UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Reverse Engineering of Dogbone Mould Into Another Product

Thesis submitted in accordance with the partial requirement of the
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By

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DECLARATION

I hereby, declare this thesis entitle “Reverse Engineering of Dogbone Mould into Another Product” is the results of my own research except as cited in the reference.

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ABSTRACT

The *reverse engineering* terms is very familiar to re-design the product existed. Most of the product existing nowadays starts from the research in *reverse engineering* study. There are a lot of advantages in this field such as the cost and time can be reduce in product manufacture and also we can integrate the product into a high level usage after a few research been made. *Reverse Engineering* consist a few important factors such as *measuring, re-design, designing a new parts using CAD sofware, analyzing, and CAM (Computer Aided Manufacturing).* In this project, the scope mostly is to *reverse engineering* the current Dogbone Mould by producing another mould of another product which is plastic *keris*. The structure of runner of this plastic *keris* mould has been modified in order to get the optimized results. There are two types of plastic materials that used in this research which is Polypropylene High-Flow and Polypropylene Low-Flow. Analysis has been done and the most optimized parameters for Polypropylene High-Flow is 260°C for Melting Temperature and 20°C for Mold Temperature with the time of injection 2.65 second. As for Polypropylene Low-Flow, the Melting Temperature and Mold Temperature is the same as Polypropylene High-Flow and the injection time is 1.52 second. *CAM* simulation has been made for the plastic *keris* mould and the results for core is achieved only for the cavity there are a minor correction has to be made into a secondary processes.

Keywords: *Reverse Engineering, measuring, re-design, designing a new parts using CAD (Computer Aided Design) software, analyzing, and CAM (Computer Aided Manufacturing)*

DEDICATION

Specially dedicated to; My beloved Father, Syed Hassan Bin Syed Ibrahim and My Mother, Nor Ashikin Binti Shuib who are very concern, understanding, patient and supporting. Thanks for everything. To My Sisters, All My Friends, and My Love Ones, I also would like to say thanks. The Work and Success will never be Achieved *without All of you.*

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Syed Mohd Fadly Bin Syed Hassan

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

CAD	-	Computer Aided design
CAM	-	Computer Aided Manufacturing
FR	-	Feed Rate
RE	-	Reverse Engineering
SS	-	Spindle Speed

CHAPTER 1
INTRODUCTION

1.1 Research Background

Reverse engineering (RE) is a process for capturing the geometry of parts/tools, and to generate a conceptual numerical model that could be utilized by computer-aided engineering (CAE) and computer-aided manufacturing (CAM) systems. (Custodio, 2001).

RE is used in different areas of design and manufacturing. In the automotive industry it is often necessary to change the shape of the prototype during the manufacturing process. The changes have to be then considered in the drawing and in the geometric model of some parts in computer-aided design (CAD) system. It is associated with the measurements of the part surface and its approximation. Reverse engineering of mechanical parts requires extraction of information about an instance of a particular part sufficient to replicate the part using appropriate manufacturing techniques. Computer vision techniques applied to three-dimensional (3D) data acquired using non-contact, three-dimensional position digitizers have the potential for significantly aiding the process. (Thompson and Henderson, 1999).

RE is the process of taking something (a device, an electrical component, a software program, etc.) apart and analyzing its functionality in depth, usually with the intention to construct a new device or program that does the same thing without actually copying anything from the original. RE is commonly done to avoid copyrights on desired functionality and may be used for avoiding patent law, though this is a bit risky: patents apply to the functionality, not a specific implementation of it. (Anonymous, 2007a)

RE is increasingly popular as manufacturers rush to meet the demands of reducing the product development time. A toolmaker can reduce the time needed to manufacture a tool and die by scanning the product or model and export the scanned data in a relevant file format for RP or to a computer numerical control (CNC) to machine the part. There are three basic steps in RE:

- The collection of the raw data of the object, it can be by a measurement machine (CMM) or a 3D scanner.
- Use a RE software to manipulate this raw data and convert it into a usable form.
- Transfer the usable data into 3D application software like CATIA or Solid Works.

The purpose of this research is to used the RE approach by using the Dogbone Mould to produce another product. Using only the system of the Dogbone Mould to produce another product which is *keris* (usually used as a decoration or a letter opener). The Dogbone is a specimen made from plastic which used in the UTM (Universal Testing Machine) to measure the tensile strength of plastic and its behavior. The most important features that need to examine on the Dogbone Mould is the location and diameters of every Guide Pins and Ejector Pins in it. A mould has several different types of plates which consists sprue and the runner of the mould. The main part is the core and the cavity of the mould. These two parts are the only parts that need to be re-designed in order to produce another product.

The research of this study involved the application of reverse engineering in producing plastic *keris* mould for plastic injection molding. The main focus of this study is the methodology and the application of reverse engineering in a real situation of product development. The process will follow normal reverse engineering steps and procedure and also will look on ways to produce a new product by taking an existing part as a reference. In this study, the main property to be identified is a design process on how to produce the plastic *keris*. By taking the product properties it will then identify the manufacturing process involved in plastic injection mold making. Therefore, the reverse engineering application is find out how to produce the plastic *keris* by redesign the core and the cavity of the Dogbone Mould.

1.2 Importance and Benefits of Research

Most of the organization facilities are theoretically claimed to have the facilities to follow in the development of mold making. Reverse engineering are known as an important element in product development. By combining reverse engineering and mold making techniques the facilities can be utilize and tested on its capabilities of producing mold by applying a combination of CAD capabilities, measurements tools and other resources possible.

The purpose of this study is to develop and redesign a core and the cavity for a plastic *keris* and to analyze the manufacturing process and its requirement of the product or part being study. Using an existing Dogbone core and cavity as a benchmark to produce another core and cavity for the plastics *keris*. Most of the purpose is to know the reverse engineering application in producing the parts of the mold for injection molding.

The reverse engineering application in some of the industry needs a high cost in term of machining and its equipments. It is also a barrier for the industry to redesign an existing product as their own manufacturing product. The product existed needs a reverse engineering process to find the actual process of design and the manufacturing process implemented on it. Therefore, by taking reverse engineering as a method to get close the manufacturing of the product, the cost of the product can be reduced. For this case the re-designed process is only the core and cavity of the Dogbone Mould. If the process is verified accurate then the mold can be manufactured and they can produce without depending on other organizations to fabricate or to purchase a mold.

Nowadays, with the knowledge in engineering field some of the components and part can be re-engineered to improve and developed their usage in manufacturing process. There are many advantages of using reverse engineering especially for a product of injection molding: (Bradley, 1998).

i) The mold manufacturing and fabrication process can be reveal.

ii) Overcome a problem occur at the old design during the designing process.

iii) Can reduce cost and mold can be fabricate by own after knowing the procedure.

iv) Results from the research can improve the level of productivity plastic process industry.

v) To identify the possibilities of reducing the cost of producing mold fabrication.

vi) To develop the capabilities of mold making fabrication process.

vii) To create opportunity to increase the utilization of CAD software, increasing equipments and machines.

1.3 Objectives of the Research

The objectives of this study are:-

1. To apply the reverse engineering method in a real situation and implementing it by using measurements tools and equipments, CAD and CAM applications.
2. To design a new mould based on the Dogbone Mould criteria.
3. Analyze the new mould to determine the optimum parameters and filling condition.
4. Re-design the mould based on analysis results.
5. Conduct a CAM simulation to determine the machining condition.

1.4 Scopes of the Research

To fulfill the objective goals, there are several equipment will be used during this research. The Dogbone Mould is a 2 piece mould type and it is used in the UTeM's Injection Mould Machine (ARBURG Allrounder 420C). The core and cavity of Dogbone Mould will the measured by using the CMM (Coordinated measuring Machine). CMM is actually a contact measuring machine using probe as a contact device to measure point by point into the product. The collection of raw data of measure of the core and cavity by CMM will be used as a guide to produce another core and cavity for another product.

The raw data of measurement for the core and cavity then will be used in CAD (Computer Aided Design) software to develop 3-D solid modeling for the core and cavity. The software that will be used during this research is SolidWorks and CATIA (**C**omputer **A**ided **T**hree-dimensional **I**nteractive **A**pplication).

After the re-designed of core and cavity has been made, the solid modeling data will be transform into CAM programming (Computer Aided Manufacturing) to manufacture the core and cavity. The CAM programming can be done using the CATIA software. The simulation data will be converted into NC codes using the HAAS parameters.

1.5 Thesis Organization

Chapter 1 - Introduction

The overall review of this research is mentioned in this chapter. The important and benefit, objective and scopes of this research are also describe in this chapter.

Chapter 2 – Literature Review

This chapter describe about the source and the history of the research which had been done by others in reverse engineering field and the methods that had being used by them

Chapter 3 – Methodology

This chapter shows how the process of reverse engineering being applied according to the equipments and methods used

Chapter 4 – The Mould Design Process

This chapter shows the steps procedures starting from the part design until the mould design.