

**UNIVERSITI TEKNOLOGI MARA**

**INVESTIGATION OF PRODUCT QUALITY  
USING VIRTUAL MANUFACTURING ON  
FORGING, PUNCHING-STAMPING AND  
WELDING**

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Thesis submitted in fulfilment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Mechanical Engineering**

November 2016

## ABSTRACT

In this master dissertation, selected manufacturing process are to be investigated with the aid of FEM/FVM simulation and the quality of the products are further analysed based on actual results. This research consist of case studies which are bulk forming, sheet metal and welding process. The first case study is divided into three (3) focuses namely: product quality analysis of water meter housing made of zinc-copper-alloy, die stress analysis for piston manufacturing and process analysis of multistage hot forging process. The parameters for simulation study were obtained from manufacturing companies. In the second case study, sheet metal forming process punching and stamping is to be investigated in term of spring back behaviour. The material of sheet metal is aluminium and mild steel. The third case study focuses on the investigation of weld induced distortion which was affected by clamping release time. GMAW welding process are simulated on a T-joint double fillet weld with mild steel as parent material. The experiments were carried out using universal forming machine and fully automatic GMAW in laboratory conditions for second and third case study respectively. The simulation result are further compared with the experimental results and it shows good agreement. Besides, simulation can provide detailed information necessary for process and design. It can be also concluded that FEM/FVM simulation technique can be applied to replace the current practice of trial and error method within research & development (R&D) stage.

## ACKNOWLEDGEMENT

Firstly I would to express my thanks to my family for their support for me to carry out this research for my master. I would also like to thank Assoc. Prof. Dr. –Ing. Yupiter HP Manurung who has given me the opportunity to carry out this research under his guidance and supervision. I would like to thank all of the industry personnel for their guidance in this research.

Furthermore, I would like to thank Johannes Assenmacher, Mark Trautvetter and Nils Bunder from Germany, Azizul Azfar AB. Azid, Adam Ridhuan Abdullah, Zulhelmi Ismet, Ammar Yasser, Norzaidi Zainal, Fareez Razak, Mohd Idzham Ibrahim and Nik Zetti Amani from UiTM, undergraduate students that have assisted in my researches. I would also like to thank all of UiTM laboratories technician’s particularly from FKM Mr. Helmi Omar, Mr. Azerif Md Ali, Mr. Harysham Zainal, Rahimi Abd Rahman and Mr. Tarmizi from FKA.

Last but not least, I would like thank my fellow postgraduate’s particularly Mr. Dendi Ishak, Mr. Robert Ngendang, Mr. Ridzwan Abd Rahim, Dr. Norasiah Muhammad, Mr. Shahar Sulaiman, Mr. Ridhwan Redza, Ms. Syahadah Yusoff, Mr. Ackiel Mohamed and Mr. Khairulnizam Kasim for their contributions in this research.

Finally, this thesis is dedicated to my lovely mother and special thanks to my sister Azllinda, brother Azllan and sister-in-law Marlissa for their support and believe in me. Alhamdulillah.

In the loving memory of Hj. Zainul Abidin bin Hussain (1951-2014),

*“I swear by the time, Most men surely is in loss, Except those who believed and do good, and enjoin on each other truth, and enjoin on each other patience.”* Al-Asr, Al-Quran (103).

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# **CHAPTER ONE**

## **INTRODUCTION**

This chapter provide general insight on the entire content of master dissertation. The background of this study is briefly presented and problem statement illustrates current challenges normally faced in the view of actual manufacturing process and simulation environment. The Objective and scope of the study will discuss the main purpose of this investigation and limitations throughout experiment and simulation. Finally, the significance of this this study and its implementation in real world are further discussed to ensure the applicability of this master dissertation.

### **1.1 BACKGROUND OF STUDY**

Manufacturing by definition means a process of producing goods for use or sales. It is a process of adding value to the raw material by transforming the goods into finished products at either small or large scale. In manufacturing of metal product there are several processes used prior to quality and quantity. Forging are one of the oldest metal processing technique from a billet. For sheet metal processing, punching and stamping are the most common process. In joining metal, welding are the process that offer most homogeneous joints [1].

Forging is one of the manufacturing processes widely used in producing discreet product. It is a process characterized by plastic deformation of a material through applied force induced by a set or more dies to form the desired shape [1,2]. The product that are produce has superior mechanical properties compared to casting and machining process. However, defects such as folds and laps, underfill will distort the quality of the forging parts [3]. These defects are caused by improper die design or process parameters [4].

A piece of metal within zero to six millimetres (mm) is considered as sheet metal. It is widely used in mechanical, electronic and civil industries. Punching and stamping are common processes involving sheet metal manufacturing [5]. Punching is a process of creating holes while stamping is process of contouring the sheet metal [1]. Both punching and stamping are forming process characterized by applying force trough