



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**STUDY AND ANALYSIS OF THE ENGINEERING QUALITY
FEELINGS BASED ON AFFECTIVE RESPONSE TO DIMENSIONAL
INTEGRATION OF PRODUCT SHAPES DESIGN
CASE STUDY [Product: Spectacles]**

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

by

MUHAMMAD HANNAN B. KAMARZAMAN

B050910184

900429-04-5345

FACULTY OF MANUFACTURING ENGINEERING

2013



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: STUDY AND ANALYSIS OF THE ENGINEERING QUALITY FEELINGS BASED ON AFFECTIVE RESPONSE TO DIMENSIONAL INTEGRATION OF PRODUCT SHAPES DESIGN: CASE STUDY [PRODUCT: SPECTACLES]

SESI PENGAJIAN: 2012/2013 Semester 2

Saya **MUHAMMAD HANNAN BIN KAMARZAMAN**,

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka, Supervisor, dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

Alamat Tetap:
JA, 6839, Kg. BARU Bkt. Sedanan
77500 SELANDAR, MELAKA

Cop Rasmi: [XV:2077x200]

Tarikh: 3 June 2013

Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby declare that this report entitled “Study and Analysis of the Engineering Quality Feelings Based on Affective Response to Dimensional Integration of Product Shapes Design Case Study [Product: Spectacles]” is the result of my own research except as cited in the references.

Signature :
Author's Name : Muhammad Hannan Bin Kamarzaman
Date : 3 June 2013

APPROVAL

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 Management) with Honors. The members of the supervisory committee are as follow:

.....
H.H.IP [XV:ꦲꦲꦶꦥ꧀]

@Haeryip Sihombing

(PSM Supervisor)

ABSTRAK

Tujuan kajian ini adalah untuk mengenal pasti dan menilai ciri-ciri reka bentuk produk yang berkaitan dengan nilai-nilai afektif / emosi (perasaan kualiti) berdasarkan perspektif Kansei Kejuruteraan. Kajian ini juga melihat dan menganalisa keperluan reka bentuk ke arah membentuk asas kepada sesebuah produk (reka bentuk cermin mata) berdasarkan pandangan 1000 responden (pelajar di negeri Melaka). Di sini, manipulasi data menggunakan kaedah logik kabur untuk menganalisis keutamaan yang diperlukan terhadap ciri-ciri reka bentuk produk berdasarkan keputusan membuat pendekatan menggunakan Proses Hierarki Analisis (AHP). Perisian yang diperlukan untuk membuat keputusan yang dijalankan terhadap keutamaan reka bentuk Expert Choice, manakala untuk memanipulasi data ke dalam Logik Kabur adalah perisian MATLAB. Statistik pengiraan dan pendekatan yang diperlukan untuk menentukan korelasi antara bentuk produk dan ciri-ciri produk dengan menggunakan SPSS V16 perisian. Berdasarkan pilihan setiap bahagian telah digabungkan ke dalam 3 reka bentuk untuk kajian ujian semu;, di mana reka bentuk 1 (rim penuh, kanta segi empat tepat, lengan tebal) adalah yang paling digemari oleh responden. Kebanyakan responden dinyatakan reka bentuk ini sebagai "Rapuh-Teguh", manakala reka bentuk tidak. Reka bentuk 2 dan 3 lebih dirasai sebagai "Tidak Selesa-Selesa". Ujian pos dijalankan, kajian ini mendapati bahawa yang paling disukai ialah reka bentuk 3 berdasarkan kualiti emosi telah dinyatakan sebagai "Tidak Selesa-Selesa". Kebanyakan perkataan Kansei berdasarkan reka bentuk bersepadu berbanding reka bentuk bahagian-bahagian adalah sedikit berbeza kerana apabila mereka bersepadu atau digabungkan, ia akan menyebabkan keutamaan kepada reka bentuk produk yang mudah dikenal pasti mengenai apa perbezaan atau persamaan mereka. Sebabnya ialah kerana emosi manusia yang semulajadi cenderung kepada persamaan dan / atau kelainan reka bentuk.

ABSTRACT

The purpose of this study is to identify and evaluate the characteristics of product design related to affective/ emotional values (quality feelings) based on Kansei Engineering perspective. This study reviews and analyze the design requirements towards the product shape basis of the product (spectacles design), through the survey conducted towards 1000 higher education students as the respondents in Melaka. The analysis conducted in this study was using the Analytical Hierarchy Process (AHP) and manipulation data based on Fuzzy Logic method; in order to find the priorities required to the characteristics of product design. The software used for the decision making carried out in this study was Expert Choice, while to manipulate the data into Fuzzy Logic was MatLab software. The analysis carried out through statistical calculation was using SPSS v16 in order to determine the correlation among the product shapes and the characteristics of product based on Kansei words. This study found that the most preferred of Rim design was Type-1 and 6, where the overall of Kansei word preference was “Beautiful-Attractive”. While to the Lens shape (that is Type-1) and Arm type (that are Type-1 and 3), the overall Kansei words preferences were “Lame-Cool”. Here, the spectacle construction of integrated designs based on such preferences of each parts were combined into 3 designs for Post Test survey, where the Design no. 1 (full rim, rectangular lens, thick arm) is the most preferred by the respondents. Most of the respondents articulated this design as “Fragile-Robust”, while Design no. 2 and Design no 3 as “Lame-Cool” respectively. Through the resurvey by post test carried out, this study found that the most preferences of 3 integrated design based on the emotional quality were articulated as “Lame-Cool”. This most preference of Kansei words based on the integrated designs versus the parts design is slightly different due to when they were integrated or combined, the most preferences result to the design product is easily identified on what their differences or similarities. This is due to the humans emotional are naturally triggered on what the most of similarity and/or incongruity appearances of design. In this study, “Lame-Cool” word is the articulation of the lens and arm design.

DEDICATION

For my beloved parents who are always supported me:

Kamarzaman bin Latip

Fauziah binti Omar

And

for My Supervisor,

H.H.IP [XV:ꦲꦲꦶꦥ]

@Haeryip Sihombing

My Co-Supervisor,

Mr Saifuddin Hafiz Yahaya,

For my families, and my friends thank for their loves and caring

ACKNOWLEDGEMENT

First and foremost, all praise is due to **Allah Subhana-Wa-Ta'ala** for bestowing me with health, knowledge and patience to complete this work. The Almighty, who made this accomplishment possible. I seek his mercy, favor and forgiveness.

Thousands of thanks to my supervisor, H.H.IP [XV:ꦠꦺꦤ꧀ꦠꦸꦁꦲꦏꦸꦁꦲꦏꦸꦁ] @Haeryip Sihombing for giving me a chance to do my project under his supervise. I would like to show my highest gratitude for his invaluable support, patient, assistance, and especially his encouragement to this project. I truly have learnt a lot and all this would not be without his guidance.

Furthermore, I would like to thank my parents for their love, care, support, and understanding to carry out this thesis to the best of my ability.

TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	vii
List of Figures	viii
List of Tables	xi
List of Abbreviations	xv
CHAPTER 1: INTRODUCTION	1
1.1 Problem Statement	5
1.2 Objectives	11
1.3 Scope of project	11
1.4 Framework of Thesis	12
1.5 Summary	14
CHAPTER 2: LITERATURE REVIEW	15
2.1 Kansei Engineering	15
2.1.1 History of Kansei Engineering	16
2.1.2 Basic of Kansei Engineering	17
2.1.3 The principal of Kansei Engineering	19
2.1.3.1 Kansei Engineering Type	19
2.1.4 Application of Kansei Engineering	22
2.1.6 Advantages of Kansei Engineering	25
2.2 Analytical Hierarchy Process (AHP)	25
2.2.1 Decomposition	26
2.2.2 Comparative Judgment	27
2.2.3 Logical consistency	27

2.2.4	Process	29
2.2.4.1	Structuring a decision problem and selection of criteria	29
2.2.4.2	Priority setting of the criteria by pairwise comparison	29
2.2.4.3	Pairwise comparison of options on each criterion	30
2.2.4.4	Obtaining an overall relative score for each option	30
2.2.5	Approaches	31
2.2.6	Advantages	31
2.2.7	Disadvantages	32
2.2.8	Raw Geometric Matrix Method	33
2.3	Fuzzy Logic	34
2.3.1	History of Fuzzy Logic	35
2.3.2	Definition of Fuzzy Logic	35
2.3.3	Membership Functions	36
2.3.4	Operation Fuzzy Logic	37
2.3.5	Fuzzy Association	38
2.3.6	Fuzzy Set Theory	39
2.3.7	The Algebraic Operations of Fuzzy Numbers	39
2.3.8	Fuzzy Product Selection	40
2.3.9	Summarization of Researches on Kansei Engineering, Analytical Hierarchy Process (AHP) and Fuzzy Logic	41
CHAPTER 3: METHODOLOGY		68
3.1	Introduction	68
3.2	Get the objectives and scope of project	70
3.3	Literature Study	70
3.4	Data collection	70
3.5	Questionnaire	71
3.6	Framework	72
3.7	Analysis	73
3.8	Data Collection Phase	74
3.8.1	Analyzing Phase	76
3.8.2	Integration Phase	76
3.8.3	Final Phase	76

CHAPTER 4: RESULT AND DISCUSSION	78
4.1 Introduction	78
4.2 Demography	78
4.2.1 Sample Size of Respondent Involved	78
4.2.2 Analysis of Respondent Background	80
4.3 Kansei Words	88
4.3.1 Interview	88
4.3.2 Preliminary survey	88
4.3.3 Preliminary Test	90
4.3.4 Kansei Words Realibility Test	91
4.5 Kansei engineering	91
4.5.1 Rim Section	92
4.5.2 Lens Section	103
4.5.3 Arm Section	111
4.5.4 Post Test	123
4.6 Correlation Analysis	130
4.7 Summary	135
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS	138
5.1 Introduction	138
5.2 Conclusion	138
5.3 Recommendations	140
References	141
Appendices	162

LIST OF FIGURES

Figure 1.1: Framework of Design Development	12
Figure 1.2: Framework of Study	13
Figure 2.1: The Process of Kansei	17
Figure 2.2: The Principles in Kansei Engineering	20
Figure 2.3: The Analytical Hierarchy Process Structure	32
Figure 2.4: A triangular fuzzy number	37
Figure 2.5: Graph of the combined A and B	38
Figure 3.1: Flowchart of Project Methodology	69
Figure 3.2: Framework of Design Development	72
Figure 3.3: Design Activities Framework	73
Figure 3.4: Framework of Study	75
Figure 4.1: Sample size on Sample Size Calculator	80
Figure 4.2: Percentage of Gender	81
Figure 4.3: Percentage of Respondent use spectacles	81
Figure 4.4: Percentage of Spectacle Power use by respondents.	82
Figure 4.5: Percentage of Respondents that Always Use Spectacles	83
Figure 4.6: Percentage of Respondent Use Contact Lens	83
Figure 4.7: Frequency of First Time Use Spectacles	84
Figure 4.8: Percentage of Numbers of Spectacles that Respondent have	84
Figure 4.9: Percentage of the Respondent that Have Sunglass	85
Figure 4.10: Frequency of Last Time Change Spectacles	85
Figure 4.11: Frequency of First Preferences	86
Figure 4.12: Percentage of Material Preferred by Respondents	87
Figure 4.13: Flow of obtaining Kansei Words	87
Figure: 4.14: Picture of spectacles design for interview	90

Figure 4.15: The Types of Rim Preferred by Respondent.	93
Figure 4.16: The Average Value of Kansei Word for Rim Design	94
Figure 4.17: The Kansei Words Preferences overall	94
Figure 4.18: The Average Values of Kansei Words based on Types	95
Figure 4.19: The Kansei Words Preference Results Based on AHP approach	96
Figure 4.20: The Average Value of Kansei Words	97
Figure 4.21: Kansei Word Preference based on Fuzzy-AHP	97
Figure 4.22: The Average Values of Kansei Word Based on Fuzzy Manipulation Data	99
Figure 4.23: The Frequencies of Preferences Kansei Words Based on AHP by Fuzzy Manipulation	100
Figure 4.24: The Dominant of Type of Rim based on AHP by Using Expert Choice	101
Figure 4.25: The Dominant of Type of Rim based on Fuzzy Manipulation by Expert Choice	102
Figure 4.26: The Average Values of Kansei Words for Lens Designs	104
Figure 4.27: The Kansei Words Preference Overall by Using AHP Approach	105
Figure 4.28: The Average Values of Kansei Words Based on Types of Lens	105
Figure 4.29: The Kansei Words Preference Based on Type of Lens- AHP	106
Figure 4.30: The Average Value of Kansei Word - Fuzzy	107
Figure 4.31: The Kansei Words Preferences Overall- Fuzzy AHP	107
Figure 4.32: The Average Values of Kansei Word Based on Fuzzy Manipulation Data	108
Figure 4.33: Kansei Word Preferences Based on AHP approach by Fuzzy Manipulation Data	109
Figure 4.34: The Dominant of Type of Lens based on AHP by Using Expert Choice	110
Figure 4.35: The Dominant of Type of Lens based on AHP by Using Expert Choice	111
Figure 4.36: The Types of Arm Preferred by Respondent	112
Figure 4.37: The Average Values of Kansei Words for Arm Designs	113
Figure 4.38: The Kansei Words Preferences Overall	114

Figure 4.39: The Average Values of Kansei Words Based on Types of Lens	114
Figure 4.40: The Kansei Words Preference based on Types Based on AHP Approach	115
Figure 4.41: The Averages Values of Kansei Words -Fuzzy	116
Figure 4.42: The Kansei Words Preference -Fuzzy	117
Figure 4.43: The Average Values of Kansei Word Based on Fuzzy Manipulation Data	117
Figure 4.44: The Percentage of Kansei Word Preferences Based on AHP approach by Fuzzy Manipulation Data	118
Figure 4.45: The Dominant Type of Arm based on AHP by Using Expert Choice	120
Figure 4.46: The Dominant Type of Arm based on AHP by Using Expert Choice	121
Figure 4.47: The Fuzzy Logic Output	123
Figure 4.48: The Average Value of Kansei Word –AHP	125
Figure 4.49: The Kansei Word Preference-AHP	126
Figure 4.50: The Average Value of Kansei Words for Design Proposed	127
Figure 4.51: The Kansei Word Preferences	128
Figure 4.52: The Expert Choice Result based on AHP	128
Figure 4.53: The Expert Choice Result based on Fuzzy Manipulation Data	129

LIST OF TABLES

Table 2.1: Definition by scholars	35
Table 4.1: Respondent counts	79
Table 4.2: Statistic frequency of gender	80
Table 4.3: Statistic frequency of Use Spectacles	81
Table 4.4: Statistic frequency of Spectacles Power	82
Table 4.5: Statistic frequency of Always Use Spectacles	82
Table 4.6: Statistic frequency of Use Contact Lens	83
Table 4.7: Statistic Frequency of First Time Use Spectacles	84
Table 4.8: Statistic frequency of Numbers of Spectacles	84
Table 4.9: Statistic Frequency of Have Sunglass	85
Table 4.10: Statistic frequency of Last Times Changes Spectacles	86
Table 4.11: Statistic frequency of First Preferences	86
Table 4.12: Statistic frequency of Last Times Changes Spectacles	87
Table 4.13: 48 Kansei Words	89
Table 4.14: Kansei Words from respondent	89
Table 4.15: Results by word grouping based on pair wise questions	91
Table 4.16: Kansei Word Reliability for Every Section of Spectacles	91
Table 4.17: The Design of Rim Consists of Six Types	92
Table 4.18: The Frequencies of the Respondents Choose the Types of Rim	93
Table 4.19: The Average Kansei Words for Rim Design	93
Table 4.20: The Frequencies of the Kansei Words Preferences Based on AHP Overall	95
Table 4.21: The Average Values of Kansei Words based on Types	96
Table 4.22: The Kansei Words Preference Result Based on AHP approach	96
Table 4.23: The Average Value of Kansei Words-Fuzzy	97

Table 4.24: Kansei Word Preference based on Fuzzy-AHP	97
Table 4.25: The Average Value of Kansei Word Based on Fuzzy Manipulation Data	98
Table 4.26: The Frequencies of Kansei Words Based on AHP approach by Fuzzy Manipulation	99
Table 4.27: The Respondent Answer to Rim Result by AHP Method	100
Table 4.28: The Rim Result based on Fuzzy Manipulation Data Based on Frequencies and Percentage	102
Table 4.29: The Types of Lens Design Tested in the Survey	103
Table 4.30: The Frequencies of the Respondents Choose the Types of Lens	103
Table 4.31: The Averages Values of Kansei Words for Lens Designs	104
Table 4.32: The Frequencies of the Kansei Words Preferences Based on AHP Overall	104
Table 4.33: The Average Values of Kansei Words Based on Type of Lens	105
Table 4.34: The Kansei Words Preference Result Based on AHP Based on Types of Lens	106
Table 4.35: The Average Value of Kansei Word - Fuzzy	106
Table 4.36: The Kansei Words Preferences Overall- Fuzzy AHP	107
Table 4.37: The Average Values of Kansei Word Based on Fuzzy Manipulation Data	108
Table 4.38: The Frequencies of Kansei Words Based on AHP	108
Table 4.39: The Respondent Answer to Lens Result by AHP Method Based on Frequencies and Percentage	109
Table 4.40: The Respondent Answer to Lens Result by AHP Method Based on Frequencies and Percentage	110
Table 4.41: The type of arms based thickness	112
Table 4.42 The Frequencies of the Respondents Choose the Types of Arm	112
Table 4.43: The Averages Values of Kansei Words for Arm Designs overall	113
Table 4.44: The Frequencies of the Kansei Words Preferences Based on AHP Overall	113
Table 4.45 The Averages Values of Kansei Words for Arm Designs based on Types	114

Table 4.46: The Kansei Words Preference Result Based on AHP Approach based on Types	115
Table 4.47: The Averages Values of Kansei Words -Fuzzy	116
Table 4.48: The Kansei Words Preference -Fuzzy	116
Table 4.49: The Average Values of Kansei Word Based on Types by Fuzzy Manipulation Data	117
Table 4.50: The Frequencies of Kansei Words Based on AHP	118
Table 4.51: The Respondent Answer to Arm Result by AHP Method Based on Frequencies and Percentage	119
Table 4.52: The Respondent Answer to Arm Result by Fuzzy AHP Method Based on Frequencies and Percentage	120
Table 4.53: Summary of Kansei Word based on each Types of Spectacles	122
Table 4.54: Summary of Design Result for each Type of Spectacles	122
Table 4.55: Summary of Expert Choice Results	122
Table 4.56: The Proposed Design for Post Test	124
Table 4.57: The Average Value of Kansei Word –AHP	124
Table 4.58: The Kansei Word Preference-AHP	125
Table 4.59: The Average Values of Kansei Word and Preferences Rate based on Fuzzy Manipulation	126
Table 4.60: The Kansei Words Preference based on Fuzzy Manipulation	127
Table 4.61: The Dominant Words based on Post Test	130
Table 4.62: Dominant Design Post Test	130
Table 4.63: The result of Dominant Design and Dominant Words Expert Choice	131
Table 4.64: The Correlation between Demography and the Dominants Kansei Word	132
Table 4.65: The Crosstabulation between Spectacles Power and F/R-Parts A	133
Table 4.66: The Crosstabulation between Spectacles Power and F/R-Parts B	133
Table 4.67: The Crosstabulation between Spectacles Power and F/R-Parts C	133
Table 4.68: The Crosstabulation between Spectacles Power and L/C-Parts A	134
Table 4.69: The Crosstabulation between Spectacles Power and L/C-Parts B	134
Table 4.67: The Crosstabulation between Spectacles Power and F/R-Parts C	134
Table 4.71: The Crosstabulation between Use Spectacles and F/R-Parts A	135

Table 4.72: The Crosstabulation between Use Spectacles and F/R-Parts B	135
Table 4.73: The Crosstabulation between Use Spectacles and F/R-Parts C	135

LIST of ABBREVIATIONS

EO	-	Enterprise Organization
HOQ	-	House of Quality
GA	-	Genetic Algorithm
FAHP	-	Fuzzy AHP
AHP	-	Analytical Hierarchy Process

CHAPTER 1

INTRODUCTION

Nowadays, by increasingly competitive market condition, the providers and/or manufacturers have to carry out a customer-focused approach to their product development (design and process) as an articulation of what the expectation of customers. By increasing the complexity and variety of products to satisfy increasingly sophisticated customers, they ultimately require the knowledge and expertise in developing products (Ameri & Dutta, 2005:577). On this, Shen *et al.*, (2000:91)

χομμεντεδ τηατ χυστομερσε νεεδσ ανδ εξπεχτατιονσ σηουλδ βε μετ ανδ εξχεεδεδ τ ηρουγη προδυχτ ιννοπατιον σινχε σατισφψινγ χυστομερ ρεθυιρεμεντσ τηρουγη τη υσε οφ ορδιναρψ προδυχτσ ισ οφτεν νοτ ενουγη το χαπτυρε ανδ ρεταιν μαρκετ σηα ρε. Ιν φαχτο, εδεν τηουγη ιννοπατιον ηασ αλωαψσ βεεν ατ τη χεντρεπιεχε οφ χομ πετιπιδνεεσσ (Δεντον, 1999:82) ανδ ασ α δομιναντ φαχτορ ιν maintaining worldwide competitiveness (Lin & Chen, 2007:115), *innovation frightens the organizations* because it inevitably linked to risk (Ahmed, 1998:30).

Viewing on this standpoint, Su *et al.*, (2006:784) commented about technological innovation that allows the company to cope the challenges from a rapidly changing market situation with intensive competition. In order to make the implementations of such initiatives are successful, the product innovation of a company must link to technological competence, such as engineering and process know-how, with customer competence such as knowledge of customer needs (Patel & Pavitt, 1997;

Hansen & Løvås, 2004)¹. The quality characteristics of this case should be prioritized from the customer's perspective and target values (or preliminary specifications) for the desired level of performance are selected based on competitive benchmarking (Cristiano *et al.*, 2000:289), besides by adopting flexible and multi-tasking technology which can be used to fabricate a wide range of products in order a company more able to meet its costumers' demand against a given capacity level (Jung, 2003:2).

On the other side, by fulfilling the requirements related to physical quality and consumers'² psychological needs, according to Van-Nam *et al.*, (2010: 575), the development and improvement made need to be focusing on the attractiveness of products developed. Even though the attempts to produce goods with attractive forms are nothing new (Bloch 1995:16) and difficult (especially in new product development), this is significantly critical in the design stage (Yung *et al.*, 2006:257). On this, due to a key success of business organizations in the current global χομπετιτιπε ενωιρονμεντ ισ τηε σατισφαχιτιον οφ τηε χυστομερ (σομε οφ τηεμ τηρο υγη τηε τεχνηολογιχαλ ιννοωατιον), τηεν τηε συχχεσσ ανδ συρτωιπαλ οφ νεω προδου χτ δεωελοπιμεντ (ΝΠΔ) ισ ασ α χρυχιαλ φαχτιορ ιν μαινταινιγ τηειρ χομπετιτιπε αδ ωανταγε. Χονσεθυεντλψ, τηισ λεδ τηε προδουχτ δεωελοπιμεντ to a more knowledge-intensive activities than ever which is not only requires the tremendous expert knowledge, but also on how effectively the analysis carried out based on design information.

Moreover, since the technology cannot stand alone and how to maximise the affective appeals of consumer products to improve the likelihood of transfer from the shelf impact to the purchase intent in today's consumer-oriented market (Barnes & Lillford, 2007:135), they must, therefore, dealt with various fields related to the

¹ According to Patel and Pavitt (1997:141), the typical and the characteristics of technological competence companies are such as follows:

- *Multi-field*, and becoming more so over time, with competencies ranging beyond their product range, in technical fields outside their 'distinctive core'.
- *Highly stable and differentiated*, with both the *technology profile* and the *directions* of localised search strongly influenced by firms' *principal products*.
- The *rate* of search is influenced by both the firm's *principal products*, and the conditions in its *home county*. However, *considerable unexplained variance* suggests *scope for managerial choice*.

² The term "consumer" is used throughout this study for its specific reference to the context of consumer purchasing decisions. It relates to the customer's choice and preference when first exposed to a range of products, before significant interaction occurs or a purchase is made.

equally are important to them, manufacturers need, however, to understand the effects of the different quality attributes to increase customer satisfaction or minimize dissatisfaction based on the non-linear relationship between the performances of quality attributes and overall customer satisfaction. For an example, Dahl *et al.*, (1999:18) view about the incorporation of the customer in the imagery invoked, and examine its effects on the usefulness, originality, and customer appeal of the resulting design. Based on a theoretical perspective, Childers and Houston (1983) stated that by showing this different type of imagery can have a very different impact

ον της δεσιγν ουτχομε. Τηισ μεανσ τηατ ιφ μονυφαχτυρερσ χαν υνδερστανδ τηε χο νσυμερσ' πσψχηολογιχαλ φεελινγσ τοωαρδσ α προδυχτ, τηειρ προδυχτ δεσιγν σηου λδ, τηερεφορε, μεετ το τηε νεεδσ οφ χονσυμερσ ασ τηε ιντερπρετατιον οφ ηυμαν σεν σιβιλιτιεσ τηατ ισ τηε μοστ διρεχτ ωαψ οφ εξπρεσσινγ φεελινγσ τοωαρδσ ουτσιδε στ ιμυλι. Ον τηισ ματτερ, επεν τηουγη Ησιαο *ετ αλ.*, (2006) στατεδ τηατ τηε ρελατιονσ ηιπ βετωεεν α προδυχτ δεσιγν ανδ αφφεχτιωε ρεσπονσε οφτεν ρεμαινσ α βλαχκ βοξ σινχε τηε χυστομερ ρεθυιρεμεντσ οφ νεω προδυχτ ισ υσυαλλψ ινχονχειωαβλε, accurately and completely acquired, to be successfully marketed, according to Yung *et al.*, (2006:257), the products must, however, fulfil the customer needs and even bring a higher satisfaction than expected.

Second, since the loyalty of customers is an important strategic purpose of worldwide managers, Bell (2002) found that customer loyalty and retention is as the most important challenges of the business to make the quality of products and services are recognized. Based on this reason, the customer satisfaction improvement will, therefore, increasing the competitiveness of companies (Chang, 2008; Hansemark & Albinsson 2004; Herrmann *et al.*, 2000; Paulson & Slotnick, 2004; Shamdasani *et al.*, 2008). On the other hand, they were also assumed to lead the attitudinal loyalty (Lovelock *et al.*, 2001) as an interpretation of the intention to make future purchases (Oliver, 1980; Patterson *et al.*, 1997; Bolton, 1998; Page & Eddy, 1999; Jones & Suh, 2000). Since the satisfaction is as an emotional post-consumption response that may occur as the result of comparing expected and actual performance (Oliver 1996), the satisfaction as a result of the disconfirmation of expectations can be labelled evaluative satisfaction, then satisfaction as an outcome

of non rational processes can be labelled as emotion-label (Cronin *et al.*, 2000). On this, the functional and affective needs have to be recognized as a primary importance for customer satisfaction (Κηλιδ, 2001) where the psychological form of a product plays a very crucial role in ensuring the success of the market (Hsiao *et al.*, 2006). On this, Hsiao *et al.*, (2006:658) discuss about how to measure and analyse human reactions to affective design and how to assess the corresponding affective design features.

Third, since the design quality is the degree to which a product design (specification) fits to customer needs and expectations, and conformance quality is the degree of match between the features of a specific product and its specification (Meirovich *et al.*, 2007:242-243), the characteristics related that determine its value in the market place and its performance of the function for which it was designed should be defined and justified (Adam *et al.*, 1981). On this, the design information transformed and accumulated is as very important in the developing a good product that has a stronger market competence (Huang *et al.*, 2006:87). On the other hand, the development process which led to a deeper understanding of how to gather and use

information about the design, testing, launch, and management of new products can be optimized, and the improvement of the production process, production quality and cost reduction can be achieved in an effective way (Dahan & Hauser, 2001:179). For an example, Clark and Westwood (1991:22) see that the application of information based design and engineering to other functions such as production and marketing, and to the business process –

product development, marketing, production and business process – product development – which bring the product development to the fore. According to the study of Tseng (2004:745), this will enable the company to the higher profit margins, better and improved customer satisfaction, as well as high-value added business opportunities due to a maximum of customer-perceived value while exploiting the potential of design that generate a huge amount of variety.