to provide valuable insights into the challenges and preferences of SMEs in the burger industry.

4.2.1 First section of survey

In the first section, respondents are warmly greeted and asked to provide information about the business, gender, income, type of meat used, and interest in incorporating patty-making machines in the production processes.

i. Question 1 : The respondent demographic for the survey on patty-making machines comprises 19 (82.6%) males and 4 (17.4%) females, highlighting a predominantly male participation. As shown below, the gender distribution indicates a potential gender disparity within the burger business sector or a higher representation of males in roles associated with patty production and machine utilization.

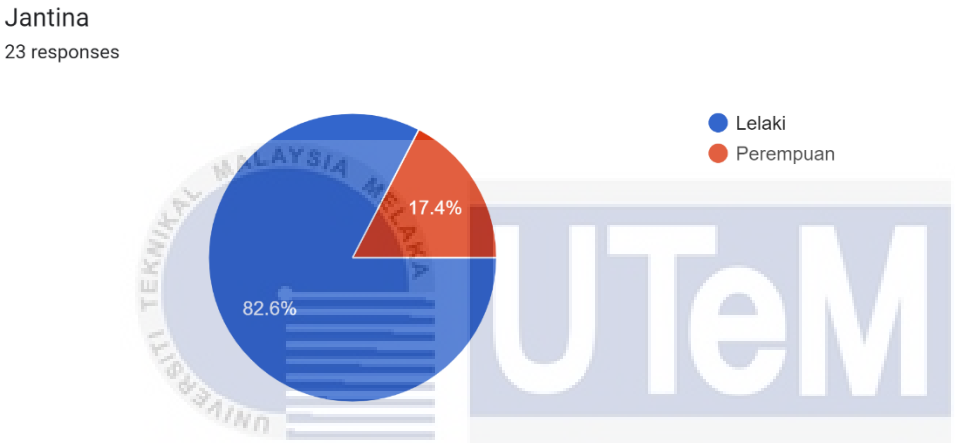

Figure 4.1 : Gender Response

ii. Question 2 : The survey focuses on key regions in Malaysia, namely Melaka, Perak, Kedah, Selangor and Kuala Lumpur. These areas were strategically chosen to capture diverse perspectives and practices within the burger-selling industry. By surveying across these regions, the research aims to comprehensively understand the nuances and challenges faced by Small and Medium-sized Enterprises (SMEs) in the burger industry nationwide. Data is provided as below.

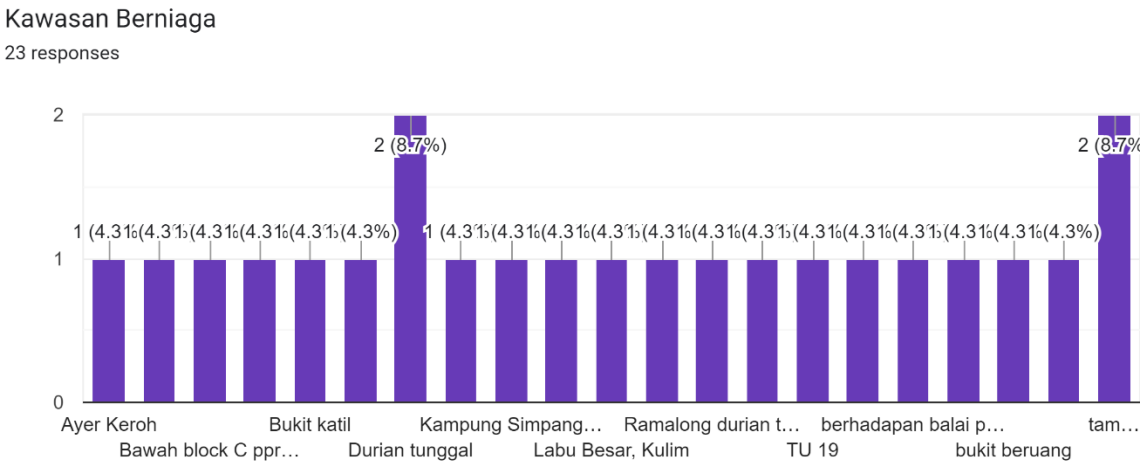

Figure 4.2 : Business Area Response

iii. Question 3 : The distribution of monthly net income among the surveyed participants highlights a diverse economic landscape within the burger-selling industry. Among the 23 respondents, a significant portion, consisting of 13 (56.5%) individuals, reported a monthly net income below RM 5,000. This subgroup reflects the challenges faced by entrepreneurs grappling with financial constraints, emphasizing the industry's need for affordable and practical solutions. In contrast, nine (39.1%) participants disclosed a monthly net income exceeding RM 5,000, representing a more financially stable segment within the surveyed businesses. Notably, one (4.3%) participant reported an impressive monthly net income surpassing RM 10,000, showcasing the potential for success and profitability in specific niches of the burger business.

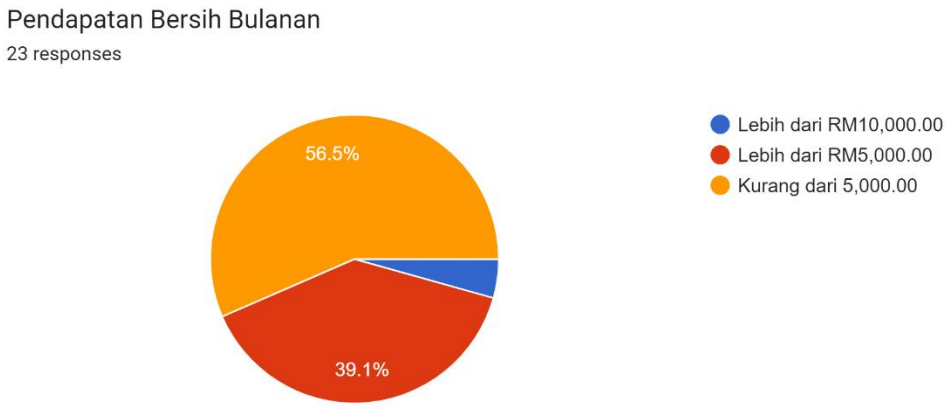

Figure 4.3 : Monthly Net Income Response

iv. Question 4 : The choice of meat sourcing in the surveyed burger-selling industry demonstrates a nearly equal split between homemade and frozen options among the 23 participants. Eleven (47.8%) participants opt for homemade meat, reflecting a trend towards personalized and potentially locally sourced ingredients. On the other hand, twelve (52.2%) participants rely on frozen meat, showcasing the convenience and shelf-life advantages associated with this option. The balance between homemade and frozen choices underscores the diverse strategies employed by businesses in the burger industry.

Figure 4.4 : Type of Meat Used for Business Response

v. Question 5 : Out of the respondents, a significant 22 (95.7%) individuals expressed keen interest in incorporating a burger patty forming machine into their production processes. This overwhelming positive response underscores a strong industry inclination towards adopting advanced technology for enhancing efficiency and quality in burger production. Only a minimal 1 (4.3%) respondent, indicated a lack of interest. The high level of interest signals a potential shift towards embracing modernized equipment, highlighting a growing recognition of the benefits these machines can offer in streamlining operations within the burger industry.

Figure 4.5 : Interested in Involving Patty Burger Forming Machine Response

4.2.2 Second section of survey

The second section delves into financial aspects and challenges faced by burger business owners. Topics include budget constraints for purchasing patty-making machines, financial limitations, space constraints, maintenance issues, and concerns about the consistency of patty shapes and product quality. Respondents are asked to rate these issues on a scale of 1 to 5.

vi. Question 6 : The budgetary preferences among surveyed participants underscore a predominant inclination towards cost-effective solutions for patty-making machines. A significant majority, comprising 19 (82.6%) participants, express a preference for machines priced below RM 8,000. This collective inclination towards a lower budget highlights the importance of affordability and financial considerations within the burger-selling industry. However, four (17.4%) participants are open to investing in a slightly higher range, ranging from RM 8,000 to RM 15,000, potentially seeking more advanced features or increased

production capacities. Recognizing these budget constraints is crucial for designing and offering patty-making machines that cater to the diverse financial preferences of small and medium-sized enterprises in the industry.

Figure 4.6 : Budget Limit Response

vii. Question 7 : The survey findings reveal a nuanced financial landscape among the respondents. A substantial 17 individuals (73.9%) find the affordability somewhat challenging, while 2 individuals (8.7%) perceive it as highly unaffordable. Interestingly, another 2 individuals (8.7%) consider the existing machines reasonably priced. Additionally, 1 individual (4.3%) views the cost as somewhat reasonable, and a similar percentage of 1 individual (4.3%) falls into an exceptional category, suggesting unique financial circumstances. This diversity in responses emphasizes the varied financial capacities within the industry and underscores the importance of tailoring solutions to accommodate different economic constraints faced by entrepreneurs in the burger business.

Figure 4.7 : Financial Constraints on Existing Machines Response

viii. Question 8 : The survey outcomes highlight diverse challenges faced by entrepreneurs concerning the space availability for placing burger patty forming machines. A significant 10 individuals (43.5%) identify it as a primary challenge, emphasizing the critical role spatial considerations play in their operations. Meanwhile, 7 individuals (30.4%) perceive it as a moderate challenge. Four respondents (17.4%) express an inability to accommodate the machines, while 1 individual (4.3%) considers it a non-issue, and another 1 individual (4.3%) views it as a minor challenge. These varied responses underscore the importance of addressing spatial constraints in the design and

implementation of patty-making machines to cater to the diverse spatial limitations within the burger industry.

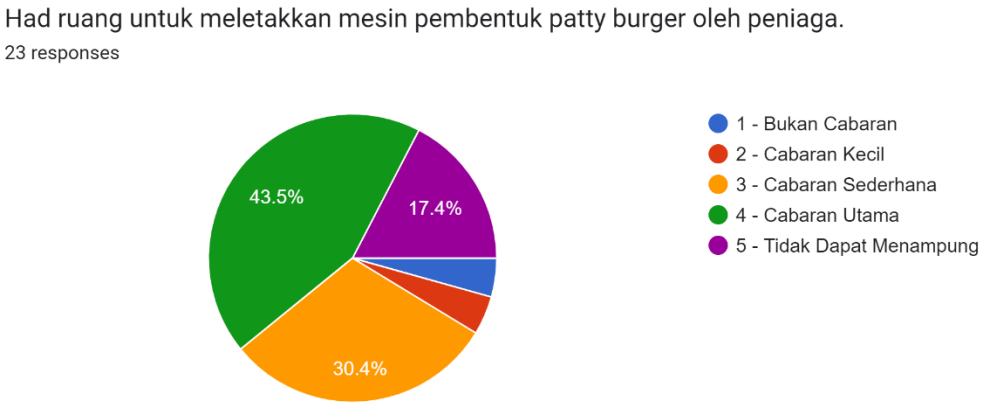

Figure 4.8 : Space Limitation Response

ix. Question 9 : The challenges entrepreneurs face concerning the maintenance and repair of existing patty-forming machines. A majority of 56.5% (13 individuals) report frequent issues, highlighting a common struggle in ensuring the consistent and efficient operation of these machines. This recurrent problem could lead to disruptions in production, affecting overall productivity and operational efficiency within the businesses. On the other hand, 21.7% (5 individuals) face occasional maintenance and repair issues, indicating a moderate impact on their operations. Interestingly, 8.7% (2 individuals) experience issues consistently, while an equal percentage claims either no issues at all or that issues are always present. This variation in reported occurrences underscores the need for targeted improvements in the design and construction of patty-making machines. Addressing these maintenance challenges is pivotal for enhancing the overall performance and longevity of these machines, contributing to a more seamless and uninterrupted production process for burger businesses in the industry.

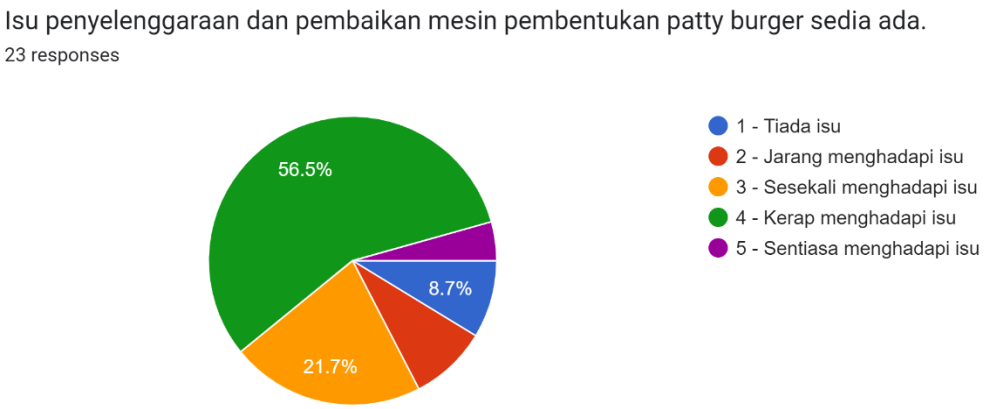

Figure 4.9 : Maintenance Issue Response

x. Question 10 : The inconsistency in the shape of burger patties, a critical aspect of product quality, emerges as a noteworthy challenge for the majority of the surveyed participants. A significant 14 (63.6%) participants report frequent occurrences of shape inconsistency in the patties produced by existing machines. This recurrent issue suggests a common struggle in maintaining uniformity in the final product, which is essential for customer satisfaction and brand reputation. The frequent deviations in patty shapes may lead to operational inefficiencies, as businesses might need to discard or reshape imperfect patties, resulting in increased production costs and potential customer dissatisfaction. This underscores the imperative for advancements in patty-making machine technology, focusing on precision and consistency to ensure a standardized product output, ultimately enhancing the overall quality and competitiveness of burger businesses. Additionally, four (18.2%) participants experience occasional inconsistencies in patty shapes, while three (13.6%) participants encounter this issue very frequently. These variations in reported occurrences indicate a range

of experiences within the industry, demanding a nuanced approach in addressing the root causes of shape inconsistencies. Tailoring solutions to accommodate the specific needs of businesses facing frequent or occasional issues can contribute to more reliable and efficient patty-making machines, fostering a more consistent and streamlined production process for burger manufacturers. While 2 (4.5%) participants rarely faces this issue.

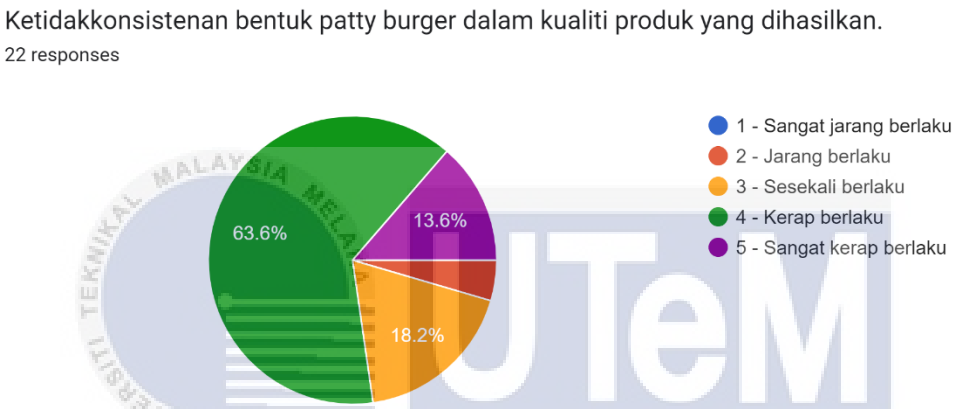

Figure 4.10 : Inconsistency in Patty Shape Response

xi. Question 11 : The constrained production capacity within a limited timeframe emerges as a significant operational challenge for a substantial portion of the surveyed burger business owners. Fourteen (60.9%) participants express a primary limitation in production capacity, indicating that their existing systems face challenges in meeting the demand within the desired timeframe. This limitation can potentially hinder business growth, as an inability to scale production quickly may result in missed market opportunities and customer dissatisfaction. The need for patty-making machines with higher production capacities becomes apparent, enabling businesses to respond promptly to

fluctuating demand and capitalize on market trends without compromising the quality and consistency of their products. Conversely, five (21.7%) participants face moderate constraints on production capacity, suggesting a need for optimization in their processes to align with market demands. On the extreme end, four (17.4) participants admit their inability to meet the demand entirely, showcasing a critical bottleneck in their production capabilities. Addressing these capacity challenges is pivotal for designing patty-making machines that not only enhance efficiency and consistency but also empower businesses to adapt to dynamic market demands swiftly. Balancing the need for increased production capacity with considerations of cost-effectiveness will be crucial in the development of solutions that align with the diverse needs of burger businesses in the industry.

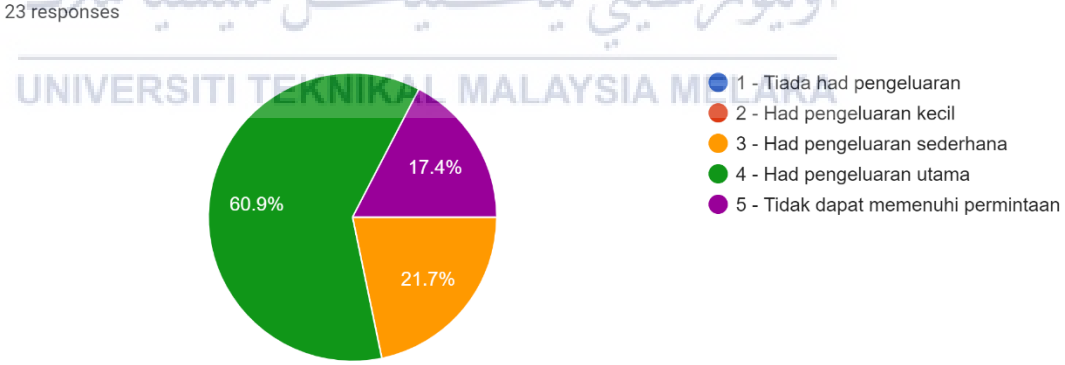

Figure 4.11 : Production Capacity Response

xii. Question 12 : a significant focus on the cleanliness and sanitation aspects of existing patty-forming machines and products within the industry. A noteworthy

65.2% (15 individuals) express heightened concerns in this regard, highlighting a strong commitment to maintaining hygienic standards in the burger production process. Furthermore, 34% (8 individuals) identify this concern as primary, underscoring the critical need to address and prioritize hygiene in both the design and ongoing maintenance of patty-making machines. These findings emphasize the industry's dedication to upholding rigorous cleanliness standards for machinery and the final products. Customizing solutions to address these concerns becomes imperative to meet the sector's elevated hygiene expectations and sustain consumer confidence in product quality and safety.

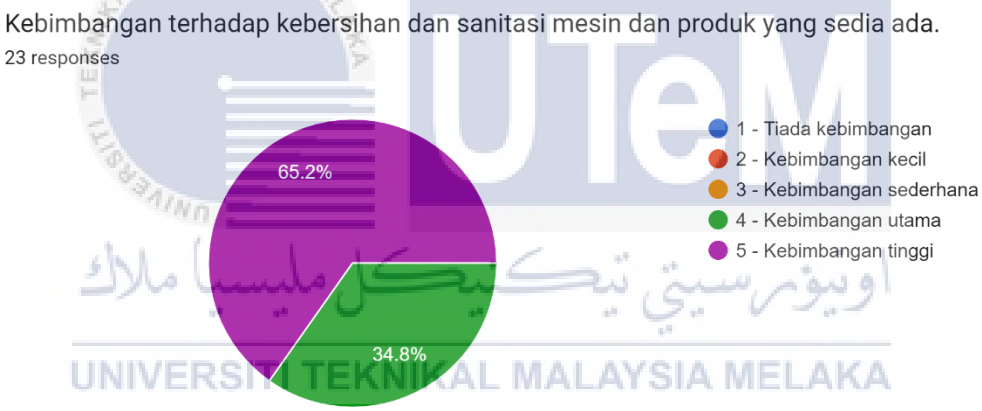

Figure 4.12 : Concerns of Cleanliness Response

4.2.3 Third section of survey

The third section explores the expectations of business owners regarding the products generated by patty-making machines. Respondents are given the opportunity to express specific needs or features they desire in the machines, such as suitable size for small areas, the ability to handle unlimited meat directly at once, productivity enhancement, affordability, and assurance of cleanliness and product quality.

xiii. Question 13 : Only one out of 23 respondents considers the query about specific needs or features for a burger patty forming machine as not applicable to future machines. This singular response suggests that the majority of participants find the question relevant, underscoring the significance of understanding entrepreneurs' specific requirements and preferences. This insight is crucial for the development of improved and customized patty-making machines in the future, ensuring that these machines align with the diverse needs and expectations within the burger industry.

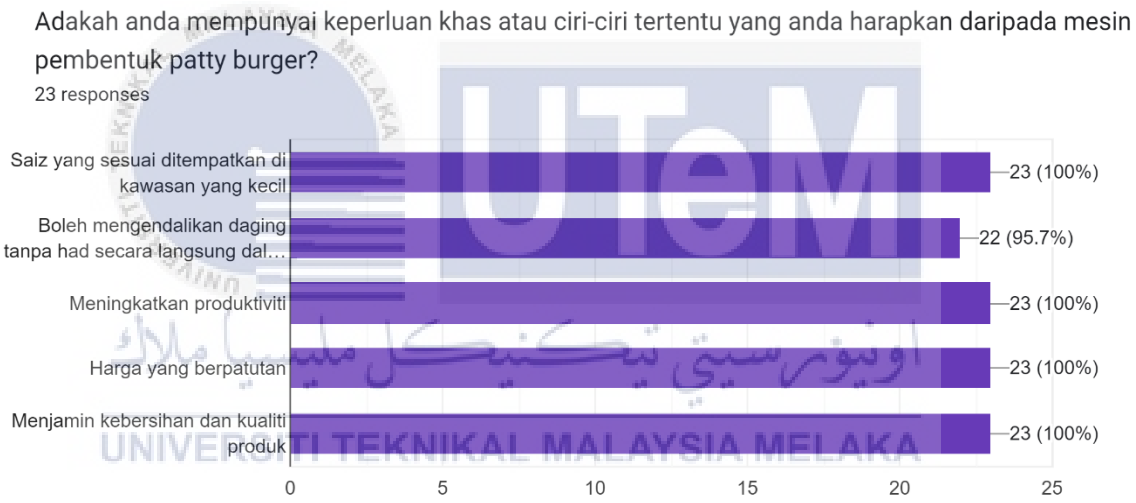

Figure 4.13 : Future Machine Recommendation Response

4.3 Implementation of Conceptual Design – Core Components

In the execution of the conceptual design, attention is directed towards the pivotal components crucial for the effective operation of the proposed solution. This stage entails the transformation of design concepts into tangible elements, with a specific focus on key components that serve as the fundamental building blocks of the system. Through careful planning and implementation, these essential elements are harmoniously integrated,

ensuring smooth collaboration and functionality to actualize the conceptual design. This phase sets the groundwork for subsequent development and fine-tuning, representing a vital stride towards bringing the envisioned solution to fruition.

4.3.1 Cylindrical Container

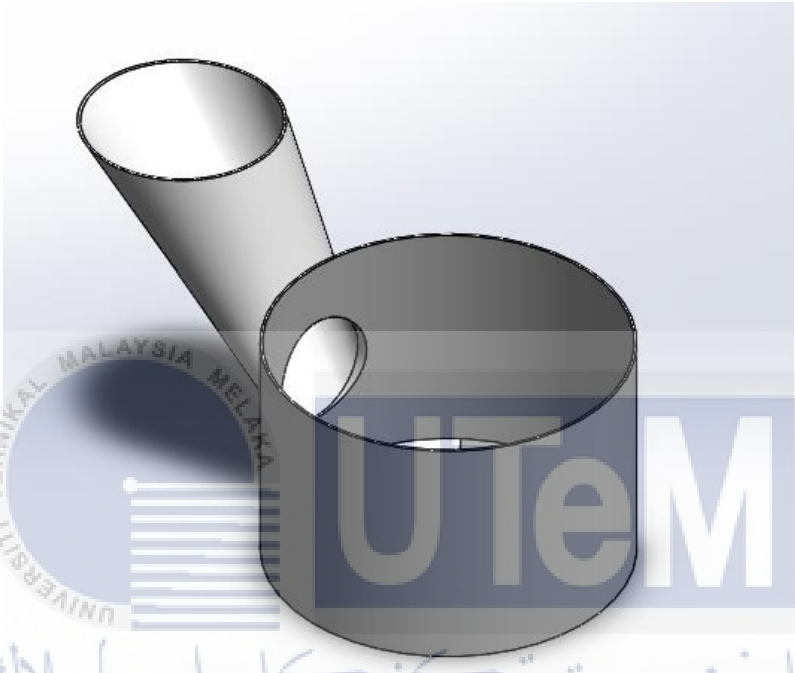

Figure 4.14 : Cylindrical Container

Integrated into the design of this cylindrical meat container, aluminum serves as a pivotal material contributing to the efficiency and durability of the patty-forming machine. Specifically, aluminum is strategically employed in components that require effective heat transfer, such as surfaces in direct contact with the minced meat or heating elements within the container. Its excellent thermal conductivity ensures that the meat is processed uniformly, contributing to the quality and consistency of the patties formed. Furthermore, the lightweight nature of aluminum facilitates the ease of handling and maneuvering the container during the loading process.

In addition to its thermal properties, the use of aluminum in the construction of this container aligns with its corrosion-resistant characteristics. This feature not only enhances the longevity of the product but also simplifies the cleaning process, maintaining optimal hygiene standards crucial in the meat processing industry. By incorporating aluminum into the design, this cylindrical meat container stands out as a durable, efficient, and hygienic component, effectively contributing to the overall functionality and performance of the patty-forming machine.

4.3.2 Patty mold

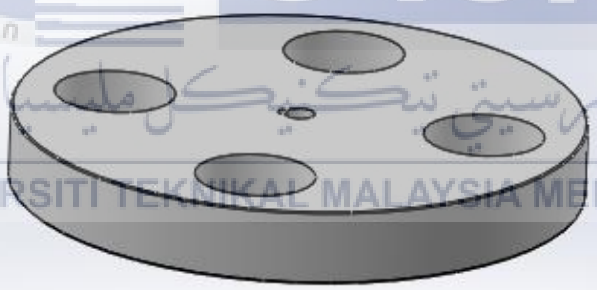

Figure 4.15 : Patty Mold

The intricately designed patty mold stands as a testament to precision engineering, crafted to mold meat into customizable sizes that cater to a diverse range of customer preferences. Powered by SolidWorks, the design seamlessly incorporates adjustable size settings, empowering small and medium-sized enterprises (SMEs) to effortlessly produce

patties with varying dimensions. SolidWork user-friendly interface ensures accessibility for SMEs, accommodating individuals with varying levels of technical expertise. The specific dimensions of the patty mold, boasting a height and diameter of mm and 380mm, respectively, result in patties standardized at 30mm in height and 80mm in diameter. Weighing in at 5.4 kilograms, the patty mold promises a robust and efficient solution, streamlining the patty production process for businesses.

The material chosen for this innovative patty mold is HDPE plastic, a deliberate selection with notable advantages. HDPE, known for its high-density and durability, aligns seamlessly with the product's requirements. Its robust nature ensures the patty mold can withstand the rigorous demands of meat shaping and frequent usage. Additionally, HDPE's smooth surface facilitates easy demolding, contributing to the efficiency and speed of the patty production process. The material choice emphasizes a thoughtful approach to design, where the compatibility of HDPE plastic enhances both the functionality and longevity of the patty mold, making it an ideal solution for SMEs seeking reliability and adaptability in their operations.

4.3.3 Motor and Mixer

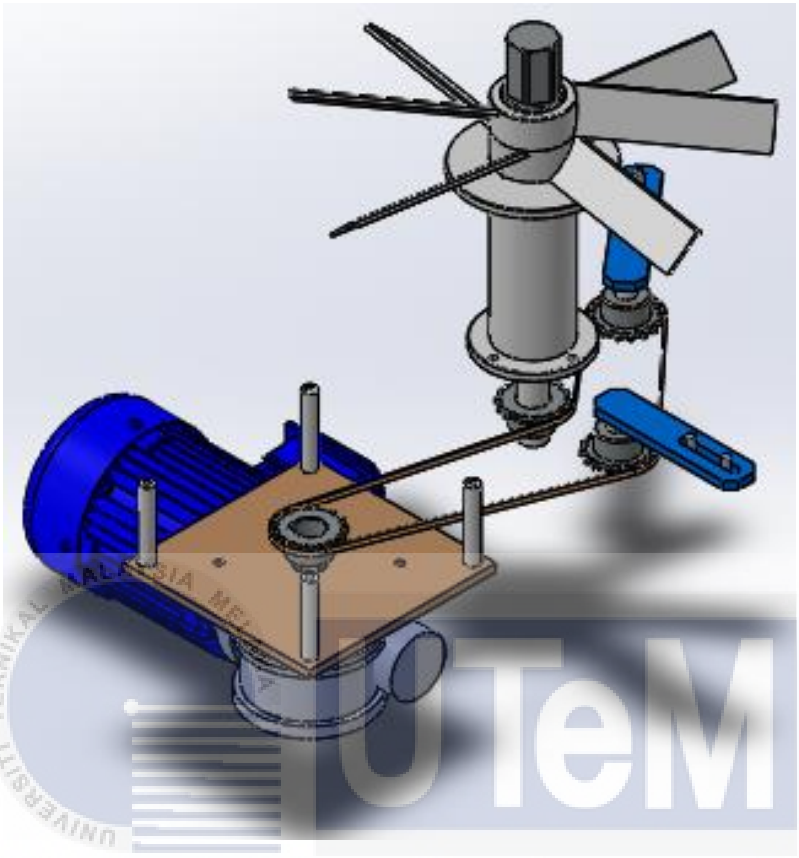

Figure 4.16 : Motor and Mixer

The integration of a blade and a high-speed motor is a fundamental aspect of this patty forming machine. The blade plays a crucial role in the meat preparation process, responsible for uniformly mixing the meat and achieving the desired texture. Powered by a high-speed motor, the blade receives the necessary rotational force for its operation. Complementing this, a meticulously designed mechanism facilitates the precise transfer of meat into the patty mold. This mechanism ensures an accurate placement within the mold cavity, guaranteeing a consistent and precise formation of patties. Together, the high-speed motor and blade, along with the transfer mechanism, orchestrate an efficient and controlled process in crafting high-quality burger patties.

Certain models of patty forming machines elevate their functionality with the incorporation of belts or conveyors for transferring the patty mix or formed patties. These belts, often composed of food-grade materials such as polyurethane or polyethylene, bring durability, ease of cleaning, and compliance with food safety regulations to the forefront. Their material characteristics align seamlessly with the hygienic requirements of the meat processing industry, emphasizing a thoughtful design approach that prioritizes both functionality and safety. Additionally, specific mechanical components like gears, cams, or sliding surfaces within the patty forming machine may be crafted from high-grade engineering plastics. These materials exhibit exceptional wear resistance, low friction characteristics, and dimensional stability under the machine's operating conditions, ensuring longevity and optimal performance of critical machine parts. The careful selection of materials, including the incorporation of a high-speed motor, underscores a holistic approach to design, addressing both functional requirements and the rigorous demands of the meat processing environment.

4.3.4 Customize Table

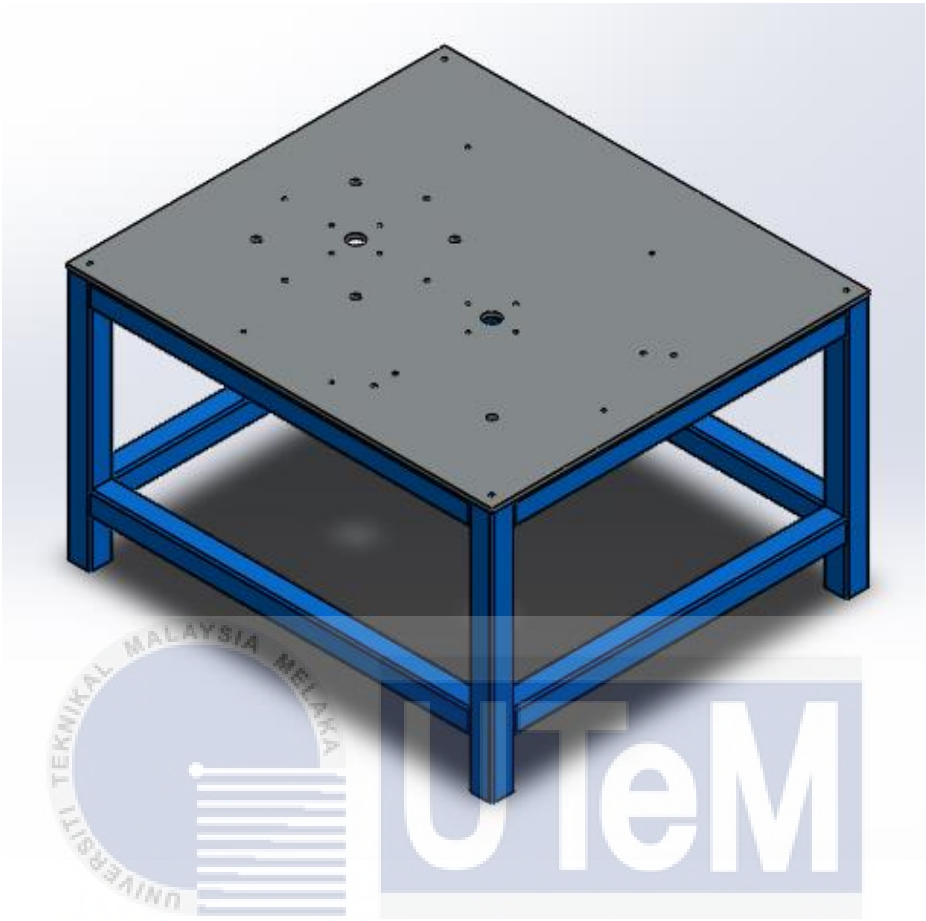

Figure 4.17 : Customize Table

The platform serves as the foundation for the burger patty-making machine, providing stability and support for efficient operation. With dimensions of 900.00mm in length, 800.00mm in width, and a height of 542.00mm, the platform is designed to accommodate the specific requirements of customer, small and medium-sized enterprises (SMEs), and vendors. Its robust construction allows it to bear a substantial weight load of up to 50N/m^2, ensuring durability during the patty production process.

The carefully considered dimensions, coupled with the ergonomic design, aim to enhance user comfort by aligning with the average human height. This thoughtful approach contributes to a more user-friendly and efficient workflow. The platform's adaptability to

varying preferences ensures its versatility in meeting the diverse needs of customers, SMEs, and vendors. Weighing 17806.38 grams, this sturdy platform not only provides a reliable base for the patty-making machine but also prioritizes user comfort and adaptability in response to the dynamic demands of the food processing industry.

4.4 Assemble Process Integration

4.4.1 Assemble

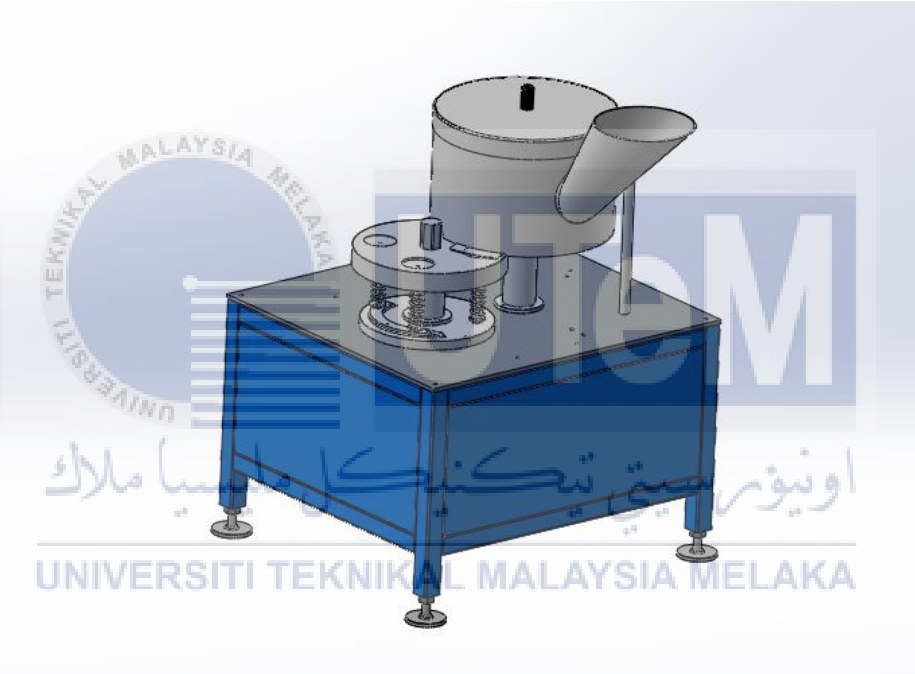

Figure 4.18 : Assemble Component

In the intricate assembly process of the patty forming machine, a meticulous combination of various components is undertaken to craft a functional and efficient apparatus. A pivotal element in this process is the cylinder container, serving as the reservoir for minced meat processed through a grinder. This container, thoughtfully designed with an appropriate capacity, features a secure lid or opening mechanism to ensure proper containment, preventing spillage or contamination.

SolidWorks proves instrumental in this assembly, providing a platform for visualizing and analyzing the integration of components. Through this software, meticulous attention is given to ensuring a precise fit, optimal functionality, and perfect alignment of each component, guaranteeing the seamless operation of the patty forming machine.

Stainless steel, renowned for its exceptional corrosion resistance and hygienic properties, is the material of choice in the food processing industry. Its ease of cleaning, resistance to staining, and non-reactive nature with food make it a preferred option. Different grades, such as 304 and 316, are selected based on specific machine needs and desired corrosion resistance levels. Complementary parts like covers, guards, and knobs are often crafted from food-grade plastics, carefully chosen for their non-toxic attributes, chemical resistance, and moldability into intricate shapes. This ensures the machine remains not only functional but also safe for food contact.

Furthermore, the seals, gaskets, and O-rings within the patty forming machine are typically made from food-grade rubber or silicone materials. These materials contribute to secure and hygienic seals, exhibit resistance to high temperatures, and play a critical role in maintaining the formed patties' purity, free from any potential contamination. The holistic selection of materials and the precise assembly process collectively contribute to the machine's reliability, durability, and adherence to the stringent hygiene standards of the food processing industry.

4.4.2 Product Analysis

The patty forming machine specifically designed to streamline the process of shaping meat into patties. By utilizing SolidWorks, a powerful computer-aided design (CAD) software, a comprehensive product analysis can be conducted to assess the functionality, efficiency, and overall design of the patty forming machine.

1. Structural Analysis

   Using SolidWorks, the structural integrity of the machine can be evaluated through finite element analysis (FEA). This analysis helps identify areas of high stress, potential weak points, and structural optimizations to ensure the machine can withstand the forces and vibrations generated during operation.

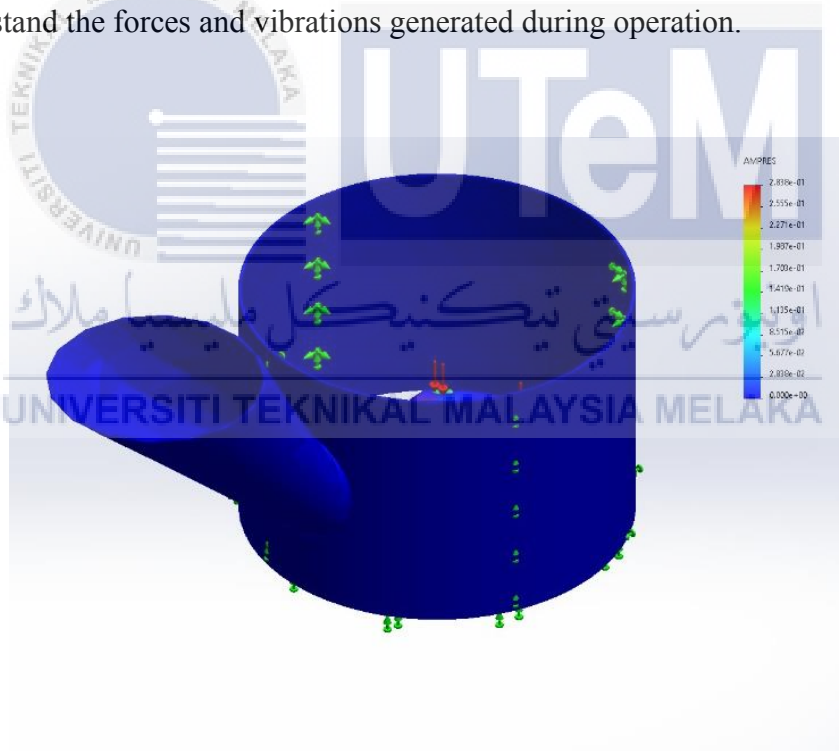

Figure 4.19 : Structural Analysis of Customize Table

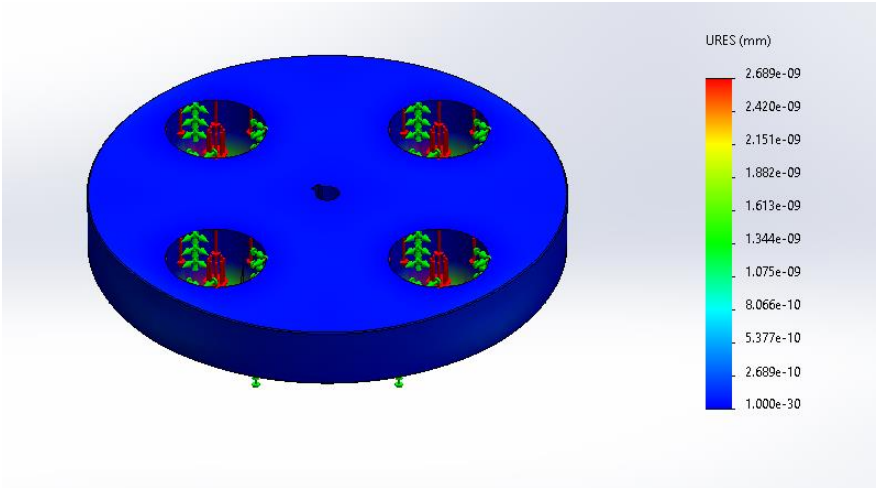

Figure 4.20 : Structural Analysis of Patty Mold

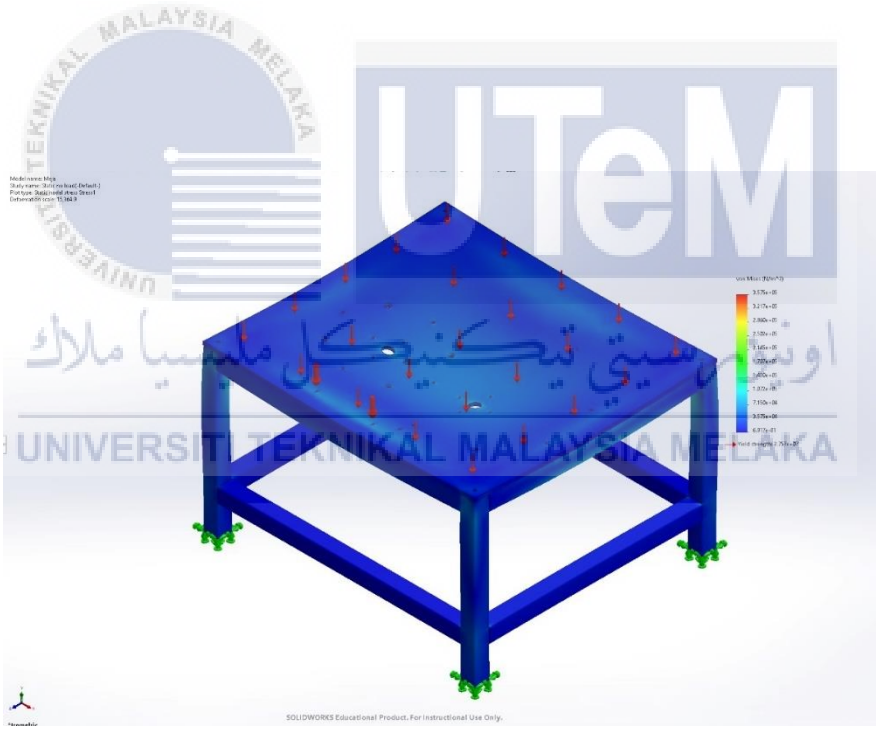

Figure 4.21 : Structural Analysis of Customize Table

2. Assembly Analysis

SolidWorks provides a comprehensive platform for assembly analysis, ensuring that all components fit together seamlessly. The software allows for interference

detection, and collision analysis, ensuring proper alignment and functionality of each part within the machine's assembly.

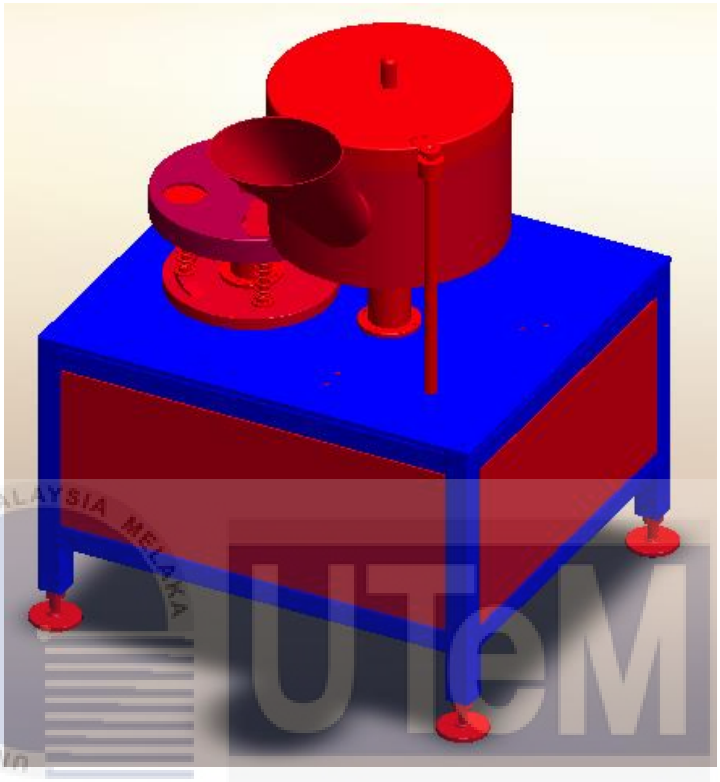

Figure 4.22 : Assembly Analysis

3. Visualization and Rendering

SolidWorks offers realistic rendering and visualization capabilities, enabling the creation of high-quality images and 3D models of the patty forming machine. This allows stakeholders, such as designers, engineers, and potential users, to visually assess the aesthetics, design details, and overall appearance of the machine.

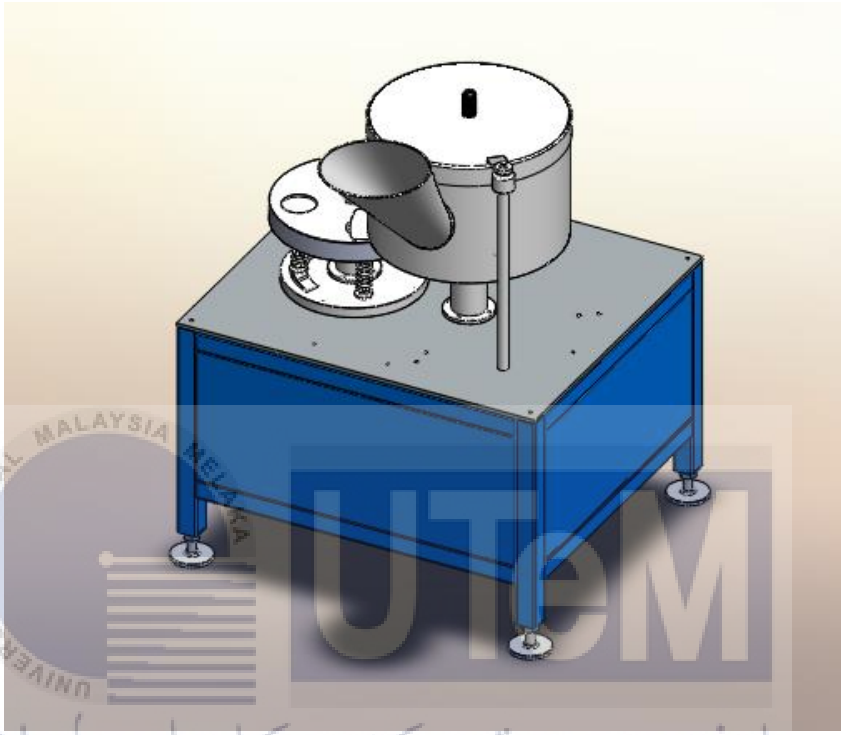

Figure 4.23 : Visualization and Rendering

4.5 Summary of Chapter

Result and Discussion presents the outcomes and discussions of the designed patty forming machine, aimed at addressing challenges encountered by SMEs in burger production. The chapter initiates with an overview of activities conducted to evaluate the machine's effectiveness. Survey results on the utilization of the patty forming machine are detailed in section 4.2.

Following this, the conceptual design implementation of core components, including the cylindrical container, patty mold, and motor with a mixer, is expounded upon. The assembly process integration is emphasized, underscoring the importance of careful component combination and the use of SolidWorks for visualization.

Material selection for key components is elucidated, highlighting the significance of materials like stainless steel, aluminum, food-grade plastic, rubber/silicone, and engineering plastics for ensuring hygiene and functionality. The chapter concludes with a thorough product analysis using SolidWorks, covering structural integrity, assembly analysis, and visualization, providing a holistic understanding of the machine's design and operational aspects.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This concluding chapter encapsulates the entirety of the thesis, offering a comprehensive summary of the undertaken work to fulfill the project objectives. The discussion encompasses the overarching results of the project, acknowledging its limitations, and ensuring stability. Moreover, recommendations for future endeavors are provided, offering valuable insights for continued research. The subsequent sections delve into a detailed summary of each research objective, emphasizing the achievements and insights gained throughout the study.

5.2 Summary of Research Objective

This section provides a detailed exposition of the outcomes corresponding to the predefined project objectives outlined in Chapter one of this thesis. The primary aim of this undertaking is to scrutinize and enhance the design of a burger patty forming machine customized for Small and Medium-Sized Enterprises (SMEs). The successful achievement of all three objectives is evident through a comprehensive assimilation of knowledge and adept problem-solving, addressing the complexities inherent in the development of an improved patty forming machine tailored to meet the specific requirements of SMEs.

5.2.1 Research Objective 1

Objective 1: To identify and evaluate the current machines used for burger patty forming in Small and Medium-Sized Enterprises (SMEs).

Objective 1 delved into identifying and evaluating current patty forming machines in SMEs. The survey results, detailed in Chapter 4, served as a valuable tool to assess the industry landscape. By exploring machine performance, operational challenges, and user experiences, the research gained insights that form the basis for informed improvements in the patty forming process. Understanding the strengths and weaknesses of existing technologies is crucial for driving innovation and enhancing efficiency within the SMEs' operational framework.

5.2.2 Research Objective 2

Objective 2: To conduct a conceptual design of a new and improved burger patty forming machine specifically tailored for SMEs.

Objective 2 focused on the conceptual design of an improved patty forming machine tailored for SMEs. The study successfully accomplished this by creating three conceptual designs, evaluating them using the House of Quality (HOQ) and PUGH method. This innovative approach not only addresses the deficiencies found in existing machines but also introduces features that elevate the efficiency and adaptability of the patty forming process. The conceptual design phase marks a significant step forward in responding to the industry's needs with a solution crafted for SMEs' specific requirements.

5.2.3 Research Objective 3

Objectives 3: Perform a SolidWorks design analysis to scrutinize and evaluate the proposed burger patty forming machine.

Objective 3 involved a detailed SolidWorks design analysis to scrutinize and evaluate the proposed patty forming machine. By performing structural, assembly, and visualization and rendering analyses, the study assessed the machine's feasibility and effectiveness. These analyses provide crucial insights into the proposed viability of improvement, guiding the subsequent stages of the machine's development. The SolidWorks design analysis ensures a thorough understanding of the machine's capabilities and limitations, setting the stage for its refinement and optimization in future iterations.

5.3 Limitations

Acknowledging the limitations encountered during the project is crucial for transparency, offering a clear understanding of the scope of study and potential areas for improvement. Firstly, the research phase faced constraints in terms of resources, including time and access to extensive literature. The comprehensive exploration of existing patty forming machines could have been enriched with a more extensive review of global practices, but resource constraints restricted the depth of this analysis. Additionally, due to the dynamic nature of technological advancements in the food industry, some information might have become outdated, potentially impacting the completeness of the research.

Secondly, the fabrication posed a significant limitation, primarily due to time constraints. The development of a physical prototype of the proposed patty forming machine was restricted by the project timeline, limiting the ability to validate the conceptual design through practical implementation. While the SolidWorks design analysis provided valuable insights, a physical prototype would have allowed for a more comprehensive assessment of the machine's real-world functionality.

Thirdly, the survey process encountered limitations related to time, location, and geographical constraints. Conducting surveys across diverse regions posed challenges in terms of logistics and response rates. The time required for in-person surveys was impacted by the geographical distribution of SMEs, leading to potential biases in the sample. Furthermore, the availability and accessibility of participants were influenced by their locations, hindering the collection of a more extensive and representative dataset.

In summary, while the project achieved significant milestones, the limitations in research depth, fabrication constraints, and survey logistics should be considered for future endeavors in refining and expanding the study. These insights underscore the importance of addressing practical challenges to enhance the robustness and applicability of future research in patty forming machine technology.

5.4 Future works

This section provides recommendations and avenues for future research, ensuring a continuous exploration of the subject beyond the current study, guiding subsequent researchers in building upon the foundation laid by this thesis.

While this study has made significant strides, there are areas for future exploration. The evolving landscape of food technology suggests continuous research into materials, automation, and sustainability. Additionally, conducting real-world trials and obtaining user feedback on the implemented machine prototypes would enhance the practical applicability of the proposed designs. Exploring collaborative ventures with SMEs for on-field testing and iterative improvements could further refine the proposed patty forming machine. The incorporation of smart technologies and data analytics for process optimization is another avenue for future exploration, ensuring that SMEs stay at the forefront of technological advancements in the burger production industry.

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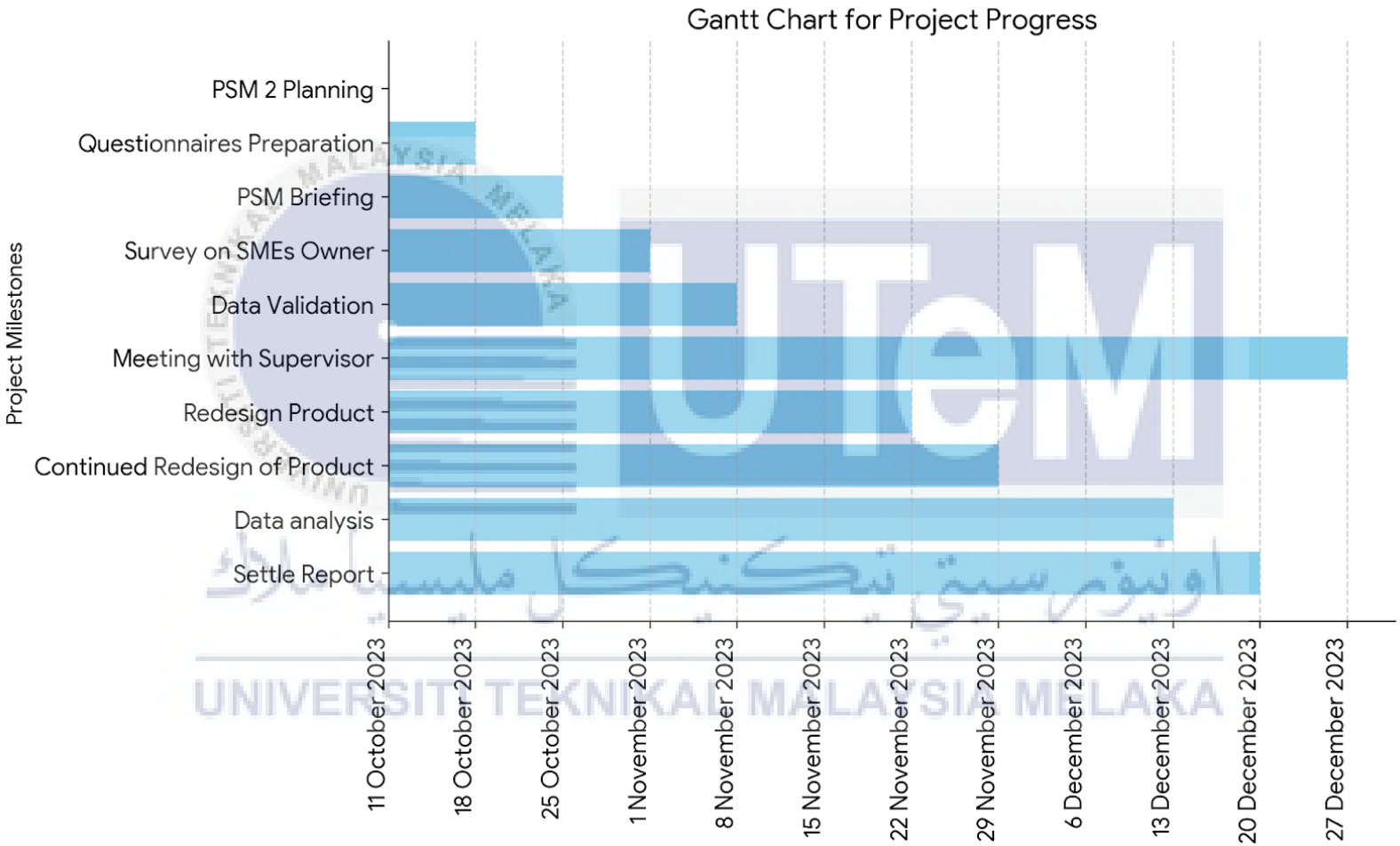
APPENDICES

APPENDIX A Gantt Chart of Bachelor Degree Project 1

PSM 1														
Week / Class	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chapter 1: Introduction														
PSM briefing session														
Introduction of the project														
Problem statement														
Research Question and Objective														
Scope research of project														
Chapter 2: Literature Review														
Finding journal and article														
Introduction of literature review														
List of content														
Chapter 3: Methodology														
Methodology briefing session														
Introduction of methodology														
Flow chart process														
Brainstorming of Project														
Realization Concept Design														
Report & Logbook submission														
Presentation PSM 1														

APPENDIX B Gantt Chart of Bachelor Degree Project 2



APPENDIX C Total Weight of Product

No.	Product	Quantity	Total weight (grams)
1	Flat Head M8x30	1	1.66
2	Gear Support Holder	4	11.79
3	Belt	1	17.28
4	Ball Bearing	4	51.69
5	Gear 70-30	2	70.21
6	Tensioner Gear	2	97.36
7	Tightening Nut	1	105.35
8	Collector Tightening Nut	1	108.62
9	Gear Support	2	148.08
10	Support Disc	1	190
11	Mixer 2	1	220.83
12	Collector Shaft	1	252.78
13	Mixer 4	1	278.4
14	Forming Disc Shaft	1	292.47
15	Lid Support	1	296.58
16	Kaki Meja	4	536.71
17	Forming Disc Support	1	574.06
18	Spring Set	4	598.32
19	Motor Support	1	627.79
20	Collector Cover	1	753.79
21	Collector Support	1	834.23
22	Cover 700	2	1603.7
23	Cover 800	2	1823.3
24	Worm Gearbox	1	2159.23
25	Collector	1	2167.74
26	Calf	1	2198.21
27	Forming Disc	1	5039.73
28	Motor	1	5552.9
29	Customize Table	1	17806.38

APPENDIX D Drawing of a product