
# A COMPARATIVE ANALYSIS OF FUSED DEPOSITION MODELLING MACHINE PERFORMANCE

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**Faculty of Mechanical and Manufacturing Engineering Technology**

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**Cheong Yew Ching**

**A thesis submitted**
**in fulfillment of the requirements for the degree of**
**Bachelor of Mechanical Manufacturing Engineering Technology (Product Design)**
**with Honours**



**Faculty of Mechanical and Manufacturing Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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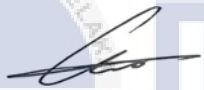
Signature : 

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**DEDICATION**

To my beloved parents, Cheong Fook Choy and Woo Lai Hoe,

To my supervisor, Ts. Dr. Syahrul Azwan Bin Sundi,

To my co-supervisor, Ts. Dr. Hambali Bin Boejang,

To the assistant engineer, Tc. Kamaruddin Bin Abu Bakar,

To the assitant engineer, En Kamaruddin.

## ABSTRACT

The additive manufacturing is one of the technologies that can fabricate or build a part in more efficiency way and at lower costs. The main objective for this project is to repair, upgrade, enhance or modified the BFB 3D Printer by using engineering design (ED) approach. The BFB 3D Touch 3D Printer available in Lab Rapid Protoryping, JTKP, UTeM is currently down for 7 years. The cost to repair the similar type of machine three dimensional printer is high. Therefore, this study is carry out to overcome the challenges. The study is started with formulation by selecting the best design solution. Besides that, the the test model was printed for the analysis of dimensional accuracy and surface finish. The test model is refering from the previous study as a reference. The dimensional accuracy and the surface finish needed to be checked by printing a testing model of the 3D printer comparing to another 3D Printer. The result is not the best and the building time is not the same as actual time because the 3D Printer need more time for heating the nozzle. The BFB 3D Touch Printer is not suitable for doing prototype but suitable for doing studying and demonstration on the studies.

## *ABSTRAK*

*Pembuatan aditif adalah salah satu teknologi yang boleh mengarang atau membina bahagian dengan cara yang lebih cekap dan pada kos yang lebih rendah. Objektif utama projek ini adalah untuk membaiki, menaik taraf, meningkatkan atau mengubah suai Pencetak 3D BFB dengan menggunakan pendekatan reka bentuk kejuruteraan (ED). Pencetak 3D Sentuhan BFB 3D yang tersedia di Lab Rapid Protoryping, JTKP, UTeM kini tidak berfungsi selama 7 tahun. Kos untuk membaiki jenis mesin pencetak tiga dimensi yang serupa adalah tinggi. Oleh itu, kajian ini dijalankan untuk mengatasi cabaran tersebut. Kajian dimulakan dengan perumusan dengan memilih penyelesaian reka bentuk yang terbaik. Selain itu, model ujian telah dicetak untuk analisis ketepatan dimensi dan kemasan permukaan. Model ujian merujuk daripada kajian lepas sebagai rujukan. Ketepatan dimensi dan kemasan permukaan perlu diperiksa dengan mencetak model ujian pencetak 3D berbanding dengan Pencetak 3D yang lain. Hasilnya tidak terbaik dan masa pembinaan tidak sama dengan masa sebenar kerana Pencetak 3D memerlukan lebih masa untuk memanaskan muncung. Pencetak Sentuhan 3D BFB tidak sesuai untuk membuat prototaip tetapi sesuai untuk melakukan kajian dan demonstrasi terhadap kajian.*

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| | | |
|---|---|---|
| D,d | - | Diameter |
| mm | - | Milimeter |
| cm | - | Centimeter |
| ° | - | Degree |
| RP | - | Rapid Prototyping |
| AM | - | Additive Manufacturing |
| 3D | - | Three-dimensional |
| 2D | - | Two-dimensional |
| CAD | - | Computer-Aided Design |
| FDM | - | Fused Deposition Modelling |
| JTKP | - | Jabatan Teknologi Kejuruteraan Pembuatan |
| ASCII | - | American Standard Code For Information Intercharge |
| ISO | - | International Organization For Standardization |
| UV | - | Ultraviolet |
| STL | - | Standard Triangle Language |
| CAM | - | Computer-Aided Manufacturing |
| STEP | - | Standard For The Exchange Of Product Model Data |
| DDM | - | Direct Digital Manufacturing |
| PLA | - | Polylactic Acid Or Polylactide |
| SLA | - | Stereolitography |
| SLM | - | Selection Laser Melting |
| SLS | - | Selection Laser Sintering |
| LOM | - | Lamianted Object Manufacturing |
| FFF | - | Fused Filament Fabrication |
| ALM | - | Additive Layer Manufacturing |
| ED | - | Engineering Design |
| PLA | - | Polylactic Acid |
| ABS | - | Acrylonitrile Butadiene Styrene |
| SFF | - | Solid Freedom Fabrication |

## LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

This chapter clearly explains about the introduction of the topic. The background explains about the additive manufacturing (AM) and the problem statement is the problem of the 3D Printer that face. Therefore, the objective has been to solve the problem statement. The scope of research is carried out to overcome the objective.

## 1.2 Background

Additive manufacturing (AM) is the industrial production name for 3D printing, a computer-controlled process that creates three dimensional objects by depositing materials in layers. Additive manufacturing (AM) differs from traditional manufacturing technologies. Rapid prototyping is the technique of fabricating a prototype model from a CAD file. In other words, additive manufacturing is the process, and rapid prototyping is the end result. The development of the technology of rapid prototyping (RP) which uses 3D printing technology makes the design or the product development process become faster. RP functions not only looking the prototype of the product but also looking for the dimensional of the product is fit to a part and how to approved the part. RP is a technique that can be used to create a data computer aided design (CAD) into 3D objects with additive manufacturing or 3D printing technology. There are many types of RP technologies, such as Stereolithography (SLA),

Fused Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS), and others. Figure 1.1 shows the work of additive manufacturing.

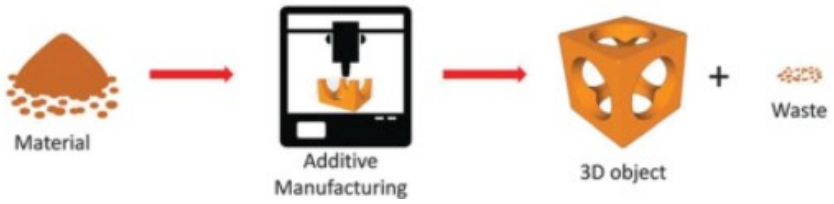


Figure 1.1**:** The work of additive manufacturing (anonymous, 2022)

## 1.3 Problem Statement

BFB 3D Touch Printer is a historical printer and it has some problems appear in the machine. There is one Fused Deposition Modelling (FDM) machine in Rapid Prototyping Laboratory, Jabatan Teknologi Kejuruteraan Pembuatan (JTKP), Fakulti Teknologi Kejuruteraan Machanical Pembuatan (FTKMP), UTeM. This machine is not functioning specifically the motion of the platform in z direction is jam and the temperature cannot be heated and its temperature cannot be read. As such, the cost for service is expensive and very difficult to find the spare parts for enhance the 3D printer. The service fee is around RM2000 until RM3000. Therefore, this study is carried out to overcome the challenge in order to reduce the cost for avoiding the purchasing a new machine. For the performance of the 3D printer, the dimensional accuracy and surface finish need to carry out for doing the analysis.

## 1.4 Research Objective

The objective that needs to be achieved in this case study are:

- To repair, upgrade, enhance or modified the BFB 3D Touch Printer by using the engineering design approach.

- To analyze the dimensional accuracy and surface finish of printed test model.

## 1.5 Scope of Research

The main scope of this research are as follows:

1. To understand the concept and process of BFB 3D Touch Printer

2. To apply engineering design (ED) process to solve the problem of the BFB 3D Touch Printer.



3. To design the supporter nozzle of the BFB 3D Touch Printer

4. To solve the problem of the z-axis of the BFB 3D Touch Printer

5. To fabricate a test model.

6. To analyze the dimensional accuracy and surface finish.