

DEVELOPMENT OF COMPUTER-AIDED MATERIALS AND
MANUFACTURING PROCESS SELECTION SOFTWARE
USING BOOTHROYD-DEWHURST METHODOLOGY

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To my beloved parent, Sulong @ Zakaria B. Sulaiman,
Rukiah Bt. Abdullah. My siblings, Zaidi, Zaiham, Siti Zamilah,
Siti Zaeidah, Siti Zaiton, Mohd Zaharuddin, Siti Zaila, Zaffi, Zahir,
Siti Zahira, Mohd Zaeim, Mohd Fitri. And especially to my wife Haryanti,
my daughters Zulaeiqa Ayume and Zunnur Aizayurie. Thank for all your support.

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ABSTRACT

The interest of this thesis is about the application system developed by selection in engineering materials and manufacturing process using the Boothroyd Dewhurst methodology as a main guidance. The implementation of this application gives opportunity to the designer to improve the best materials by using the best process during the early steps of product design. A prototype application system called CAM-MaPS and the uses of Visual Basic software had implemented the proposed methodology. By selecting the parts on knowing the common materials and process, in which to produce will be compared to the future result by using the CAM-MaPS for optimization.

ABSTRAK

Tujuan menghasilkan tesis ini adalah untuk membangunkan satu sistem aplikasi di dalam melakukan pemilihan bahan kejuruteraan dan juga proses pembuatan yang menggunakan kaedah Boothroyd Dewhurst sebagai rujukan. Pada peringkat awal reka bentuk sesuatu pengeluaran, penggunaan sistem aplikasi ini juga memberikan peluang kepada pereka bentuk untuk meningkatkan lagi penggunaan bahan yang dikira terbaik malahan juga bagi proses pembuatan. Maka terhasilah satu prototaip aplikasi sistem yang menggunakan kaedah Boothroyd Dewhurst dan perisian Visual Basic dan dikenali sebagai CAM-MaPS. Perbandingan keputusan hasil daripada aplikasi sistem akan dibandingkan dengan bahagian produk yang telah dipilih di mana bahan dan juga proses di dalam menghasilkannya adalah diketahui dan perbandingan ini dilakukan bagi mengoptimumkan sistem aplikasi tersebut.

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LIST OF SYMBOLS AND ABBREVIATION

ECM	Electro chemical machining
EDM	Electro discharge machining
Kg	Kilogram
mm	Millimetre
MPa	Mega Pascal
Ø	Diameter
Ti-O	Titanium Oxide
WEDM	Wire electro discharge machining

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CHAPTER 1

INTRODUCTION

1.1 Project Introduction

In the era of industrial of manufacturing of products or parts, the most important parts is the systematic in earlier selection of engineering materials and manufacturing processes combinations. With the right choice of selection in materials and processes it will increase the profit by reducing the manufacturing cost, time, labor and other involved activities in producing the products. At the same time it will increase the quality and the quantity of the products and parts. By those advantages in right selection of materials and processes during manufacturing activity, an application of a prototype system is developed to select processes and material that can be generated automatically. This application uses programming Visual Basic version 2005 and it is user friendly. The developed application is hope on having graphic user interface (GUI) which can intriguing user to use it. It's also should be designed with low rate entry data from user and on the other hand user could selects any appropriate prepared data from the application. Adopted time for processing data by using this application is expected speedier by using manual method which made by one design engineer or whosoever which included in

selection of materials and processes. Symbols or icons also will be asserting in this application to facilitate user to choose according desirable suitability parts.

1.2 Project Objective

The objective of this project is to develop a prototype software system for selection of material and manufacturing processes based on Boothroyd-Dewhurst DfM methodology. By using this application it will help user to do selection in materials and manufacturing processes in a short time. The data or parameter key in by the user to be generated by computer to get the result and it is an intelligent method, comparing with the manual method.

1.3 Scope

To accomplish this project, there are some scopes or limitation given by the supervisor. Following are the scopes project proposed:

1. Review on Boothroyd-Dewhurst DfM methodology.
2. Use Microsoft Visual Basic programming language for prototype system development.
3. Develop a prototype software system for selecting the proper material and manufacturing process.
4. Select the mechanical products for case study.
5. The materials selection limit to metal only.

1.4 Problem Statement

There are many process manufacturing resides within industries nowadays. It comprise of conventional, CNC and advance processes. Similarly material resides within markets now, which are found in several kinds. Sometime a designer tends to conceive parts in terms of processes and materials which they are most familiar and exclude those which proved more economic. Then the opportunities for major manufacturing improvements may be lost through such limited selections of manufacturing processes and associated materials in the early stage of the product design. Figure 1.1 and Figure 1.2 show on survey were made on designers in Britain on their knowledge on material and processes occur in industry [1].

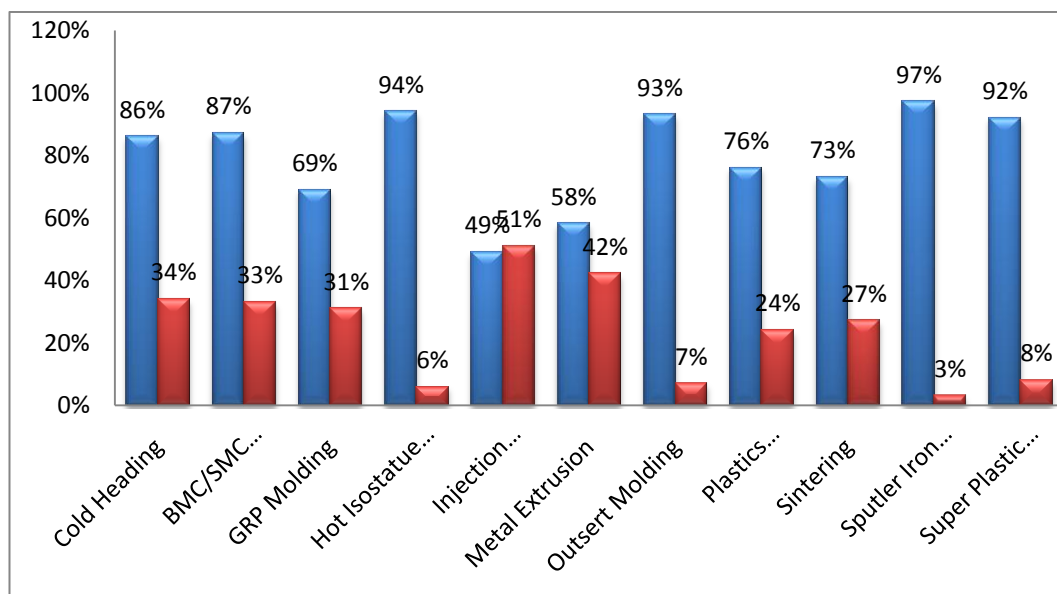


Figure 1.1 Survey of designers' knowledge of manufacturing process: ■, great deal/ fail amount; ■, little or nothing

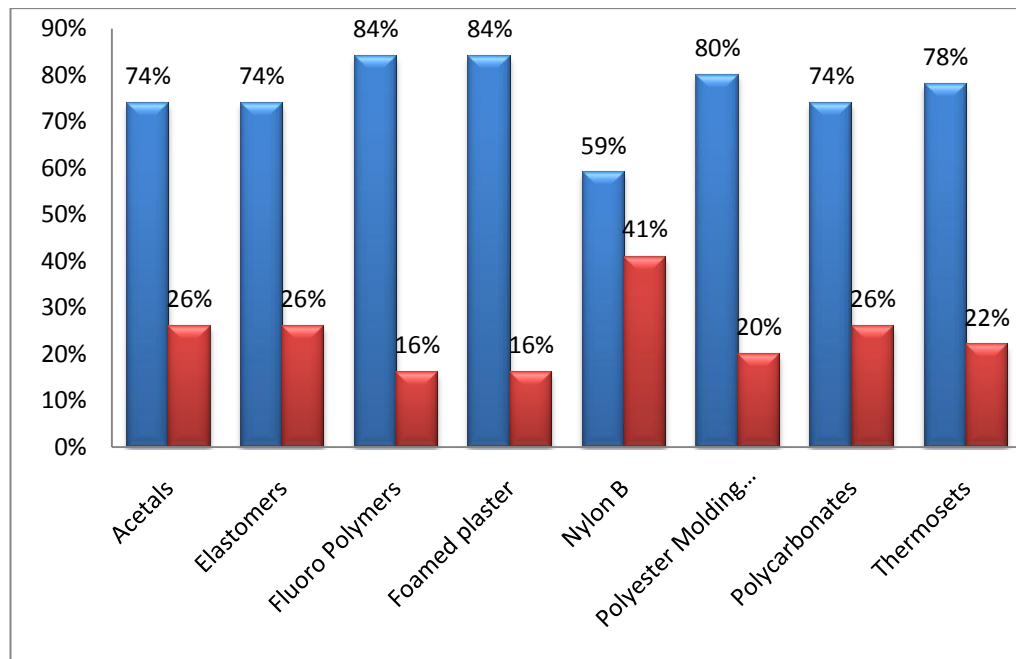


Figure 1.2 Survey of designers' knowledge of polymer materials: ■, great deal/fail amount: ■, little or nothing [1]

By using Boothroyd-Dewhurst DFM methodology it will solve the problem in choosing appropriate material and processes. But nowadays it was done manually by referring the tables and it would be quite time-consuming to choose what kinds of material and processes suitably in producing product or part. Sometimes error also occurs during referring the tables because it has been lots items within one table. Due to this, by developing a prototype software application, it is able to solve problems easily.

1.5 Selected Parts

To ensure the different in result after generated by prototype software, two different types in shape was selected. The first is prismatic part and the second one is

rotational part. The part has been selected to do the selection by using the Boothroyd Dewhurst methodology by states all the parameter of the part such as shape attributes, material properties, production factor, dimension and image of parts. After that the parameters will be key in into the prototype software application system. For the selected prismatic part, it was a handle of gun stapler. Figure 1.3 shows the actual view of the part. In actual situation, this handle made from steel where it requires strong and rustless. The main function of handle is to acting as a medium to transfer forces from hand gripping to active the knuckle system of gun stapler. Finally, the selection of material and manufacturing process of this part will do it by using the Boothroyd Dewhurst methodology.



Figure 1.3 The handle of stapler gun

For the second part with rotational shape, was a selected part which is gear. Figure 1.4 shows the actual gear to do the analysis by using Boothroyd Dewhurst methodology. The main function of this gear is to acting as medium of power transmission to ensure some system is functioning. The power sources might come from motor, human forces or nature energy like water or wind. The requirement of material properties is in high strength; resist to high temperature and other factor will be discussed in more detail in chapter 6.

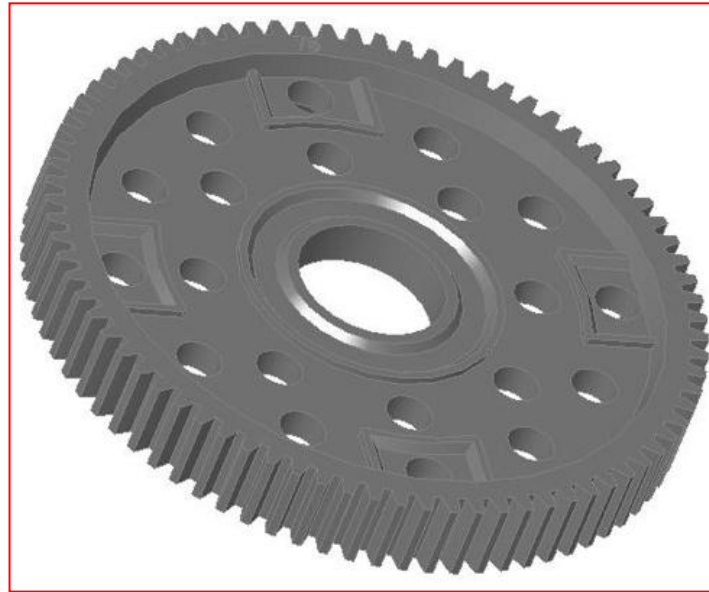


Figure 1.4 The selected gear for case study

1.6 Thesis Structure

Chapter 1 explains more on introduction, objective, scope, problem statement and the selected material as a case study. Chapter 2 is more focused on the literature view to complete this project. This chapter explains more on manufacturing processes, metal materials and the previous studies of related with this field. In chapter 3, the selection material and processes by using Boothroyd-Dewhurst DFM methodology was explained. Steps of selection and related factors were described. The related factors which will discuss in this chapter is more on shape attributes, material properties and production factors. The related software as a tool develop this system will be explained in detail in chapter 4. In this case the use of software is Visual Basic version 2005. In chapter 5, the topic discusses more on about the Structure of Prototype Software. The figure of guide user interface (GUI) has been shown to give more understanding for the reader. Verification of prototype software will be done in chapter 6 by using prismatic and rotational parts. The results generated by software will be discussed in chapter 7. In chapter 8, all progress and

suggestions will conclude and the chapter of sources on the materials studies will be listed at references.

1.7 Summary

The main purpose of this research carried out in developed a prototype system was to facilitated user in making selection of manufacturing processes and metal material. There were elected a few scopes and will be focused on the directions to determine the results. Most important is how to used Boothroyd and Dewhurst's method which will be core in production software application later. To ensure the result by using developed prototype software is right, comparison will be made by using selected parts which are material and process are already know.