



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND DEVELOPMENT OF CUSTOMIZED DRINKING  
BOTTLE FOR SME**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Manufacturing Engineering Technology (BETD) (Hons.)

by

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## DECLARATION

I hereby, declared this report entitled "Design and Development of Customized Drinking Bottle for SME" is the results of my own research except as cited in references.

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## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the Bachelor's Degree in Manufacturing Engineering Technology (Product Design) With Honours. The member of the supervisory is as follow:

.....

(Project Supervisor)

## **ABSTRAK**

Pada masa kini, pengeluaran botol minuman bukanlah sesuatu yang baru dalam industri pembuatan. Ia melibatkan proses reka bentuk dan membuat prototaip acuan menggunakan Rapid Prototyping. Tetapi dalam kes-kes tertentu, mereka menggunakan mesin CNC untuk membuat acuan. Dalam projek ini, proses ini adalah untuk mereka bentuk dan menghasilkan satu botol minuman peribadi untuk PKS. PKS adalah Perusahaan Kecil dan Sederhana yang membantu ahli perniagaan atau orang untuk memulakan perniagaan dalam perusahaan kecil dan sederhana. Objektif utama projek ini adalah kaedah 'Reverse Engineering' dilakukan pada botol dan acuan yang sedia ada untuk membuat reka bentuk yang baru dan untuk mereka bentuk dan menghasilkan botol minuman berdasarkan keperluan pelanggan. Ini kerana, beberapa syarikat PKS tidak mempunyai alat reka bentuk yang sesuai untuk mereka bentuk botol dan tidak mempunyai reka bentuk botol mereka sendiri, jadi, mereka perlu membeli botol daripada syarikat lain. Dengan perisian CAD, 'SOLIDWORKS', reka bentuk yang dibuat berdasarkan keperluan pelanggan didapati daripada pertemuan dengan pengurus pengeluaran syarikat. Reka bentuk botol yang direka akan digunakan untuk menghasilkan prototaip dengan menggunakan mesin 'Prototyping Rapid'.

## **ABSTRACT**

Nowadays, drinking bottle production is not something new in the manufacturing industry. It involves the design process and making a mold using Rapid Prototyping and makes the prototype. But in certain cases, they used the CNC machine to make the mold. In this project, the process is to design and develop a custom drinking bottle for SME's. SME is a Small and Medium Enterprises that provides the businessman or people to start the business in small or medium enterprises. The main objective of this project are reverse engineering method apply on the existing bottle and mold to make a new design and to design and develop the drinking bottle based on the customer requirement. This is because, some of the SME company do not have the appropriate design tools to make the bottle design and do not have their own bottle design, so, they need to buy the bottle from another company. Using 3D CAD software, the design are made based on the customer requirement from the meeting with the production manager. The prototypes of the bottle design are fabricated by using the Rapid Prototyping.

## **DEDICATION**

Special dedication,  
To my beloved parents  
Mr. Ahmad Bin Abu  
Mrs. Puziah Binti Tasi

To my beloved sibling  
Nadia Izwannie Binti Ahmad  
Nor Fatir Atila Binti Ahmad  
Nuhizammil Fitri Bin Ahmad  
Naufal Hazwan Bin Ahmad

To my friends, lecturers, assistant engineers, my supervisor, Eng. Hassan Bin Attan and who had contributed to this project until it success.

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# LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

SME	-	Small-Medium Enterprises
CAD	-	Computer Aided Design
RP	-	Rapid Prototyping
RE	-	Reverse Engineering
HDPE	-	High Density Polyethylene
PET	-	Polyethylene Terephthalate
LDPE	-	Low Density Polyethylene
PP	-	Polypropylene
PS	-	Polystyrene
PVC	-	Polyvinyl Chloride
STL	-	Standard Triangulation Language
lbf/g	-	Pound mass per gram
mm	-	Millimetre
L/g	-	Litre per gram
BOM	-	Bills of Material
CAM	-	Casio Camera
CMM	-	Coordinate Measuring Machine
CCD	-	Charge-Coupled Device
CAI	-	Computer-Aided Inspection
LS	-	Laser Sintering
SLA	-	Stereo Lithography Apparatus
CT	-	computed tomography
CRT	-	Cathode Ray Tube
DFM	-	Design for Manufacturability
DFA	-	Design for Assembly
FDA	-	<i>Food and Drug Administration</i>

NSF	-	National Science Foundation
USDA	-	United State Department of Agriculture
°C	-	Celsius

# CHAPTER 1

## INTRODUCTION

This project is about to design and develop customized drinking bottle for small-medium enterprises (SME). In this project, design and fabricated of the bottle used the CAD software and the manufacturing machines in our facilities. There are some methods that used to complete this project where it involves the research about the bottle design, study about the mechanism and structure of blow mold and the materials will be used and also this project used the Reverse Engineering technology to the existed mold in our facilities. Based on the existed mold, a new design bottle used CAD software based on the customer need are made and produce a prototype used the Rapid Prototyping to give customer or company to make a valuation. If there are no problems, the mold design and the mold prototype used the Rapid Prototyping are made. As conclusion, this project is used the machines in our facilities and the CAD software that provide in our facilities.

### 1.1 Background

Drinking bottle production is not something new in the manufacturing industry. It involves the design process and making a mold using Rapid Prototyping machines and makes the prototype. In this project, the process is to design and develop a custom drinking bottle for SME's. SME is a Small and Medium Enterprises that provides the businessman or people to start the business in small or medium enterprises. Material used for the drinking bottle is plastics such as HDPE, PET, LDPE, PP, and PS. Besides that, the design of the bottle nowadays too many and have their own identity. Some of the company use the RP machine to make the prototype to know the customer needs and some just use 3D CAD data to show to the customer. The type of mold is used in bottle production is blow molding. The blow mold is a process used to produce hollow objects from thermoplastic. The basic blow

moulding process has two fundamental phases. First, a parison (or a preform) of hot plastic resin in a tubular shape is created. Second, compressed air is used to expand the hot preform and press it against mould cavities. The pressure is held until the plastic cools. The material that suitable for this mold is aluminium, and alloys. But the aluminium is preferred to use because the durability and can conduct heat.

## **1.2 Scope of Project**

In this project, the existed bottle and mold was used as a reference and make a new design of drinking bottle. By using reverse engineering process, a new design using CAD was created based on the existing bottle. The CAD data can also be used to make prototype using RP machine by converted the file to STL file. Then, the CAD software is use to make the mold of the bottle and the file was converted to the STL file where it was been used to the RP machine for make the prototype. The product from RP machine will produce same as actual product.

## **1.3 Problem Statement**

Based on the project, the problem statements are:

1. The researched company do not have the appropriate design tools to make the bottle design.
2. The researched company do not have their own bottle design and they need to buy the bottle from another company.

## **1.4 Objective of Project**

The objectives of this project are:

1. To reverse engineering to the existing bottle and mold, then make a new design of the bottle design for SME.
2. To design and develop the prototype of the drinking bottle.
3. To design and develop the prototype of the mold of the drinking bottle.
4. To design and develop prototype of the drinking bottle based on the costumer requirement.

# **CHAPTER 2**

## **LITERATURE REVIEW**

### **2.1 Introduction**

In this chapter, the literature review of this project will be discussed. All the literature review such as the material, the machine, and the method that will be used in this project is described in this chapter. The research about the material, machine and method is been made and there are some important point that show in literature review. The research is making based on the books, article, journal and the internet source to complete the literature review.

### **2.2 Plastic Bottle**

Plastic is material that use in many products around us including plastic bag, car component, hand phone case, furniture etc. Based on the SKS Bottle and Packaging, Inc, Leonardo Da Vinci is a first person that produced a substance that same as plastic where he created a combination of animal glue, vegetables glue, and the organic fibre and dried it. Then, Alexander Parkes introduced the man made plastic in 1862 at the Great International Exhibition in London. At that time the cost raw materials of plastic is expensive. So, it's not been commercialize to the public. After that, Leo Baekland invented a 'Baletite' where it's function to control heat and pressure and combined with his other invention 'Bakelizer', he able to control the reaction of chemical. With this invention, the resin is form where have same molecular as plastic. The invention of the Balelite leads the way for other additions to the world of plastics including rayon, cellophane, nylon, PVC, saran, Teflon, and polyethylene. Before plastic bottle is use, people is used the glass for keep their water or milk. In January 29, 1878, Lester Milk Jar was patented (Bill Lockhart,

2011). At that time, milk is one of the important businesses where everyone drinks milk at earlier morning. So, the company that runs milk business use the glass bottle to deliver to the people. In 1947, the plastic bottle is uses commercially but because of the cost is still expensive, plastic bottle is not popular among the people that time. After the high density polyethylene is introduced in 1953, people start to use the plastic to replaces the glass as container because to their lightweight nature and relatively low production and resistance to breakage compared with glass bottles.



Figure 2.1: First Glass Bottle (Bill Lockhart, 2011)

### 2.2.1 Material Used In Plastic Bottle

Plastic bottle is made using blow molding where plastic pallet from plastic factory is heated and blow by the air from the blow molding machine. The plastics pallet will follow shape of the mold after the blow and the plastic bottle is produced follow the shape of the mold. There are several material is used in plastic bottle production. Based on the American Chemical Council and *ebottle.com*, the materials are:

- i. **Polyethylene Terephthalate (PET, PETE)** - PET is tough, clear surface and has good gas and moisture barrier properties. Excellent barrier to oxygen, water, and carbon dioxide. High impact capability and shatter resistance. Excellent resistance to most solvents. Capability for hot- filling (maximum temperature 160°F). PET provides very good alcohol and essential oil barrier