SOFTWARE DEVELOPMENT BY INTEGRATING THE INTEGRATED USING AXIOMATIC DESIGN-LUCAS DESIGN FOR ASSEMBLY (DFA)

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TABLE OF CONTENTS

CHAPTER	TITLE		PAGE
	TITLE		i
	SUPERVISOR DECLARATION		ii
	STUDENT DECLARATION		iii
	ACKNOWLEGEMENTS		v
	ABSTRACT		vi
	ABSTRAK		vii
	TABLE OF CONTENT		viii
	LIST OF TABLE		xi
	LIST OF FIGURE		xii
	LIST OF APPENDICES		xiii
1	**INTRODUCTION**		
	1.1	Background	1
	1.2	Problem Statement	2
	1.3	Project Objective	2
	1.4	Project Scope	2
	1.5	Importance of Study	3
	1.6	Expected Output	3
	1.7	Summary	3

2 LITERATURE REVIEW

2.1	Introduction		4
2.2	Axiomatic Design		4
	2.2.1	Customer Domain	5
	2.2.2	Functional Domain	5
	2.2.3	Physical Domain	6
	2.2.4	Process Domain	6
	2.2.5	Hierarcies	7
	2.2.6	Zigzagging	8
	2.2.7	Design Axioms	9
2.3	Lucas DFA Method		10
	2.3.1	Design Assembly Analysis	12
2.4	Design for Assembly		16
	2.4.1	DFA Guidelines	17
2.5	Pugh Method		20

3 METHODOLOGY

3.1	Introduction	22
3.2	Overview	22
3.3	Information Gathering	25
3.4	Axiomatic Design	25
3.5	Pugh Method	25
3.6	Lucas DFA	26
3.7	Summary	26

4 RESULT AND DISCUSSION

4.1 Introduction 27
4.2 Axiomatic Design Analysis-DFA Software
4.3 Axiomatic Design Analysis – Dfa Software With Case Study (Car Window Regulator) 35
4.4 Proposed design 40
4.5 Designs for Assembly (DFA) Analysis 41
4.6 DFA comparison 43

5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion 47
5.2 Future Recommendation 48

REFERENCES 49

APPENDICES

Appendix A 51
Appendix B 54
Appendix C 100

LIST OF TABLE

TABLE NO.	TITLE	PAGE
2.1	Characteristic of four domains	6
4.1	Comparison of original design and proposed design	42
4.2	Result from Axiomatic Design Analysis – DFA software	43
4.3	Result from DFMA software	43
4.4	Result from Axiomatic Design Analysis – DFA software	44
4.5	Result from DFMA software	44
4.6	Result from Axiomatic Design Analysis – DFA software	45
4.7	Result from DFMA software	45

LIST OF FIGURE

FIGURE NO.	TITLE	PAGE
2.1	Domains in Axiomatic Design	4
2.2	Hierarchical decomposition	7
2.3	Hierarchical decomposition of a design problems and zigzagging between design axioms	8
2.4	The Design for Assembly Analysis	12
2.5	Manual Assembly	17
2.6	Hook- Under	18
2.7	Snap Fits	19
2.8	Pugh method	21
3.1	Design Methodology Flowchart	24
4.1	Customer Requirement	28
4.2	Functional Requirement	29
4.3	Conceptual Design Solution	30
4.4	Pugh Method	31
4.5	Cost Analysis	32
4.6	Part Essential	32
4.7	Manual Handling	33
4.8	Fitting Analysis	33
4.9	Component part of original window regulator	35
4.10	Customer Requirements Analysis	36
4.11	Functional Requirements Analysis	37
4.12	Conceptual Design Analysis	38
4.13	Pugh Method Analysis	39
4.14	Alternative Design	40

4.15	DFA analysis for best alternative design	41
4.16	DFA analysis for current design	41
4.17	Explode view Air Filter	44
4.18	Explode view of Standing Fan	45

LIST OF APPENDICES

APPENDIX NO	TITLE	PAGE
A-1	Project Gantt chart FYP 1	51
A-2	Project Gantt chart FYP 2	52
A-3	Project Flow chart	53
B-1	Axiomatic Design –Customer Requirement Code	54
B-2	Axiomatic Design –Functional Requirement Code	59
B-3	Axiomatic Design –Conceptual Design Solution Code	64
B-4	Manual Handling- DFA Analysis Code	69
B-5	Fitting Analysis- DFA Analysis Code	71
B-6	Part Essential – DFA Analysis Code	73
B-7	Cost Analysis- DFA Code	83
B-8	Pugh Method Code	91
B-9	Main Code	94
C-1	Car Window Regulator Original Analysis	100
C-2	Car Window Regulator Alternative Analysis	101
C-3	Amsoil Air Filter Analysis	102
C-4	Standing Fan Analysis	103

ABSTRACT

In today competitive world, companies try to cut down the manufacturing cost and at the same time increase their profit .In order to be a competent player in the market, the product should arrive into market within a short time and reasonable price. This study is developing an intelligent computer based evaluation system for assembly by Integrating the integrated Axiomatic Design and Lucas DFA. The software is developed by using Microsoft Visual Basic 6.0. Through the concept of Axiomatic Design and Lucas DFA, it can be reduce the assembly cost at the early stage of the design phase and faster reach the market. However, there is a need of developing evaluation software regardless the technique or methods developed. The software that could simulate and evaluate the design virtually would reduce the product developing time. Thus the product could reach into the market dead in time. The objective of this paper is to present the framework for software development that integrating the integrated Axiomatic Design and Lucas DFA. The expected output is the evaluation software.

ABSTRAK

Persaingan dunia pada hari ini, syarikat-syarikat berusaha untuk mengurangkan kos pengeluaran produk dan pada masa yang sama mereka cuba untuk meningkatkan keuntungan syarikat. Untuk bersaing di pasaran dunia, produk yang dihasilkan mestilah berada dipasaran di dalam masa yang cepat dengan harga yang berpatutan. Kajian ini ialah untuk membangunkan kepintaran computer berdasarkan system penilaian untuk menyusun menggunakan Integrate Axiomatic Design bersama kaedah Lucas DFA. Kebanyakan pembuat menghasilkan beberapa jenis kaedah untuk mengurangkan kos pemasangan pada peringkat permulaan untuk fasa perancangan. Oleh itu, perisian penilaian hendaklah dihasilkan berdasarkan kaedah yang digunakan. Perisian ini mestilah boleh menghasilkan simulasi penilaian terhadap rekaan sebenar produk di mana untuk mengurangkan masa pengeluaran produk. Jadi, produk ini hendaklah berada di pasaran secepat mungkin. Tujuan kajian ini adalah untuk memaparkan hasil kerja menghasilkan perisian yang berasaskan Integrate Axiomatic Design bersama kaedah Lucas DFA. Hasil yang dijangkakan ialah penilaian perisian.

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

In today competitive world, companies try to cut down the manufacturing cost and at the same time increase their profit. In the high labor cost economies, it was recognized that one untapped source of reduced costs was assembly cost. It is one of the major operations in manufacturing. As a result, assembly cost will be higher than it should be which directly will make overall cost of product increase. Considering on that factor, this project will be analyze to analyze the assembly product using DFA method.

Competitions in designing field are now getting more severe. Product must be designed so it can compete in the market, mean the successful indicator for a design will determined by the sale. A design with a good package will attract more customers to buy it. Nowadays, customer are not also seeking a high quality product but also valuable in terms of price. So, customers will defined either the product is good or bad although in engineering field the product was approve good.

Quality and price are the important packages that must have in a product to reach market target. As quality is totally general and depend on the product, this project is aim to improve design features in terms of price, more specifically assembly cost. Designer always put manufacturing and material cost as a major factor that will affect overall cost of the product with ignoring assembly cost. Assembly effectiveness will affect overall cost and time to manufacture the product.

Some modifications surely must make to the product so assembly effectiveness can be improved. This problem needs a designer to be more creative. There is many ways to be creative, depend on the capabilities of human mind. Sometimes, even professional are not always creative. Axiomatic Design and Lucas DFA are guidelines for people to be more creative to solve much kind of problems. This method will make designer can design a good product and assemble at minimum cost and time.

1.2 PROBLEM STATEMENT

The problem is to develop computer base systems that integrate product design for evaluation system(s) techniques. The problem formulations are:

1. How to reduced part for the product using Axiomatic Design Analysis?
2. The validity of the develop software is still uncertain.

1.3 OBJECTIVE

The objective of this project is to develop an intelligent computer based evaluation system for assembly by Integrating the integrated Axiomatic Design and Lucas DFA

1.4 SCOPE

(i) A car window regulator, filter and standing fan component are selected as a case study.
(ii) Microsoft Visual Basic 2006 6.0 will be use to develop the software.
(iii) Information about car window regulator component is from previous PSM.
(iv) Lucas DFA are selected as the DFA tool.

1.5 SIGNIFICANT OF STUDY

The significant of study is aim to reduce the time, cost and parts to maintain the efficiency of the product design assembly using DFA method.

1.6 EXPECTED OUTPUT

(i) A software for assembly sequences in manufacturing sectors.
(ii) A system to support for in optimizing the efficiency of assembly process in the early stages.

1.7 SUMMARY

This chapter described about overall introduction of this project. Background of this project will discuss after defining problem statement. Then, scopes and objectives of this project is determined as a guidelines of the project.

REFERENCES

1) Lucas Engineering Systems Ltd, University Of Hull. *Design For Manufacture and Assembly Practitioners Manual*. Version 10, 1993

2) Dieter, G.E *"Engineering Design*",3rd edition, McGraw-Hill, inc, New York,2000.

3) Poli *"Design for Manufacturing",* Butterworth Heinemann,2001..

5) A.M. Goncalves-Coelhe, Antonio J.F. Mourao, Axiomatic design as support for decision-making in a design for manufacturing context: A case study, *Int. J. Production Economics, 109,2007, 81-89*

6) Suh, N.P *Axiomatic Design – Advances and Applications Massachusetts Institute of Technology*, Oxford University Press, New York.Oxford 2001.

7) Turban, E, Aronson, J. E, and Liang, T.P.(2005). *Decision Support Systems and Intelligent Systems, Pearson Prentice Hall.*

8) *Klir, George J.; St Clair, Ute H.; Yuan, Bo (1997). Fuzzy set theory: foundations and applications. Englewood Cliffs, NJ: Prentice Hall.*

9) *N.P. Suh, Axiomatic Design: Advances and Applications, (Oxford University Press, New York, 2001*

10) K.G. Swift, B. L. Miles and G Hird (1987), A Systematic Approach To Product Design for Assembly Volume II

11) Kim Y, Cochran D, *Reviewing TRIZ from the perspective of Axiomatic Design,*2000.

12) C J Barnes, G F Dalgleish, G E M Jared (1997) , *Assembly Sequence Structure In Design For Assembly*

13) O. Kulak, M.B. Durmusoglu and S. Tufekci (2005), *A complete cellular manufacturing system design methodology based on axiomatic design principles*,

14) O. Coma, C. Mascle and P. Véron (2003), *Geometric and form feature Recognition tools applied to a design for assembly methodology*, Computer Aided Design.

15) Mann*, Axiomatic Design And TRIZ: Compatibilities and Contradictions part 1,* Second International Conference on Axiomatic Design, Cambridge, MA, June 10 & 11 2002.