

DEVELOPMENT OF CONCEPTUAL JIGS FOR  
PACKAGING TIE PLATE USING TRIZ APPROACH

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
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**DEVELOPMENT OF CONCEPTUAL JIGS FOR PACKAGING  
TIE PLATE USING TRIZ APPROACH**

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

by

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This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

## **ABSTRAK**

Projek ini adalah berkaitan dengan pembangunan konsep reka bentuk jig untuk pembungkusan tie plate menggunakan Teori Penyelesaian Masalah Inventif (TRIZ). Objektif projek ini adalah untuk mengenal pasti prinsip-prinsip reka bentuk dengan menggunakan 40 Prinsip Inventif TRIZ dalam pembangunan konsep jig bagi pembungkusan tie plate, untuk melaksanakan rekabentuk produk dan pembangunan pemilihan konsep untuk memilih rekabentuk yang sesuai konsep jig bagi pembungkusan tie plate dan untuk mereka bentuk dalam 3D dan menganalisis konsep jig yang dipilih untuk pembungkusan tie plate daripada dua bahan yang berbeza iaitu akrilonitril butadiena stirena (ABS) dan Keluli Karbon Rendah (AISI 1020) untuk pembungkusan tie plate dengan menggunakan SolisWorks 2013. TRIZ digunakan untuk menyelesaikan masalah dan mendapatkan rekabentuk nombor prinsip dengan menggunakan 39 parameter kejuruteraan, 40 prinsip berdaya cipta dan percanggahan jadual matriks. Selepas itu konsep lakaran digunakan untuk menjana idea untuk rekabentuk jig. Pemilihan konsep dijalankan untuk mengenal pasti konsep rekabentuk yang paling sesuai boleh dipilih sebagai konsep akhir. Dengan menggunakan perisian reka bentuk SolidWorks 2013, konsep akhir dilukis dalam bentuk tiga dimensi (3D) dan analisis ini dijalankan untuk membuat perbandingan antara dua jenis bahan ABS dan AISI 1020. Keputusan analisis menunjukkan ABS adalah bahan yang sesuai digunakan dalam pembuatan jig untuk pembungkusan tie plate. Bagi tujuan penambahbaikan dalam projek ini, perisian yang disyorkan untuk analisis adalah CATIA dan ANSYS, ini adalah kerana kedua-dua perisian ini adalah lebih banyak fungsi untuk membuat analisis berbanding dengan SolidWorks. Cadangan kedua ialah menggunakan Selective Laser Sintering (SLS) proses untuk membina prototaip. Ini kerana SLS adalah salah satu AM mesin yang terbaik untuk menghasilkan prototaip dengan beberapa manfaat seperti ciri-ciri mekanikal yang lebih baik dan permukaan yang baik.

## **ABSTRACT**

This project is related to the development of design concepts jig for packaging tie plate using the Theory of Inventive Problem Solving (TRIZ). The objective of this project is to identify the design principles of 40 Inventive Principles of TRIZ in development of conceptual jig for the packaging tie plate, to implement product design and development of concept selection to select the suitable design of conceptual jigs for the packaging tie plate and to design in 3D and analyse the selected conceptual jig for the packaging tie plate from two different material acrylonitrile butadiene styrene (ABS) and Low Carbon Steel (AISI 1020) for packaging tie plate by using SolidWorks 2013. TRIZ is used to solve problems and get the number of principle design by using 39 engineering parameters, 40 inventive principles and contradiction matrix table. After that concept sketching is used to generate the idea for design jig. Concept selection is carried out to identify the most appropriate design concept can be selected as the final concept. By using design software of SolidWorks 2013, the final concept is drawn in the form of three - dimensional (3D) and the analysis is conducted to make a comparison between two types of ABS and AISI 1020. The results of the analysis show that the ABS is an ideal material used in the manufacture of jigs for the packaging tie plate. For the purpose of improvement in the project, the recommended software for analysis is CATIA and ANSYS, this is because both of this software is more applicable and function to compare with SolidWorks. The second recommendation is using Selective Laser Sintering (SLS) process to build the function prototype. This is because SLS is one of the best AM machine to produce prototype with several benefits in it such as better mechanical property and surface roughness.

## **DEDICATION**

Especially to my beloved parents and whole my family thank you very much to give me fully support, and also for my respective Lecture and my Supervisor, thank you so much for teaching and guided me. Last for my friends, I appreciate for your support. And all people participate also thank you very much.



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## **LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE**

3D	-	3 Dimensional
ABS	-	Acrylonitrile butadiene styrene
AM	-	Additive Manufacturing
AISI 1020	-	Low Carbon Steel
BS	-	Brainstorming
FKP	-	Fakulti Kejuruteraan Pembuatan
FOS	-	Factor of Safety
m	-	Metre
mm	-	Millimetre
PDD	-	Product Design and Development
SLS	-	Selective Laser Sintering
SPCC	-	Steel Plate Cold-Rolled Carbon
SD	-	Standard
Sec	-	Second
TRIZ	-	Theory of Inventive Problem Solving
&	-	And
USSR	-	Union of Soviet Socialist Republics

# **CHAPTER 1**

## **INTRODUCTION**

This chapter provides the background of the project. The projects focus on the development of the conceptual jig of the packaging tie plate using Theory of Inventive Problem Solving (TRIZ) approach. This chapter also describes the problem statement, followed by the objective, and scopes of the project.

### **1.1 Background**

Nowadays, technology grows rapidly. Manufacturing sector, particularly affected by this situation to support production to meet higher consumer demand. In the product development process, engineers as an important role in finding new ideas, in order to solve the problems faced by the workers. Mass production is intended to increase productivity in order to reduce the unit cost of the product. Therefore, to achieve goals those require tools to support the production and fulfil the market demand.

In manufacturing works, a jig is a type of custom made tool used to locate and guide the workpiece. The purpose of a jig is to provide repeatability, accuracy, and interchangeability in the manufacturing of products (Henriksen and Erik Karl, 1973). The use of jigs and fixtures is similar and related that the terms are sometimes confused or used interchangeably. The difference is in the way the tool is guided to the work piece.

A jig is a special device that holds, supports, or is placed on a part to be machined. The jig is not only locates and holds the workpiece but also guides the cutting tool

while the operation is performed. Jigs are usually equipped with hardened steel bushings for guiding drills or other cutting tools (Hoff man, 2011). A fixture is used for locates, holds, and supports the work securely so the required machining. Another tool such as set blocks and feeler or thickness gauges are need used with fixtures as reference the cutter to the workpiece (Hoff man, 2011).

There are many types of jigs, every type is custom made to do a specific job. Many jigs are created because there is a necessity to do so by the tradesmen. Some are made to increase productivity through consistency, to do repetitive activities or to do a job more precisely (Hoff man, 2011).

Tie plate is one of the automotive parts that are placed in CamPro engine for proton cars. Tie plate is a product resulting from the stamping process. The function of tie plate is to divide the piston holes found in a car engine before casting process. Means the tie plate will be part of the engine block after casting process is done. Because the engine is an important and requires high accuracy, so the quality of flatness of tie plate is very important and emphasized during the manufacturing process.

The theory of inventive problem solving (TRIZ), is a theory that uses a systematic method that can generate innovation and creative problem solving (Altshuller et al., 2002). Among the industries that use TRIZ to produce competitive products are Samsung, Motorola, Intel, LG, Motorola, Christian Dior, Whirlpool, Delphi Automotive, Boeing and Procter & Gamble (Hamm, 2008). TRIZ consists of several methods that help in bringing the idea to design, including physical conflict, contradiction matrix and curve-S (Mann, 2007).

Thus, this study discussed about the application of TRIZ as problem solving and generates the ideas to develop a conceptual design jig for the packaging tie plate. Product design and development (PDD) of concept selection is used to define the best of conceptual jig. As a result, Solid Work 2013 software is used to analysis the selected conceptual jig.

## **1.2 Problem Statement**

The problem examined in this study is related to productivity problems in the product packaging for tie plate. Tie Plate is a product resulting from the stamping process. Tie plate is one of the automotive parts located inside the CamPro engine for PROTON cars. Due to the increasing demand for the car, then automatically the demand for tie plate also increases, and this condition has created a problem for the production of tie plates. This is because the production process is still using the traditional method by manually in the production and packaging process. Because of that, the manual method is no longer relevant to use. The manual packaging processes totally using the human power as a source and this takes a long time for the production process to produce a product. So, to increase productivity and to meet consumer demand, new methods or concepts must be developed to replace the traditional manual method. In addition, it can also reduce the use of manual labour and help to reduce the cost and production time for the tie plate.

## **1.3 Objective**

The objectives of this project are;

- a) To identify the design principles of 40 Inventive Principles of TRIZ in development of conceptual jig for the packaging tie plate.
- b) To implement product design and development of concept selection to select the suitable design of conceptual jigs for the packaging tie plate.
- c) To design in 3D and analyse the selected conceptual jig for the packaging tie plate by using SolidWorks 2013 software.

## **1.4 Scope Of Project**

This project focuses on the design of conceptual jigs for packaging tie plate using TRIZ approach. This project is not described about process selection. The 39 Engineering Parameters, 40 Inventive Principles and Contradiction Matrix Table of TRIZ method are used as problem solving and as guideline to identify the design principle. Product design and development is used for concept selection to select the suitable design concept of jig for the packaging tie plate. As the result, SolidWorks 2013 software is used to design in 3 dimensions (3D) and to analysis between two materials, Acrylonitrile butadiene styrene (ABS) and Low Carbon Steel (AISI 1020) to select the suitable material for making the Jig.