Development of Coated Peanut Separator and Frying Skillet Machine

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Abstract: Coated peanut which known as *Kacang Bersalut Istimewa Deqyoung* is a product made from groundnut mix with flour and special spices. Currently, there are some issues with the product that slow down the production process. The groundnut is sticking and become like a ping pong size ball and the time consuming to fry is longer. Coated peanut separator and frying skillet machine can overcome the problems and able to increase the production. Furthermore, the machine aim to facilitate workers to carry out their duties and to assist small and medium industries (SMEs) in Malaysia. The design convenient, determination of the material selection and the main components that help to operate the machine are the main aspects have been considered. Design analysis helps to identify the capability of the machine when the forces act at some main parts of the machine. The comparison between manual method and semi-automatic method shows that the production increase. By using semi-automatic method of production, the increment shows almost 84 percent of production compares to manual method.

Keywords: Coated peanut separator, frying skillet, design analysis, production line

1. Introduction

Small and medium enterprises (SMEs) play significant contribution to the economic development, social uplifting and political stability of every country. Any kind of business in the urban or rural area can be established by SMEs [1]. Besides that, in other definition of SMEs, a small scale firm is a company with less than 50 full-time employees and with an annual turnover of not more than 10 million, whereas a medium scale enterprise is a company with 51 to 150 employees [2]. Deqyoung Vision Enterprise is one of the SMEs entrepreneurs. They produce spicy coated peanut called Kacang Bersalut Istimewa. The company claimed that their products are very special products and were well accepted by the consumers. Currently, there are selling locally and also exporting their product. The demand for the product has increased to double from what they used to produce.

Implementation of the coated separator machine and frying skillet machine is one of the convenience to the workers. The conveyor system is definitely the automation which materials are moving and it is one of the advantages in production line process. The experimental result shows that this system has the advantages of convenient implementation, low cost, short cycle and stable operation, also of the remarkable energy-saving effect and broad application value [3].

Conveyor system is an economical and highly efficient way to move goods and facilitate material handling in a facility without using manual labor. Conveyor system is capable of moving thousands of parcels per hour on an individual basis, and when utilize in parallel, it can achieve virtually unlimited handling rates. Besides that, this system allows quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries [4].

Benchmarking is the process of designing new products or upgrades to current ones [5]. This process can sometimes involve reverse engineering which is taking apart competitor's products to find strengths and weaknesses and also one of a continuous process to find and implement best practices that will lead to superior performance. Besides that, it could utilize product dissection to not only derive its benefits as a hands-on learning exercise but to integrate it into the context of concurrent design [6].

The requirement of this research is to identify the specifications of the existing products. After benchmarking the existing product, need to be identify the limitation of the SMEs to buy or having these existing products. Mostly, all of these current products were expensive due to high-tech of machines.

2. Methodology

Engineering design can be defined as the set of decision making process and activities. It usually used to determine for producing an object or product that the functions will be desired by the customer. Creating something with potential efforts for a part of mankind is the greatest human achievement. Before creating a new product or service, the design process are guided for success designing [7]. The method has been well

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accepted and used worldwide, but as always, there has been some criticism too.

Thus, the all the phases that are already been stated is successfully used by quite many companies especially in the start-up sector. Analysis section become the next phase of engineering design process [8]. It is very important to analyze all the results or data that have been collected in the study [9].

The design is an interactive and evolving process, complex by the requirements and constraints coming from several contextual aspects such as well as materials, technologies and organizations [10]. Models of the design process with development of the designing proceed from one stage to the next stage, but with feedback loops showing the iterative returns to earlier stages which are frequently necessary.

The conceptual design makes the greatest demands on the designer for striking improvements. It is the phases where engineering science, practical knowledge, production methods and commercial aspects need to be brought together and where the most important decisions are to be decided. Detailing is the last phase, in which is a very large number of small but essential points remain to be decided. The quality of this work must be good and meet the objective. Otherwise, delay and expense or even failure will result [11].

Engineering design specification is where the details the requirements that must be met in order for the product or process to be successful. There are some issues need to be emphasized. The engineering design problem need to be identify in intended to overcome and invert into special features of machine [12].

The purpose of engineering design specification is all of need required by the customer and all required parameters need to be listed out. Engineering test or analysis is done to make sure the product meets the requirement and archives the objective [13]. Usually customer requirement considering about the machines functional operation, economical, geometric limitations, reliability, safety and most importantly it have to be easy to use.

3. Design Process

In this phase, all the mechanism and components involved and related to the frying skillet and separator conveyor were determined in the product decomposition diagram as shown in Table 1. There are three alternative potential mechanism with different function. In this section also tell about the product decomposition of components and the functions, and concept selection for the product.

The design concept is concerned lots to the SME's company in various industry because bad design structure cause system failure, hazard at workplace and increase of maintenance cost [14].

Function decomposition components of the machines is a hierarchical structure of functions, not forms. It helps to identify whether the functions are connected, and where the interface connections might be. This method shows the high relationship of the components function in

between main component and sub-component that allowed the system to perform in cycle operation and good condition all the time.

Concepts of developing innovative solutions that will meet the specifications that have been satisfy the needs of the customer. A concept is to generate the complete range of alternative design solution for a product, and hence to widen the search for potential new solutions. A concept is usually expressed as a sketch or as a rough three-dimensional model and often accompanied by a brief textual description.

In this manner, morphological charts provide a sense of the size of the design space. A morphological chart also is known as a table based on the function analysis. On the left side of the chart the functions are listed, while on the right side, different mechanisms which can be used to perform the functions listed are drawn. It is a visual aid used to come up with different ideas. The idea generation is accomplished by creating single systems from different mechanisms illustrated in the morphological chart.

Table 1: The morphological chart and list of parameters of the coated peanut separator machine and frying skillet machine.

Function	Potential Mechanism		
	Alternative 1	Alternative 2	Alternative 3
Power Supply	Electricity	Generator	Battery
Turn on/off switch type	Push button	Toggle switch	Rotary switch
Housing material	Aluminum	Stainless steel	Mild steel
Cover Shape	Square	Filleted square	Round
Caster frame joining method	Screws	Rivet	Welding
Motor type	Direct current	Alternate current	Servo
Speed controller	Knob control	Digital control	Manual speed control

The concept selection is the concept where each component to be selected. Based on the morphological chart, the best component is selected by circling the component. The components that have been chosen are based on the combination of three alternative from the morphological chart.

The components are selected by the customer requirement as shown in Table 2. By evaluating the components, the designer could have the clear view on the component need to be selected for designing the product. The actual parts or components like mild steel square hollow, aluminum sheet plate and others are used

to fabricate the main structure and body of the machine as shown in Fig. 1.
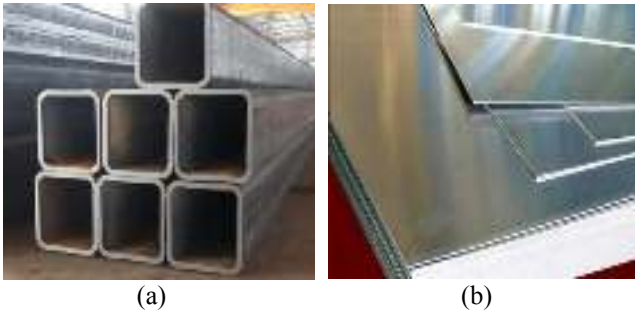

(a)   (b)

Fig. 1 The actual components of the machine (a) mild steel square hollow and, (b) aluminum sheet plate

Table 2: The final concept selection for this product.

Function	Specifications	Details
Power Supply	Electricity	3 phase electricity
Turn on/off switch type	Push button	Excel power push button
Housing Material	Aluminum	0.2 mm thick
Cover Shape	Square	
Caster frame joining method	Welding	MIG/TIG
Motor type	Direct current	Power Window
Speed controller	Knob control	2V-40V 10A

Prototyping is an activity and a tool that has received considerable attention in the product development research communities in recent times [15]. In terms of an information system, prototypes are employed to build an information system that intuitive and easy to manipulate for end users. The user feedback gained from developing a physical system that the users can touch and see facilitates an evaluation response that the analyst can employ to modify existing requirements as well as developing new ones.

4. Results and Discussion

The design of the coated peanut separator and frying line machine has been analyzed before proceed to the fabrication and manufacturing process. The analysis purpose is to adapt the design, match with the implementation environment, and designing it for performance [16].

The product design has been applied to show the model of the coated peanut separator and frying line machine with actual dimension for fabrication. The software used to apply this engineering drawing is SolidWorks. Fig. 2 and Fig. 3 show the design product of coated separator machine and frying line machine respectively. The machine is divided into two main section which are separator and frying.

Fig. 2 The design of coated peanut separator machine that consists 3 parts of separator section and PVC conveyor belt.
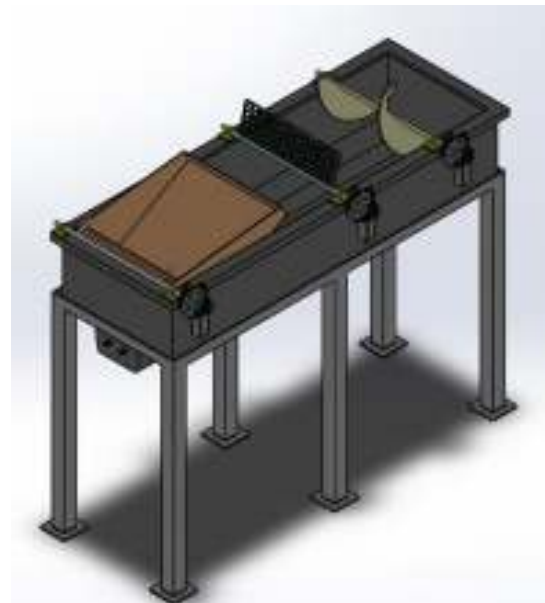

Fig. 3 The design of frying skillet machine which the main parts of this machine are heater, oil tank, propeller, rotating wire mesh and coated peanut cage.

Parametric design calculation analysis is one of the method to gain the data accurately. The calculation that has been made is to determine the specification of the component that suit with other function for the machines. The motor used for coated peanut separator machine and frying skillet were the same specification.

The specification of the motor are 60 rpm output speed and 12V output voltage. The motor that have been used power window motor. Because of the speed of the motor and torque were suitable, power window was chosen.

The engineering design drawing has been develop by considering the material selection and main components follow by the cost. Some of the manufacturing processes

involve in preparing this machine structure are such as measuring process, material selection, cutting, welding, assembly and others. In the beginning, the marking and cutting process is done according to the sketches that have been made. This is the next procedure after engineering design drawing and component selection have been applied.

Detail drawing shows the detail part giving a complete and exact description of its form, dimensions, and construction. Analysis is carried out on the part of the acting frame and charged. The simulation is aimed at studying the resilience of the machine structure so that the weakness of the machine structure the quality of the machine can be improved. In this study, static analysis and fatigue analysis were applied at the main parts of the coated peanut separator machine and frying skillet machine.

Static analysis is terms for simplified analysis wherein the effect of an immediate change to a system is calculated without respect to the longer-term response of the system to that change as shown in Fig. 4 and Fig. 5. Fatigue analysis examines how it is failure under a repeated or otherwise varying load which never reaches a level sufficient to cause failure in a single application. It can also be thought of as the initiation and growth of a crack, or growth from a pre-existing defect, until it reaches a critical size, such as separation into two or more parts.
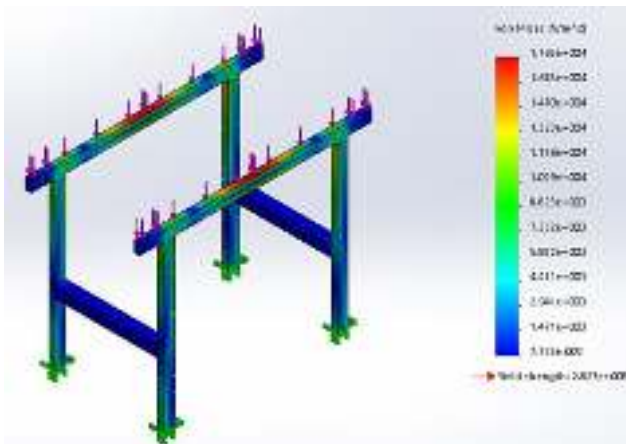

Fig. 4 The static analysis for frame of the coated peanut separator machine with maximum yield strength that applied at this frame is 1.765e+04 N/m^2.

This analysis process is based on production that can be derived through manual and semi-automatic methods. Analysis is done based on parts or components production, profit from sales proceeds and percentage of increase in production. Table 3 shows the comparison of different production process between the manual method and semi-automatic method.
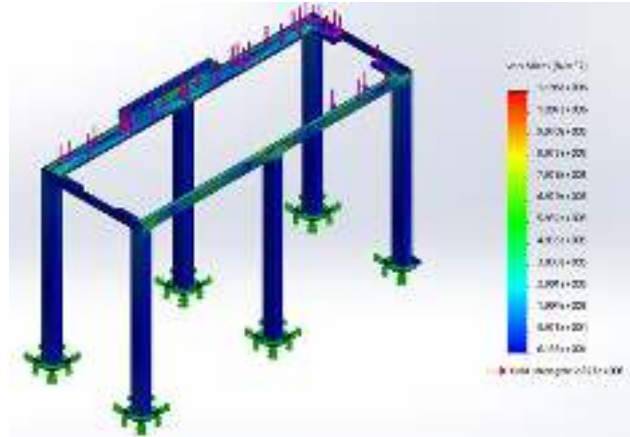

Fig. 5 The static analysis for frame of the frying skillet machine with maximum yield strength that applied at this frame is 1.196e+6 N/m^2.

Coated peanut separator and frying skillet machine are attached together as a single production line. By using these semi-automatic machines, they are targeting the production increase double or more from their usual production amount. Based on the analysis that have been made, the production has increased 83.5 percent of production which means from 25 kg increased to 41 kg per day like showing in Fig. 6.

Table 3: The comparison of production between the manual method and semi-automatic method.

Time(Hour)	Manual Method (kg)	Semi-Automatic Method (kg)
1	3.2	5.2
2	6.4	10.4
3	9.0	15.0
4	12.2	20.0
5	15.5	25.2
6	18.9	30.4
7	21.5	35.0
8	25	41.0

The average mass of production by using manual method is 3.2 kg per hour. It increased into 5.2 kg per hour by using semi-automatic method. To recover the production cost, analyze of repayment period was made. The profit each month by comparison between manual method and semi-automatic method is RM 3000.00 and RM 5500.00 respectively. Total cost of the machine is RM 11000.00. Table 4 shows the refund period calculation.
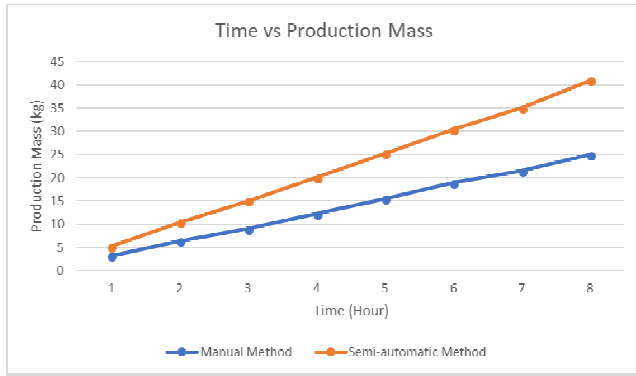
Fig. 6 The comparison of production between the manual method and semi-automatic method against time.

Table 4: The calculation of refund period between semi-automatic and manual method.

Description	Calculation
Net Profit	Semi-Automatic Method – Manual Method = RM 5500.00 – RM 3000.00 = RM 2500.00 / month
Net Profit Per Day	= RM 2500.00 / 24 days = RM 104.20 / day
Refund Period	= RM 11,000 / RM 104.20 = 105.5 = 106 days

Fig. 7 shows the breakeven point from the net profit per day which is RM 104.20 on the first day, then it achieves the refund payment which is RM 11000.00. From graph analysis, it shows that the period refund payment stops at 106th day. After the breakeven point was achieved, it gave more profit and not accommodate the fix cost.
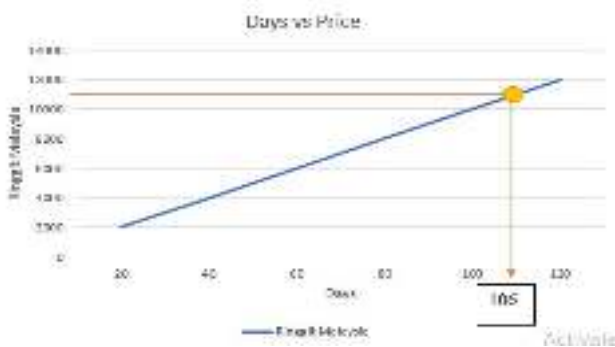

Fig. 7 The breakeven point from the net profit per day on the first day until it achieves the refund payment.

Therefore, the breakeven point shown in the line chart indicating the repayment term for machine purchases can be done more quickly. With this, the purchase of a new machine can be purchased in a short time to speed up the production of *Kacang Bersalut Istimewa Deqyoung*.

5. Summary

Planning of develop a machine should be taken into in terms of cost and production to be used. These machines developed for the use of small and medium enterprise (SMEs). The planning made for the developed project will focus on better machine designs. After conducting the experiments, the comparison between manual method and semi-automatic method of production, the increment shows almost 83.5 percent of production from manual method. From the analysis that have been made, the breakeven point shows that after 106 days to refund the payment.

Acknowledgement

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