PRODUCT DESIGN IMPROVEMENT THROUGH DESIGN FOR ASSEMBLY (DfA) AND THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ) METHODOLOGY

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To my beloved family and parents. Thank for all your support.

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ABSTRACT

The goal of this project is to improve product design of consumer product by integrating Boothroyd-Dewhurst Design for Assembly (DfA) methodology with a Russian Theory of Inventive Problem Solving (TRIZ). The outcome of previous research has shown integrating several design tools has improved the reliability and reduce cost of the product.

A consumer product was selected as a case study to evaluate the integration of both design tools. The Boothroyd-Dewhurst Design for Assembly Methodology (DfA) is used as a quantitative improvement tools. The powerful tool can reduce parts number of a product and is expressed in percentage. While, the Russian Theory of Inventive Problem Solving (TRIZ) is used to improve the design qualitatively.

The results show that the integration of these tools can be a very powerful design tool for product design engineers in reducing cost by eliminating unnecessary parts while improving the ease of user handling and reliability of the consumer product.

ABSTRAK

Matlamat projek ini adalah untuk meningkatkan reka bentuk produk pengguna dengan mengintegrasikan metodologi *Boothroyd-Dewhurst Design for Assembly* (DfA) dengan *Theory of Inventive Problem Solving* (TRIZ). Hasil penyelidikan sebelumnya telah menunjukkan integrasi beberapa alat reka bentuk telah meningkatkan kebolehpercayaan dan mengurangkan kos produk.

Satu produk pengguna telah dipilih sebagai kajian kes untuk menilai integrasi kedua-dua alat reka bentuk. Metodologi *Boothroyd-Dewhurst Design for Assembly* (DfA) digunakan sebagai alat penambahbaikan kuantitatif. Ia boleh mengurangkan bilangan bahagian produk dan dinyatakan dalam bentuk peratusan. Sementara itu, metodologi *Theory of Inventive Problem Solving* (TRIZ) digunakan untuk meningkatkan reka bentuk kualitatif.

Keputusan menunjukkan bahawa integrasi metodologi ini boleh menjadi satu alat reka bentuk yang sangat berguna untuk jurutera reka bentuk produk dalam mengurangkan kos dengan menghapuskan bahagian-bahagian yang tidak perlu serta meningkatkan dan memudahkan pengendalian pengguna dan kebolehpercayaan produk pengguna.

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LIST OF ABBREVIATIONS

DFMA	-	Design for Manufacture and Assembly
TRIZ	-	Theory Inventive Problem Solving
D.E	-	Design efficiency
TM	-	Total manual assembly time
CM	-	Total cost of manual assembly
NM	-	Theoretical minimum number of parts
No.	-	Number

CHAPTER 1

INTRODUCTION

1.1 Introduction to the problem

The significant demands made on engineers to reduce assembly time, improve performance and reliability at a reduced cost requires the ability to improve the design of the existing product. It necessitates the improvement of the existing design to reduce the number of parts and ease of user handling. In addition, the improved design needs to be performing the same function or more with ease of assembly, reduce in cost and ease of handling. Some of the method that can be used to get this opportunity is by using DFMA and TRIZ.

DFMA and TRIZ share similar ‘best practice’ that allows systematic transfer to other generically similar situations. In DFMA, this knowledge of process has focused on manufacturing industry and the ‘best practices’ identified after intensive periods of assessing and analyzing what defines an efficient manufacture or assembly operation over one that is less efficient. The method presents this knowledge in terms of quantified metrics that enable a user to assess how long will series of given tasks will take, rules that enable the user to improve the system, and then quantify the level of that improvement.

In TRIZ, the knowledge base from which best practice has been extracted and comprises a substantial proportion of the world’s most successful patents, taken from all fields of engineering endeavour. The main focus of TRIZ has been the creation of a systematic innovation capability.

1.2 Objective of the project

The objective of this project is to improve product design through Design for Manufacture and Assembly (DFMA) methodology and Theory of Inventive Problem Solving (TRIZ) approach.

1.3 Scope of the project

Scopes of this project are limited to:

i. Conduct patent search of related invention.
ii. Integration for improvement on mechanical part of a selected consumer product (fruit juicer extractor).
iii. Application of Boothroyd-Dewhurst Design for Assembly (DfA) methodology.
iv. Integrate the quantitative improvement by Boothroyd-Dewhurst DfA to qualitative improvement by Theory of Inventive Problem Solving (TRIZ).

1.4 Methodology of study

The methodology of study begins with literature review on both design tools DFMA and TRIZ. The scrutinized on the combination of these two tools on previous researches are also conducted to see the effectiveness of design improvement.

1.5 Significant of study

The research will be carried out within two semesters. Semester 1 (Master Project I – MP I) will focus on defining a problem statement, collecting and reading literature review on DfA and TRIZ, identify the product to study, and apply DfA method such as evaluate both original and improvement design part of the product.

Semester II (Master Project II – MP II) will focus on design evaluation, and design improvement using TRIZ method and also integration of DfA and TRIZ. The flow of this master project activity is shown in Figure 1.1.

The research finding shall be indispensable of improving the existing product design in terms of cost, minimize parts numbers and ease of handling. The capability of Boothroyd-Dewhurst DFMA methodology should help product design engineer to increase product design efficiency. Additional Theory Inventive Problem Solving (TRIZ) strategies should usefully deploy to qualitatively enhance Boothroyd Dewhurst DFMA capability.

With the application of DFMA and TRIZ methodology this research will benefits design engineering as a guide on how to apply this two powerful design tools for a more reliable and better functional products at a lower cost. This will indirectly benefit the consumer and the environments.

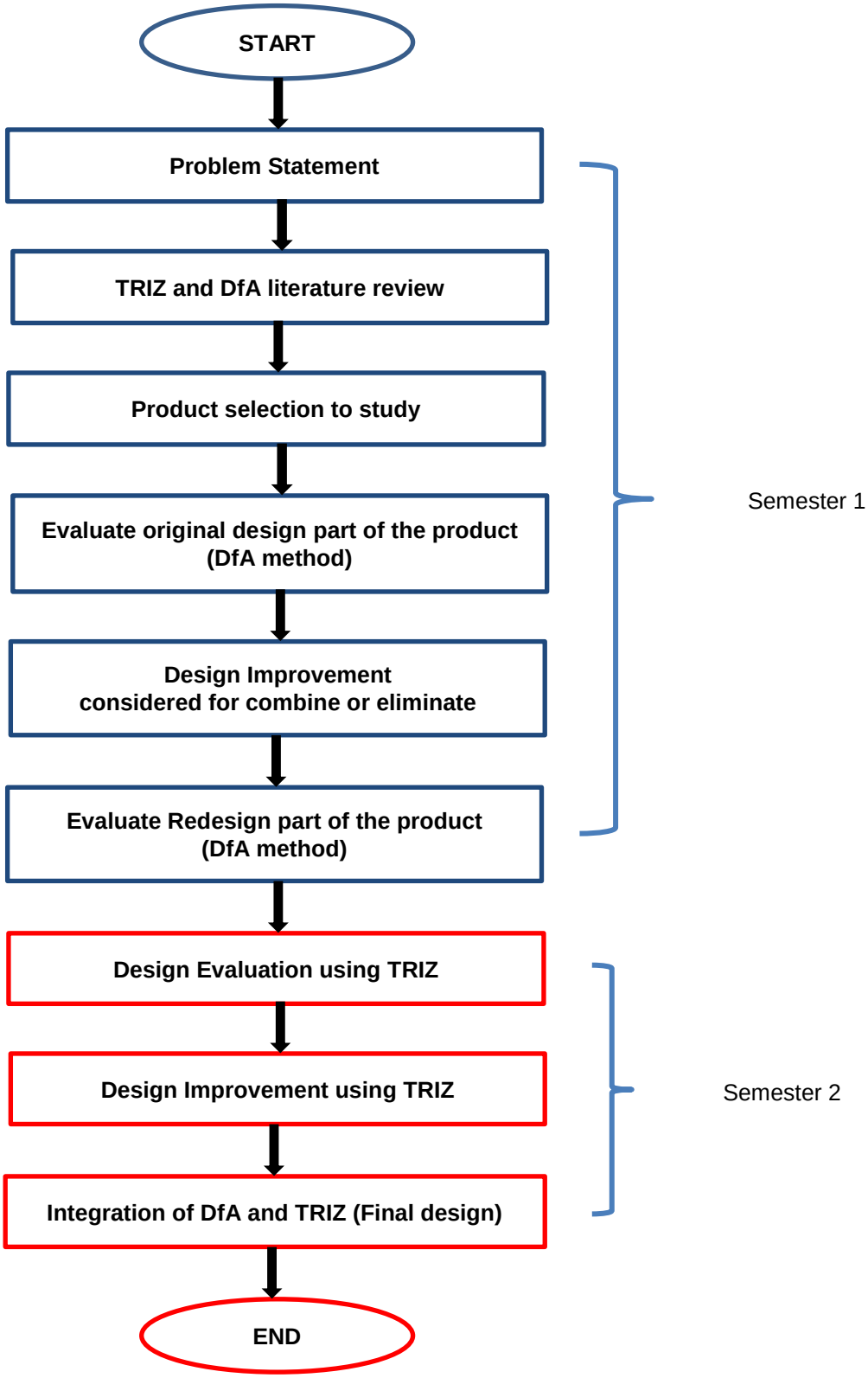

Figure 1.1: Flow chart of the project activities for MP 1 and MP 2.

1.6 Research planning schedule

This thesis consists of eight chapters. Chapter 1 presents the introduction of the thesis, Product Design Improvement through DfA and TRIZ methodology where the topic include are objective, scopes, methodology of study and significant of study of the project. The literature reviews in Chapter 2 reports on relevant previous findings that are related to the research and also the review of the related discusses topics. The detail information on the research methods and tools that will be used in the case study is explained in Chapter 3. For the Chapter 4, the data information of the product case study will be explained in details. Chapter 4 also consists of the original data analysis of the product case study using the DfA methodology. In Chapter 5, the TRIZ Methodology is applied and the proposed improvement of the original data case study is discussed. In Chapter 6, it covers both of the selected design problems solving tools and analysis of the new improvement of the product case study. The discussion of the case study result is in Chapter 7, while the conclusion of the case study is concluded in Chapter 8.

The time management of all activities for the MP, Product Design Improvement through DfA and TRIZ methodology projects shown in Gantt chart MP I (Appendix A) and Gantt chart MP II (Appendix B).

1.7 Patent search

Appendix C will show several patent search related with the product case study. Most of the inventors focus on system that operates the juicer and also the feature.

1.8 Summary

Through this thesis, the objective of the project is hopefully achieved as expected which is contained the important result such as success to improve design of the product case study by applying the selected methods and also develop a product that have maximize value, convenience, suitable and easy to use by the consumer. On the other hand, this chapter is providing information about the aim for the rest of the chapter.

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