ABSTRACT

Theory of Inventive Problem Solving (TRIZ) is one of the Value Engineering (VE) systematic tools to improve the value of products by examination of function, by which designer can systematically solve problems and enhance decision-making. Design for Manufacture and Assembly (DFMA) is an approach to improve product performance and to simplify product. This project report describes work to integrate DFMA and TRIZ to improve and value added the current design of consumer product. The used of TRIZ concept will eliminate the contradiction problem that occurred during the process of improvement of the product by applying the principles proposed by TRIZ. TRIZ had simplified 39 standard technical characteristics that cause conflict. These are called the 39 Engineering Parameters. The conflict then can be solved by referring to the 40 Inventive Principles. Results from case studies showed that the integrating of DFMA and TRIZ can improve the product design efficiency value, minimize assembly complexity, reduce the overall assembly time and cost, and reduce the number of part in product improvement compared by just using single tool.

ABSTRAK

Teori Mencipta Penyelesaian Masalah (TRIZ) adalah salah satu peralatan sistematik dalam Kejuruteaan Nilai (VE) untuk meningkatkan nilai sesuatu produk dengan menganalisakan fungsinya, di mana pereka dapat menyelesaikan masalah secara sistematik dan keputusan yang dibuat dapat ditingkatkan. Sementara itu, Rekabentuk untuk Pembuatan dan Pemasangan (DFMA) adalah kaedah untuk meningkatkan keupayaan produk dan memudahkan rekabentuk produk. Dalam laporan ini, kerja untuk meningkatkan keupayaan produk dan penambahan nilai untuk rekabentuk produk pengguna terkini dihuraikan dengan menggunakan kaedah pergabungan di antara (DFMA) dan (TRIZ). Penggunaan konsep (TRIZ) akan menghapuskan percanggahan masalah yang dihadapi semasa proses meningkatkan nilai produk dengan mengaplikasikan prinsip yang dicadangkan oleh (TRIZ). (TRIZ) telah menyimpulkan 39 sifat teknikal yang boleh menyebabkan konflik. Ia dipanggil 39 Parameter Kejuruteraan. Walaubagaimanapun, konflik tersebut dapat diselesaikan dengan merujuk kepada 40 Prinsip Mencipta. Keputusan daripada kajian menunjukkan pergabungan di antara (DFMA) dan (TRIZ) akan meningkatkan nilai kecekapan rekabentuk produk, meminimakan kekompleksan pemasangan, mengurangkan masa dan kos pemasangan, dan mengurangkan bilangan jumlah bahagian dalam pembangunan produk berbanding dengan hanya mengunakan satu peralatan sahaja.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

TRIZ	-	Theory of Inventive Problem Solving
VE	-	Value Engineering
DFMA	-	Design for Manufacture and Assembly
MP 1	-	Master Project 1
MP 2	-	Master Project 2
DFA	-	Design for Assembly
DFM	-	Design for Manufacture
VA	-	Value Analysis
ARIZ	-	Algorithm for Inventive Problem Solving
QFD	-	Quality Function Deployment
FMEA	-	Failure Mode Effect and Analysis
6σ	-	Six Sigma
ID	-	Identification
Q&A	-	Question and Answer
TM	-	Assembly time
CM	-	Assembly cost
NM	-	Theoretical minimum number of part
DE	-	Design efficiency

LIST OF SYMBOLS

α	-	Alpha
β	-	Beta
n	-	Labor cost per second

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction to the Current Product Development Problem

Now a day, product design simplification is important due to the rapid changing of customer demands, more competition and so on. Yet, manufacture is being forced to produce product that meet the customer requirement with high expectation such as product functionality but in lower cost. So, designer needs to design product with maximize value in order to fulfill that requirement. In recent decades the search for significant cost-saving effects that characterize major process innovations has driven manufacturers towards simplifying their products. In fact, when compared to process improvements in the production of complex assembled products, product innovations have a more profound impact on productivity, costs and quality [1].

Basically, there are two sort of problems for any given product design or process which are those where the solution is generally known and those where it is not. If the solution is generally known, it can be found in books, journals, or technical paper. Problems where the solutions are not generally known are called inventive problems and often offer contradiction requirements. Mostly, many people will

choose a compromised solution, where not all of the requirements are met and those that are met, are not optimized in order to resolve contradictory requirements or conflict [2]. In this case, there are several ways to solve the problem. The use of integrated several VE tools will help to resolve conflict and generate new solutions from outside the experience.

1.2 Objective

To integrate Theory of Inventive Problem Solving (TRIZ) tool, and Design for Manufacture and Assembly (DFMA) methodology in order to improve and value added the current design of consumer product

1.3 Scope

The study will focus on the:

i) Application of DFMA methodology to identify detailed design problems and generate remedial design solutions.
ii) Application of TRIZ method to improve the value added product development.
iii) Consumer product as case study – Sponge Mop

1.4 Methodology of Study

This thesis is conducted accordingly in two parts which is Master Project 1 (MP 1) in semester 1 and Master Project 2 (MP 2) in semester 2 as shown in Figure 1.1. The flow chart showed clearly the processes of the thesis activities in order to meet the time constrain. After the project had determined, the literature review on VE, DFMA and TRIZ methodology are studied in the early stage. The studies are done by reviewing the related books, journals and articles. For a while, the consumer product for the project analysis purpose is also been selected. The selected product then is been evaluated by using DFMA methodology and from the results some improvements are proposed.

However, the proposed improvement activities will be continuing also in the MP 2. It is continuously process as in the stage of evaluation the new design with using integrated VE tools, it may have some unsuitability idea. So, the others proposed improvement need to do. Lastly, the discussion and conclusion will be done after the accurate analysis result on the new design is evaluated where, the new design of integration tools is compared to the new design of DFMA methodology in terms of percentages of part count reduction and design efficiency increment.

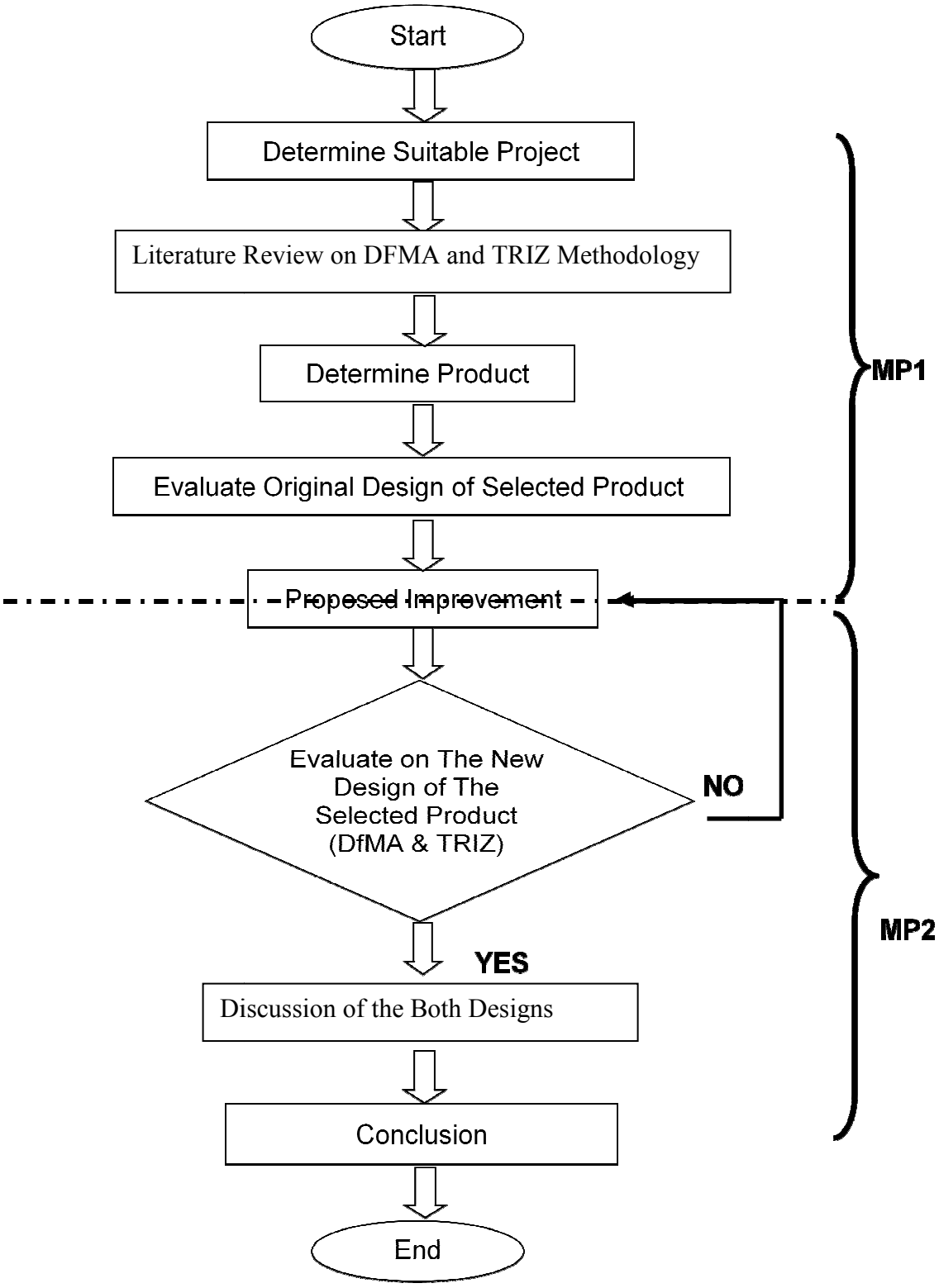

Figure 1.1: Flow chart of the project activities for MP 1 and MP 2.

1.5 Significant of Study

The significant of this thesis is to prove the use of integration of VE tools will give a better result of product design in term of simplification, product cycle life, efficiency, quality, function and also product value. In this thesis, product design improvement is done by integration of TRIZ and DFMA methodology. Hopefully with the result of this study, it can give an overview to others about the advantages of using integration problem solving tool in product development and then will attract more organization to use this method for their product development purpose.

The result of integration problem solving tools should achieve improvement better than single tool with the main improvement is to reduce assembly and manufacture process time and cost. However, in case the improvement in term of cost and time does not show much improvement, the others factor such as product simplification, function and life cycle should be considered.

1.6 Report Structure

This thesis consists of nine chapters. Chapter 1 presents the introduction of the thesis, Product Design Improvement through TRIZ and DFMA 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. The next chapter consists of the original data analysis of the product case study. In this Chapter 5, the DFMA Methodology is applied. The proposed improvement of the original data case

REFERENCES

1. Lucchetta, G., Bariani, P. F., Knight. W. A., *Integrated Design Analysis for Product Simplification.* University of Padova, Italy.

2. Triz-journal.com. *Utilization of TRIZ with DFMA to Maximize Value* [Online]. Available: http://www.triz-journal.com. [2009, July 21]

3. Wikipedia. *Value Engineering* [Online]. Available: http://en.wikipedia.org/wiki/Value_engineering. [2009, July 9]

4. Wikipedia. *TRIZ* [Online]. Available: http://en.wikipedia.org/wiki/TRIZ. [2009, July 20].

5. Darell. L. Mann. *Integration and Application of TRIZ and DFMA*. Systematic-innovation.com. 2002.

6. Kai Yang., Basem, E.H. *Design for Six Sigma – A Roadmap for Product Development.* New York: McGraw-Hill. 2003.

7. Altshuller, G. and Henry. *The Art of Inventiving (And Suddenly the Inventor Appeared)*. Technical Innovation Center. 1994.

8. Rajesh. J., Philip. S. *Design for Six Sigma – A Holistic Approach to Design and Innovation*. New Jersey: Wiley. 2008.

9. Boothroyd, G . and Dewhurst, P. *Product Design for Manufacture and Assembly*. New York: Marcel Dekkel. 2002.

10. Zhongsheng Hua, Jie Yang, Solomani Coulibaly, and Bin Zhang. Integration TRIZ with Problem Solving Tools: A Literature Review From 1995 to 2006. *International Journal Business Innovation and Research*, Vol 1. 2006.

11. Triz-journal.com (2009). *Innovation; The next Frontier for Six Sigma* [Online]. Available: http://www.triz-journal.com. [2009, July 27]

12. Chung-Shing, W. and Teng-Ruey, C. Integrated QFD, TRIZ and FMEA in Conceptual Design for Product Development Process. *Proceedings of the 13th Asia Pacific Management Conference.* Melbourne, Australia: APMR. 2007. 1085-1095.

13. Ideationtriz.com. *Ideation/TRIZ: Innovation Key to competitive Advantage and Growth* [Online]. Available: http://www.ideationtriz.com/paper_ITIRZ_Innovation_Key.htm. 2009.

14. Daniela, S., Elena, M., Nicolae, I. and Thomas, R. A TRIZ Approach to Design for Environment. Galway Mayo Institute of Technology. Unpublished.

15. Darell. L. Mann. *Beyond Systematic Innovation: Integration of Emergence and Recursion Concepts into TRIZ and Other Tools*. Systematic-innovation.com. 2002.

16. Valery, K., Jun-Young, L. and Jeong-Bai, L. TRIZ Improvement of Rotary Compressor Design. *Proceedings of TRIZCON2005, the annual conference of the Altshuller Institute,* Brighton, MI USA: 2005.

17. Noel, L. R. *A Proposal to Integrate TRIZ into the Design Product Process* [Online]. Available: http://www.triz-journal.com/archives/2002/11/b/index.htm. 2002.

18. Masaya, T. and Manabu, S. *The Possibility of VE Activities as New Product Planning by Utilizing TRIZ Techniques.* The SANNO Institute of Management, Tokyo, Japan.

19. Ahmad Humaizi Bin Hilmi. *Design and Analysis of a Paintball Marker Using Boothroyd-Dewhurst DFMA Methodology*. Master Thesis. Universiti Teknologi Malaysia; 2005.

20. Noor Laili Binti Ali, *Design for Assembly: Design Improvements for Assembled Product Using Boothroyd-Dewhurst DFMA Methodology*. Bachelor Project Thesis. Universiti Teknologi Malaysia: 2009.

21. Chong Teik Seng, *Development of the Prototype System for Design for Assembly (DFA) Using Boothroyd-Dewhurst DFMA Methodology*. Bachelor Project Thesis. Universiti Teknologi Malaysia: 2006.

22. Baizura Binti Zubir @ Zubair. *Assemblability Design Effieciency (ADE) Analyses for Design for Automatic Assemblies (DFAA).* Master Thesis. Universiti Teknologi Malaysia; 2008.