

Utilizing cultural elements to enhance the sustainability of product

by

Yu Li

A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Industrial Design
Auburn, Alabama
May 04, 2020

Sustainable design, Cultural design, Design method, Design guideline

Copyright 2020 by Yu Li

Approved by

Tin-Man Lau, Chair, Professor of Industrial Design
Rich Britnell, Professor of Industrial Design
Christopher Arnold, Associate Professor of Industrial Design

Abstract

In the early nineteenth century, the most important environmental issues were not a widespread concern. Humans believed that resources in the planet seemed immeasurably vast, and that nature itself would digest everything and continue to grow. In recent years, our understanding of nature has dramatically changed. We are now facing several environmental issues such as shortage of resources, pollution and waste generation. More and more people are starting to realize that today environmental problems are not simple environmental problems, but design problems.

Therefore, increasing the sustainability of products has attracted public attention greatly in recent years. However, when most designers suggest how to make the product more sustainable, they neglect the importance of product life extension. “In many cases, longer-lived products could save resources and generate less waste and increase the sustainability of products significantly, because fewer units are needed to satisfy the same needs.” (Keoleian & Menerey, 1994, p. 656)

There are several ways to meet the need to extend product life. Cultural factors have the most crucial influence on the extension of product life. This thesis focusses on building the relationship between cultural elements in the product and sustainability, and how to use cultural elements to increase the product’s sustainability. Finally, this thesis will generate guidelines to help product designer to create a sustainable product or improve the sustainability of their design with the use of cultural elements. By following the guidelines, the designer has the opportunity to create holistically sustainable product, providing a new method to address severe environmental problems while at the same time ensuring the profit of the manufacturer.

Acknowledgments

I want to say thanks to all professors and office staff in my department first; all of them gave me significant support and help in the last three years. Then, I would like to express the most profound appreciation to my major professor Tin-Man Lau. He is not only the guide in my academic area but also good friend and teacher in my life. I'm also grateful to my committee members, Rich Britnell, and Christopher Arnold. I would never finish my thesis and graduate without your help. Also, thanks to Jerrod Windham; I asked for a lot of additional help from him. Finally, I want to say thank you to all my friends and my parents. Thank you all for your encouragement and support.

Table of Contents

Table of Contents.....	iv
List of Tables	viii
List of figures.....	ix
List of Abbreviations	xii
Chapter 1	1
Introduction	1
1.1 Problem Statement.....	1
1.2 Need for Study	2
1.3 Objectives of Study.....	3
1.4 Assumptions of Study.....	3
1.5 Scope and Limits.....	4
1.6 Definition of Terms.....	5
1.7 Anticipated Outcome	6
Chapter 2	7
Literature Review	7
2.1 Motivation of this research	7
2.2 Culture.....	10
2.2.1 Definition of culture.....	10
2.2.2 Cultural characteristics and differences	11
2.2.2.1 No group can escape culture.....	11

2.2.2.2 Characteristics of culture	11
2.2.2.2.1 Culture pattern.....	11
2.2.2.2.2 Two aspects of culture	12
2.2.2.2.3 Culture universals	12
2.2.2.3 Culture differences.....	15
2.2.2.4 Layer of culture.....	18
2.2.2.5 Cultural relativism.....	18
2.2.3 Incorporation of culture and design.....	19
2.2.3.2 Cultural influences on design process.....	19
2.2.3.3 Cultural design framework.....	22
2.2.3.3.1 The “spatial perspective” of culture.....	22
2.2.3.3.2 Cultural design framework.....	24
2.2.4 Extension of product life and sustainability.....	27
2.2.5 Culture as attachment in product	28
2.2.6 Semiotics analysis in culture.....	29
2.3 Value Perception.....	30
2.3.1 Concept of Value Perception	30
2.3.2 The form and aesthetic influence.....	32
2.3.2.1 The Form of Product.....	33
2.3.2.2 Color	34
2.3.2.2.1 Color Characteristics.....	34
2.3.2.2.2 Visual Effects of Colors.....	35
2.3.2.3 Line and Shape.....	38

2.3.2.4 Texture	40
2.3.2.5 Material	42
2.3.3 Function	44
2.3.4 The human factors.....	48
2.3.4.1 Definition of human factors.....	48
2.3.4.2 Physiological Characteristics of Human.....	48
2.3.4.3 Psychological Characteristics of Humans.....	51
2.3.5 Contextual Differences	52
2.4 Sustainable Design.....	54
2.4.1 Definition of Sustainable Design.....	54
2.4.2 Sustainable product and product life cycle	55
2.4.3 Two approaches of sustainable design.....	57
2.4.3.1 Cradle to Grave.....	57
2.4.4 OKALA.....	59
2.5 Conclusion	63
Chapter 3	65
Guideline.....	65
3.1 Extract cultural elements.....	65
3.2 Apply cultural elements in design.....	70
3.3 Conclusion	80
Chapter 4	81
Design Application.....	81
4.1 Introduction.....	81

4.2 Extracting cultural elements.....	81
4.3 Applying cultural elements.....	91
4.4 Final model	97
Chapter 5	103
Conclusion	103
5.1 Conclusion	103
5.2 Recommendations and Further Study.....	103
References.....	105

List of Tables

<i>Table 1</i> Cultural universals described by anthropologist George Murdock	13
<i>Table 2</i> Cultural universlas described by Donald Brown	14
<i>Table 3</i> Addition cultural universals described by Donald Brown	15
<i>Table 4</i> Differences in color preferences	35
<i>Table 5</i> Color's psychological effects	36
<i>Table 6</i> Color effects on different culture.....	38

List of figures

<i>Figure 1</i> Culture differences	16
<i>Figure 2</i> Cultural influences on engineering designers and their effects on design processes	20
<i>Figure 3</i> culture influences in design process by Leong	21
<i>Figure 4</i> Spatial perspective of culture.....	23
<i>Figure 5</i> Cultural design framework by Lin	25
<i>Figure 6</i> Matrix model from Leong	26
<i>Figure 7</i> the elements could influence color perception	37
<i>Figure 8</i> Different perception of people to lines by Niku	40
<i>Figure 9</i> Quality Function Development	46
<i>Figure 10</i> Different height of people in different culture area	50
<i>Figure 11</i> Learning follows asymptotic curve	52
<i>Figure 12</i> Product life cycle	56
<i>Figure 13</i> Cradle to Grave model	57
<i>Figure 14</i> Cradle to Cradle model	58
<i>Figure 15</i> Ecodesign strategy wheel	59
<i>Figure 16</i> Ecodesign strategy wheel based on product life cycle	63
<i>Figure 17</i> Final design method.....	65
<i>Figure 3</i> culture influences in design process by Leong	66
<i>Figure 18</i> Culture space and the culture space framework for hybridization culture.....	67
<i>Figure 19</i> Reclassify the cultural elements in matrix model	68
<i>Figure 20</i> Relationship between the culture space and Matrix Model	69

<i>Figure 21</i> Product life cycle in Okala	71
<i>Figure 22</i> Elements could be influenced by each phase of the product life cycle.....	72
<i>Figure 23</i> Cultural design approach.....	74
<i>Figure 24</i> Detail cultural design strategy.....	76
<i>Figure 25</i> Qianlijiangshan ruler	77
<i>Figure 26</i> Fuji	78
<i>Figure 27</i> Wedgwood	79
<i>Figure 28</i> Sustainable design and cultural design	80
<i>Figure 29</i> Generating design criteria with culture space	82
<i>Figure 30</i> Reclassifying the cultural elements with matrix culture space	84
<i>Figure 31</i> Selecting culture elements.....	85
<i>Figure 32</i> Square dish	88
<i>Figure 33</i> "Clustering Chinese Plum Blossoms"	89
<i>Figure 34</i> Chinese ink brush and four treasures of the study	91
<i>Figure 35</i> Applying cultural elements in cultural design	92
<i>Figure 36</i> Two strategies in Ecodesign strategy wheel	93
<i>Figure 37</i> Utilizing lacquering technique.....	94
<i>Figure 38</i> Plum form.....	95
<i>Figure 39</i> Special place to store ink brush.....	95
<i>Figure 40</i> lacquer resources.....	96
<i>Figure 41</i> Saving energy and material.....	97
<i>Figure 42</i> Final sketches.....	97
<i>Figure 43</i> Final CAD Model1.....	98

<i>Figure 44</i> Final CAD Model2.....	99
<i>Figure 45</i> Final CAD Model3.....	99
<i>Figure 46</i> Final Model1.....	100
<i>Figure 47</i> Final Model2.....	101
<i>Figure 48</i> Final Model3.....	102

List of Abbreviations

QFD	Quality Function Deployment
-----	-----------------------------

Chapter 1

Introduction

1.1 Problem Statement

Nowadays, most designers would only consider the 3R principle (Reduce, Reuse, and Recycle) in their design process and neglect other important factors that could affect the sustainability of their product. However, only simple 3R thinking is insufficient to improve the sustainability of the product. One of the most vital factors that designers neglect is the extension of product life in the design process. There are several ways to extend a product's life through design; one of the most crucial is to add cultural element in the product. This thesis will direct the designer to design more sustainable products with cultural elements.

The first problem for designers is how to utilize cultural elements in design. Culture is a very complicated concept; different people have different definitions of culture according to different usage. Different cultures display various expressive form; how to classify them and how to extract those cultural elements are a significant challenge to designers. Since cultural elements could be tangible or intangible, picking them from a specific culture is difficult, especially if a culture is formed from several other cultures, which makes it more complex for designers to distinguish the appropriate elements for sustainable design. Moreover, what if there is a specific culture whose cultural elements cannot be extracted and those cultural elements are not suitable to apply in product design? Alternatively, does a group living in this world without culture exist? Those are all the question that challenge designers in cultural design; therefore, understanding culture and figuring out how to utilize those cultural elements in design is a big problem.

Secondly, how to enhance the sustainability of the product by adding cultural elements as product attachment users can perceive is another problem. Additionally, there is no sustainable design strategy that includes cultural aspect holistically. Thus, how to design so that user can perceive the cultural elements in product and how to consider both cultural design approach and sustainable design approach are another significant challenges for designs

As discussed above, there are several problems to hamper designers in their work to design sustainable products with the cultural element. Unfortunately, there are few design guidelines including both cultural design and sustainable design to guide designers; this thesis will address that lack.

1.2 Need for Study

We are facing several severe environmental issues right now, and those problems threaten human living. Those problems will have to be addressed. Moreover, more and more people are starting to realize that humans have caused environmental problems, and environmental problems are design problems (Braungart & McDonough, 2013). That is why this thesis is important.

Currently, most designers believe that if they consider 3R thinking in their design, their product will be a sustainable product. However, that is far from the truth. In this thesis, , I will focus on how to utilize culture to enhance the sustainability of the product by extending the product lifespan. This is the area which most designers have ignored. In order to enhance the sustainability of the product, the designer will have to take cultural design and sustainable design both into account. Currently, there is no design guideline considering all product development aspects in every stage of the product life cycle that considers cultural design at the same time.

By following these guidelines, the designer has the opportunity to create sustainable products, holistically, to enhance the sustainability of the products. Providing a new method to address the severe environmental problem at the same time ensures the profit of the manufacturer.

1.3 Objectives of Study

- To classify culture expressive form
- To define culture
- To study cultural design
- To define product useful life
- To define sustainable design
- To summarize the different sustainable design methods
- To study value perception
- To classify the factors could affect value perception
- To develop a framework for both cultural design and sustainable design
- To apply the guidelines to product design

1.4 Assumptions of Study

This study was directed based on the following assumptions:

- The definition of sustainable design is accepted by most designers
- The definition of culture defined by Hofstede in 2005 is accepted by most designers
- The product with higher sustainability has higher attraction to consumers
- Sustainable design is helpful to address environmental issues
- Every culture can be represented by cultural universals

- Extension of product lifespan will greatly enhance sustainability.
- The higher value of product perceived by users will extend the lifespan of product.

1.5 Scope and Limits

For this study, the scope will be limited to different geographic cultures. Culture can be divided into six layers according to Hofstede (2005)

- A national level according to one's country (or countries, for people who migrated during their lifetimes)
- A regional and/or ethnic and/or religious and/or linguistic affiliation level
- A gender level, according to whether one was born as a girl or as a boy
- A generation level, separating grandparents from parents from children
- A social class level, associated with educational opportunities and with a person's occupation or profession
- For those who are employed, organizational, departmental, and/or corporate levels according to the way employees have been socialized by their work organization

Those six different layers of culture are not always in harmony, and nowadays, they often overlap with each other. For example, religious values may conflict with generational values. It is too broad to involve all layers of culture in our research, so this thesis only focuses on geographical culture difference. Therefore, this research will only consider the national level and regional level as our target.

Adding cultural elements in the product as product attachments will not only benefit sustainability on the environment but also social, economic, and cultural sustainability. For example, the user perceives certain cultural elements in the product; a certain culture could

inheritance too. Though, the research on the sustainability of society, economy, and culture are vast, this paper will only discuss the environmental influence on sustainability.

1.6 Definition of Terms

Culture: Culture is a collective phenomenon and is shared at least partially with other people living in the same social group (Hofstede, 2005). An orientation to individual perception, thinking and acting of persons belonging to a specific social group (Thomas, 2003).

Culture pattern: The pattern of behavior which characterizes a people and makes it different from others (Graham, 1957).

Function: Functions are the ‘what’ of a product, describing what the product is to accomplish (Gause & Weinberg, 2007).

Human factors: Human factors, also known as ergonomics, is the study of the measurements, capabilities, and limitations of the human body and how humans and machines interact with each other (Niku, 2009).

Sustainable design: A design philosophy that seeks to maximize the quality of the built environment, while minimizing or eliminating negative impact to the natural environment (McLennan & Berkebile, 2004).

1.7 Anticipated Outcome

The primary outcome of this study is to provide a new design guideline for designers to enhance the sustainability of their design with cultural elements. Using this guideline, designers could have the chance to extract cultural elements from the target culture and design the product with cultural elements while considering the cultural influence on product development in every stage of product life cycle, to improve the sustainability holistically. A practical product will be developed based on the design guideline.

Chapter 2

Literature Review

2.1 Motivation of this research

In the early nineteenth century, the most severe environmental issues were not a worldwide concern. Humans believed that natural resources on Earth seemed immeasurably vast, and nature itself would digest everything and continue to grow. Ralph Waldo Emerson (1957) described nature as the resource that will never changed by people. In recent years, our understanding of nature has dramatically changed. “New studies indicate that the oceans, the air, the mountains, and the plants and animals that inhabit them are more vulnerable than early innovators ever imagined. However, modern industries still operate according to paradigms that developed when human had a very different sense of the world” (McDonough & Braungart, 2009, p. 26). Nowadays, we are facing two main environmental problems: Resource Consumption and Depletion, Pollution and Waste Generation.

Environmental damage caused by human activity begins with the consumption of renewable and nonrenewable resources. Renewable resources should have the ability to replenish itself after being used in a short time. But, at present, renewable resources are heavily exploited by humans, which results in a significant loss of biodiversity (Sitarz, 1994). According to the estimation of humanity’s global footprint by WWF, we are using the resources of more than one and a half planets nowadays. (WWF, 2016)

Additionally, resources and energy use ultimately produce residuals that create significant environmental impacts. A report from the World Wildlife Foundation (2019) warns that an additional 104 million metric tons of plastic is at risk of leakage to our ecosystems by 2030 without a drastic change in approach. Waste is another severe problem. “According to

some accounts more than 90 percent of materials extracted to make durable goods in the United State become waste almost immediately” (McDonough & Braungart, 2009, p. 27). Sometimes the product itself scarcely lasts longer. What is more, the real situation is more severe than we thought, McDonough & Braungart (2002) imply “the product itself contains average only 5 percent of the raw material involved in the process of making and delivering” (p. 28).

Designers have a direct impact on the environment since all designers create products with natural resources, so the design is at the core of the environmental issues now. We can understand environmental issues are equal to the design issue. Humans don’t have pollution problem, they have a design problem. (Braungart & McDonough, 2013). William McDonough (2013) presents this opinion in his book *The Upcycle*, which indicates that there is a great desire on the part of designers to address environmental issues. Thus, product-related environmental issues are getting more and more political, and public awareness and many trends relating to sustainable design have come out. Development of sustainable products is necessary not only for politics but also for industry.

When most designers discuss how to make the product more sustainable, they neglect the importance of product life extension. “In many cases, longer-lived products could save resources and generate less waste and increase the sustainability of products significantly, because fewer units are needed to satisfy the same needs.” (Keoleian & Menerey, 1994, p. 656) It is not hard to understand that a longer-lived product means less pollution and waste in production, and it also reduces the cost and waste in the distribution process. Such product life extension is one of the most direct ways to reduce environmental impacts associated with human activities (Stahel, 1998). Extension of product life also is described as the 6th stage in OKALA eco-design strategy. Thus, we should never stop emphasizing the importance of the extension of product life. But, the

extension of product life does not mean there are no limitations and products can last or exist forever. “Useful life measures how long a system will operate safely and meet performance standards when appropriately maintained and not subjected to stresses beyond stated limits. Retirement is the defining event of useful life” (Keoleian & Menerey, 1994, p. 656). Making the product last is one of the most essential responsibilities of designers. For example, the plastic bottles we use today will produce toxic material after long term usage. How to make a bottle last longer, but not too long is the problem designers should think about. Having an understanding of extension of product life builds a solid foundation for the designer to create a sustainable product and it has great importance to address our environmental issues.

There are several methods to address the problem of product life extension. Adding cultural elements as a mean to creating a sense of product attachment can play the most indispensable role in it. Stefano Marzano (1999) discussed the necessity of cultural value in a product. He indicates that the designer needs to make the product which lasts longer, and – more importantly – which people want to keep it longer. With added cultural and personal values, people would form an emotional bond with those products. Therefore, product life can be extended by adding cultural elements to enhance the sustainability of the product.

As discussed above, it is clear that cultural elements as product attachment in the product, which builds the emotional relationship between user and product, can extend the product life. The sustainability of the product can be improved as well. However, there are few guidelines for process integration that the designer can utilize cultural elements to enhance the sustainability of products in the design process.

2.2 Culture

2.2.1 Definition of culture

Culture is one of the most complex word in English. The word *culture* comes from the Latin root *colere* (to inhabit, to cultivate, or to honor). In general, it refers to human activities; different definitions of culture reflect different theoretical bases for understanding or criteria for evaluating human activity. The concept has a different definition in various dictionaries, and people give a different definition to culture in various areas. Here are two definitions of culture which are more suitable for this research.

Hofstede (2005) defines culture as a sort of ‘software of the mind.’ According to him, every person carries patterned ways of thinking, feeling and reacting. These are partly unique and partly shared with others. The unique part belongs to the individual’s personality level. The common part belongs to the collective level. Culture is a collective phenomenon and is shared at least partially with other people living in the same social group. Culture can be treated as the collective programming of the mind that distinguishes the members of one group or category of people from another. Thomas (2003) defines culture as an orientation to individual perception, thinking and acting of persons belonging to a specific social group. Such an orientation is defined with so-called “cultural standards”. Cultural standards are values, norms, and points of reference, which are shared by persons belonging to a social group or community and seen as binding and normative by its members.

According to both definitions, we can understand that culture is a collective phenomenon, and culture influences the way people think, feel and react, so culture will also influence the designs of products for people with different cultural backgrounds.

2.2.2 Cultural characteristics and differences

2.2.2.1 No group can escape culture

There is a common sense that it is impossible for any group or individuals to divest themselves of their own culture. Hofstede (2005) states that in his book *Cultures and Organizations*, no group can escape culture. “Creating shared rules, even if they are never written down, is a precondition for group survival” (p, 12). Also, he states an example inspired by the novel by William Golding, *Lord of the flies*. A group of people from different areas are marooned on an uninhabited island after a plane wreck, and they have not met each other before, so they lack a common language and shared habits. The first thing they would do is to create a new common language and shared rules for behavior, cooperation, and leadership. The point of this example is to indicate that no group can escape culture and particulars of that culture will largely depend on chance, inheriting from existing values. Once the culture is set, as children are born into the group, that culture will reproduce itself.

Thus, all groups of in the world exist with a specific culture, and from all those cultures could be extracted cultural elements for designers in the design process.

2.2.2.2 Characteristics of culture

2.2.2.2.1 Culture pattern

Firstly, we need to understand what a culture pattern is. Saxon Graham (1957) explains what culture pattern is in his book *American culture*. It is the pattern of behavior which makes people in one group different from others. Each society teaches new members certain ways of behaving; the result is that Japanese act like Japanese and Americans act in their particular way. The composite ways of behavior which distinguish the Japanese living in Japan is called their

culture pattern. And he implies that the culture pattern is highly variable. The Japanese differ significantly from American. Americans are easily distinguished from Ukrainians. Therefore, we can find out different culture have different patterns and characteristics, and the difference of culture patterns will increase as the geographic distance expands. For example, the people in mainland China share many of the same customs and traditions with people in Taiwan. However, the culture is different between Chinese culture and European culture since the distance from mainland China to Europe is greater than the one to Taiwan. What is more, the difference between various culture pattern can be expressed in a more detailed way.

2.2.2.2.2 Two aspects of culture

After we understand what pattern of culture is and how it influences the behavior of people, we will have to know two more aspects of culture: material culture and nonmaterial culture.

“Material culture consists of the physical products of human society ranging from weapons to clothing styles. Nonmaterial culture refers to the intangible of the products of human society (value, beliefs, and norms)” (Scupin, 2016, p.43). Both material culture aspect and immaterial culture aspect of culture are available to be the design inspiration for the designer in the design process, especially in the research stage.

2.2.2.2.3 Culture universals

“Culture universals are essential behavioral characteristics of societies, and they are found all over the world.” (Scupin 2016, p.54) so culture universals can also be understood as expressive forms. George Murdock, an anthropologist compiles a list of culture universals from

hundreds of societies. Murdock's list of cultural universals can be seen in Table 1; it includes such basics as language, cooking, family, folklore, games, community organization, decorative art, education, ethics, mythology, food taboos, numerals, personal names, magic, religious rituals, puberty customs, toolmaking, and sexual restrictions (cited in Scupin, 2016).

age grading	faith healing	joking	pregnancy usages
athletics	family	kin group	property rights
bodily adornment	feasting	kin terminology	propitiation of supernatural beings
calendar	fire making	language	puberty customs
community organization	folklore	magic	religious rituals
cooking	food taboos	marriage	residence rules
cooperative labor	funeral rites	mealtimes	sexual restrictions
cosmology	games	medicine	soul concepts
courtship	gestures	modesty	status differentiation
dancing	gift giving	mourning	toolmaking
decorative art	greetings	music	trade
division of labor	hairstyles	mythology	visiting
dream interpretation	hospitality	numerals	weaning
education	housing	obstetrics	weather control
ethics	hygiene	personal names	
ethnobotany	incest taboos	population policy	
etiquette	inheritance	postnatal care	

Table 1 Cultural universals described by anthropologist George Murdock (Scupin 2016, p.54)

Another American professor of anthropology, Donald Brown (1991) provides a list of hundreds of items he suggests as universal in his book *Human Universals*. The list from Donald Brown is the most comprehensive list of cultural universals so far and Steven Pinker (2002) lists all Brown's universals in the appendix of his book *The Blank Slate*. Table 2 and table 3 show the list created by Brown

abstraction in speech	contrasting marked and	females do more direct	linguistic redundancy	nouns	rhythm	statuses and roles
and thought	nonmarked sememes	childcare	logical notions	numerals (counting)	right-handedness as	statuses, ascribed and
actions under self-control	(meaningful elements in	figurative speech	logical notion of "and"	Oedipus complex	population norm	achieved
distinguished from those	language)	fire	logical notion of "equivalent"	oligarchy (de facto)	rites of passage	statuses distinguished
not under control	cooking	folklore	logical notion of "general/ particular"	one (numeral)	rituals	from individuals
aesthetics	cooperation	food preferences	logical notion of "not"	onomatopoeia	role and personality seen	statuses on other than
affection expressed and felt	cooperative labor	food sharing	logical notion of "opposite"	overestimating objectivity	in dynamic interrelationship	sex, age, or kinship
age grades	copulation normally	future, attempts to predict	logical notion of "opposite"	of thought	(i.e., departures from role	bases
age statuses	conducted in privacy	generosity admired	logical notion of part/whole"	pain	can be explained in terms	stop/nonstop contrasts
age terms	corporate (perpetual)	gestures	logical notion of "same"	past/present/future	of individual personality)	(in speech sounds)
ambivalence	coyness display	gift giving	magic	person, concept of	sanctions	succession
anthropomorphization	crying	good and bad distinguished	magic to increase life	personal names	sanctions for crimes	sweets preferred
antonyms	cultural variability	gossip	magic to sustain life	phonemes	against the collectivity	symbolism
baby talk	culture	government	magic to win love	phonemes defined by	sanctions include removal	symbolic speech
belief in supernatural/ religion	culture/nature distinction	grammar	male and female and adult	sets of minimally	from the social unit	synonyms
beliefs, false	customary routines	group living	and child seen as having	contrasting features	self distinguished from other	taboos
beliefs about death	dance	groups that are not	different natures	phonemes, merging of	self as neither wholly passive	tabooed foods
beliefs about disease	death rituals	based on family	males dominate public/ political realm	phonemes, range from	nor wholly autonomous	tabooed utterances
beliefs about fortune	decision making	hairstyles	males more aggressive	10 to 70 in number	self as subject and object	taxonomy
and misfortune	decision making, collective	hand (word for)	males more prone to	phonemic change,	self is responsible	territoriality
binary cognitive distinctions	directions, giving of	healing the sick (or attempting to)	lethal violence	inevitability of	semantics	time
biological mother and social	discrepancies between speech,	hospitality	males more prone to theft	phonemic change, rules of	semantic category of	time, cyclicity of
mother normally the	thought, and action	hygienic care	manipulate social relations	phonemic system	affecting things and	tools
same person	dispersed groups	identity, collective	marking at phonemic,	planning	people	tool dependency
black (color term)	distinguishing right and wrong	incest between mother	syntactic, and lexical levels	planning for future	semantic category of	tool making
body adornment	diurnality	and son unthinkable	marriage	play	dimension	tools for cutting
childbirth customs	divination	or tabooed	materialism	play to perfect skills	semantic category of giving	tools to make tools
childcare	division of labor	incest, prevention or	meal times	poetry/rhetoric	semantic category of location	tools patterned
childhood fears	division of labor by age	avoidance	meaning, most units of	poetic line, uniform	semantic category of motion	culturally
childhood fear of	division of labor by sex	in-group distinguished	are non-universal	length range	semantic category of speed	tools, permanent
loud noises	dreams	from out-group(s)	measuring	poetic lines characterized	semantic category of other	tools for pounding
childhood fear of strangers	dream interpretation	in-group, biases in	medicine	by repetition and variation	physical properties	trade
choice making (choosing	economic inequalities	favor of	metaphor	poetic lines demarcated by	semantic components	triangular awareness
alternatives)	economic inequalities,	inheritance rules	metonym mood- or	pauses	semantic components,	(assessing
classification	consciousness of	insulting	consciousness- altering	polysemy (one word has	generation	relationships among
classification of age	emotions	intention	things or things that	several related meanings)	semantic components sex	the self and two
classification of	empathy	interest in bioforms (living	and/or	possessive, intimate	sememes, commonly used	other people)
behavioral propensities	entification (treating pat terns	techniques and/or	substances	possessive, loose	ones are short, infrequently	true and false
classification of body parts	and relations as things)	resemble them)	morphemes	practice to improve skills	used ones are longer	distinguished
classification of colors	envy	interpreting behavior	mother normally has consort	preference for own children	senses unified	turn-taking
classification of fauna	envy, symbolic means of	intertwining (e.g., weaving)	during child rearing years	and close kin (nepotism)	sex (gender) terminology is	two (numeral)
classification of flora	coping with	jokes	mourning	prestige inequalities	fundamentally binary	tying material (i.e.,
classification of	ethnocentrism	kin, close distinguished	murder proscribed	private inner life	sex statuses	something like string)
inner states	etiquette	from distant	music	promise	sexual attraction	units of time
classification of kin	explanation	kin groups	music, children's	pronouns	sexual attractiveness	verbs
classification of sex	face (word for)	kin terms translatable by	music related in part to dance	pronouns, minimum two	sexual jealousy	violence, some forms
classification of space	facial communication	basic relations of	music related in part to	numbers	sexual modesty	of proscribed
classification of tools	facial expression of anger	procreation	religious activity	pronouns, minimum three	sexual regulation	visiting
classification of	facial expression of contempt	kinship statuses	music seen as art (a creation)	persons	sexual regulation includes	vocalic/nonvocalic
weather conditions	facial expression of disgust	language	musical repetition	proper names	incest prevention	contrasts in
coalitions	facial expression of fear	language employed to	musical variation	property	sexuality as focus of interest	phonemes
collective identities	facial expression of happiness	manipulate others	musical repetition	psychological defense	shelter	vowel contrasts
conflict	facial expression of sadness	language employed to	speech forms	mechanisms	sickness and death seem	weaning
conflict, consultation	facial expression of surprise	misinform or mislead	musical redundancy	rape	as related	weapons
to deal with	facial expressions, masking	language is translatable	musical variation	rape proscribed	snakes, wariness around	weather control
conflict, means of	/modifying of	language not a simple	myths	reciprocal exchanges (of	social structure	(attempts to)
dealing with	family (or household)	reflection of reality	narrative	labor, goods, or services)	socialization	white (color term)
conflict, mediation of	father and mother, separate	language, prestige from	nomenclature (perhaps	reciprocity, negative (revenge,	socialization expected	world view
conjectural reasoning	kin terms for	proficient use of	the same as classification)	retaliation)	from senior kin	
containers	fears	law (rights and obligations)	nonbodily decorative art	reciprocity, positive	socialization includes	
continua (ordering as	fears, ability to overcome some	law (rules of membership)	normal distinguished from	recognition of individuals	toilet training	
cognitive pattern)	feasting	leaders	abnormal states	by face	spear	
		lever		redress of wrongs	special speech for	
					special occasions	

Table 2 Cultural universals described by Donald Brown (Pinker, 2002, p.435-439)

Additions Since 1989

anticipation	males, on average, travel greater	resistance to abuse of power,
attachment	distances over lifetime	to dominance
critical learning periods	males engage in more	risk taking
differential valuations	coalitional violence	self-control
dominance/submission	mental maps	self-image, awareness of
fairness (equity), concept of	mentalese	(concern for what others think)
fear of death	moral sentiments	self-image, manipulation of
habituation	moral sentiments, limited	self-image, wanted to be positive
hope husband older	effective range of	sex differences in spatial
than wife on average	precedence, concept of (that's	cognition and behavior
imagery	how the leopard got its spots)	shame
institutions (organized	pretend play	stinginess, disapproval of
co-activities)	pride	sucking wounds
intention	proverbs, sayings	synesthetic metaphors
interpolation	proverbs, sayings-in mutually	thumb sucking
judging others	contradictory forms	tickling
likes and dislikes		toys, playthings
making comparisons		

Table 3 Addition cultural universals described by Donald Brown (Pinker, 2002, p.439)

The table shown above provides a resource to extract the element of culture in design process. One thing needs to mention is that there are countless cultural elements existing and there are no research or article could involve all cultural elements even the list from Donald Brown (1991).

2.2.2.3 Culture differences

Cultural differences manifest themselves in several ways. Hofstede (2005) concludes that four aspects cover the total concept rather neatly: symbols, heroes, rituals, and values. In figure 1 those have been pictured as the skin of an onion. Indicating the symbols representing the most superficial and values the deepest manifestation of culture, with heroes and rituals in between. (p, 7) This means each different culture have different symbols, heroes, rituals, and the

most different are their core values. For example, the main difference between Chinese culture and American culture are their culture values, reflected by different foods, languages, and arts...

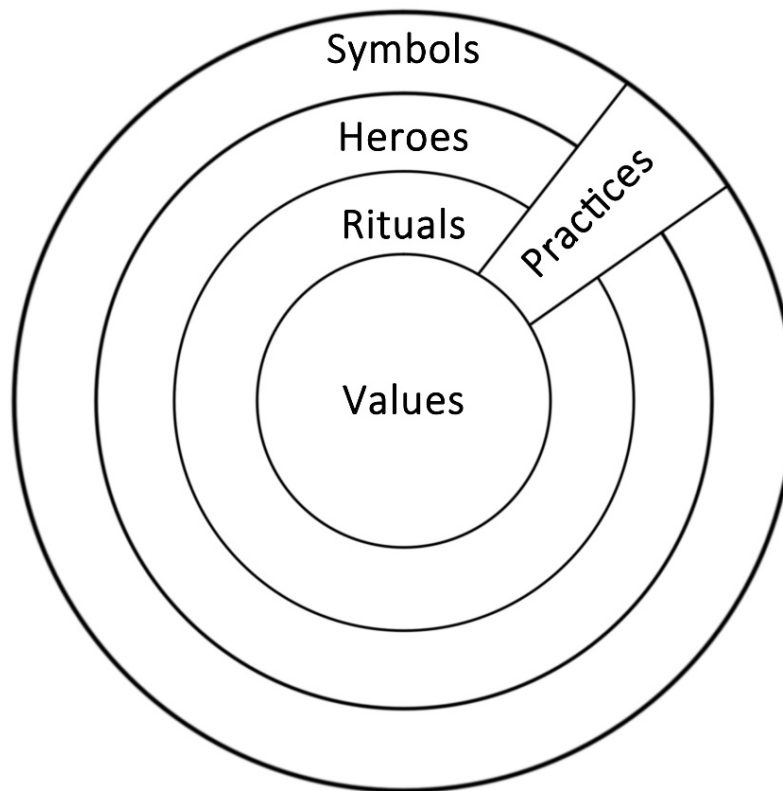


Figure 1 Culture differences (Hofstede, 2005, p.8)

“Symbols are words, gestures, pictures, or objects that carry a particular meaning that is recognized as such only by those who share the culture” (Hofstede, 2005, p.8).

“Heroes are person, alive or dead, real or imaginary, who possess characteristics that are highly prized in a culture and thus serve as models for behavior” (Hofstede, 2005, p, 8). Even the cartoon characters can serve as cultural heroes, such as Batman and Snoopy in the United State.

“Rituals are collective activities that are technically superfluous to reach desired ends but that, within a culture, are considered socially essential. Rituals include discourse, the way

language is used in text and talk, in daily interaction, and in communicating beliefs” (Hofstede, 2005, p, 9).

The core of culture is formed by values. According to Hofstede (2005), values are feelings with an added arrow indicating a plus and a minus side. And they deal with pairings such as the following:

Evil versus good

Dirty versus clean

Dangerous versus safe

Forbidden versus permitted

Decent versus indecent

Moral versus immoral

Ugly versus beautiful

Unnatural versus natural

Abnormal versus normal

Paradoxical versus logical

Irrational versus rational (p, 9)

From what we have discussed above, we can conclude that each culture has different cultural values and different expressive forms. Therefore, it is not meaningless to design the product with the different cultural elements, and the product with different culture values that can be distinguished by users. Values from separate countries offer, and are expressed through various symbols, heroes, and rituals as well. For example, one of the cultural values of USA is heroism, and it is reflected in characters in America, like Batman and Superman, and people mimic the way they talk and act.

2.2.2.4 Layer of culture

As we know, as almost everyone belongs to multiple cultural groups and subcategories. At the same time, we unavoidably carry several layers of mental programming within ourselves, corresponding to different levels of culture. Hofstede (2005) divides culture into six layers:

A national level according to one's country (or countries, for people who migrated during their lifetimes)

A regional and/or ethnic and/or religious and/or linguistic affiliation level

A gender level, according to whether one was born as a girl or as a boy

A generation level, separating grandparents from parents from children

A social class level, associated with educational opportunities and with a person's occupation or profession

For those who are employed, organizational, departmental, and/or corporate levels according to the way employees have been socialized by their work organization (p, 18).

Since those six different layers of culture are not in harmony, and nowadays, they were often overlapping with each other. For example, religious values may conflict with generation values. It is too broad to involve all layers of culture in our research, and this research only focuses on geographical culture difference. So, in this research, we would only consider the national level and regional level as our target.

2.2.2.5 Cultural relativism

We unavoidably judge other cultures as better or worse. And a question is being asked whether there is any culture is better than others or worse than others? There is no measure for

proving specific culture as superior or inferior to others. Hofstede (2005) indicates there is no right to judge to another culture as “low” or “noble”. “However, “every culture can and should apply such judgment to its activities, because its members are actors as well as observers” (Hofstede, 2005, p. 25). All cultures cannot make fair judgment to others objectively since the evaluate system have to be influenced by their own culture.

Thus, there is no need for people to judge which culture is better, and all cultures in the world are equal. For designers, all cultures can be chosen to be the subject of the design application.

2.2.3 Incorporation of culture and design

2.2.3.2 Cultural influences on design process

Since it is clear that culture plays an essential role in design, the design process will be affected by cultural influences. The designer will have to take cultural factors into account in the design process. There are two aspects of culture that influence design process mainly discussed in this research.

First, since culture has potential and unavoidably influences on designers, then designers will generate different design approach according to different cultural influences. Those culturally influenced approaches will affect the design process (Gautam & Blessing, 2007). Compared to the regular design process, Vivek Gautam and Lucienne Blessing concentrated on the influences that affect designer passively. For the designer who is not even concerned about the cultural factors in their design initiative will still generate different design processes since all engineering designer cannot divest themselves from the cultural influences. This aspect is the

design process influence by culture passively. Figure 2 indicate the culture influences on design process

Hofstede (2005) also makes some similar statements. According to him, culture influences the way people think, feel and react, and culture will influence the way designers design as well. Therefore, designers with different culture backgrounds will have different culturally influenced approaches, and they will have different design processes. However, the passive influences in design process are hard to control and measure, so there is no way to scale the level of design passively affected by specific culture.

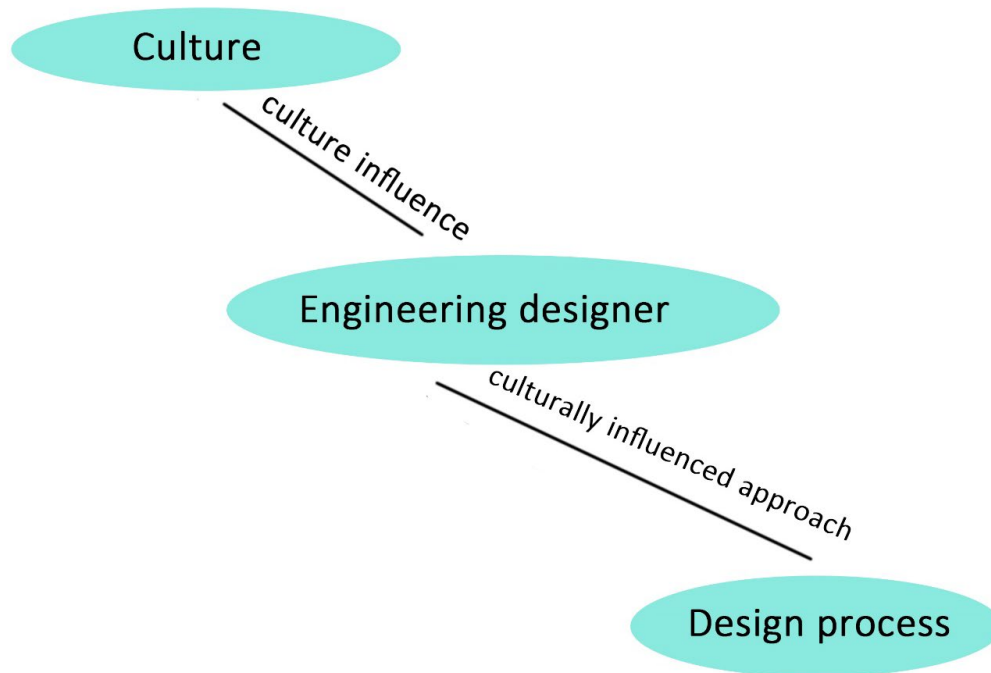


Figure 2 Cultural influences on engineering designers and their effects on design processes(Gautam &Blessing, 2007, p.2)

Another aspect is that designers in the cultural design process intentionally show their intent to apply specific cultural elements in their design intentionally. Benny Ding Leong (2003)

drew another model to explain how culture influences the design process. He identifies three key research components, or anchors:

Core knowledge, which refers to the essential cultural cognition or point of orientation, design criteria that equates with the value orientation, and (design) methods that directed the designer how to design with criteria. Figure 3 show the culture influences in design process by Leong

The designer will be required to have basic core knowledge of selected culture and learn cultural cognition before designing, as they generate specific design criteria that also need to be guided by value orientation. For example, if a designer is going to design a dining table for a traditional Chinese family in China, the designer will have to study core knowledge of Chinese culture. After he knows the family is the core cultural value which differs to other cultures, the design criteria will be created automatically. Therefore, the designer will make the table in a round shape and big enough so that all family members could share food at the table together, according to the specific design criteria based on cultural cognition.

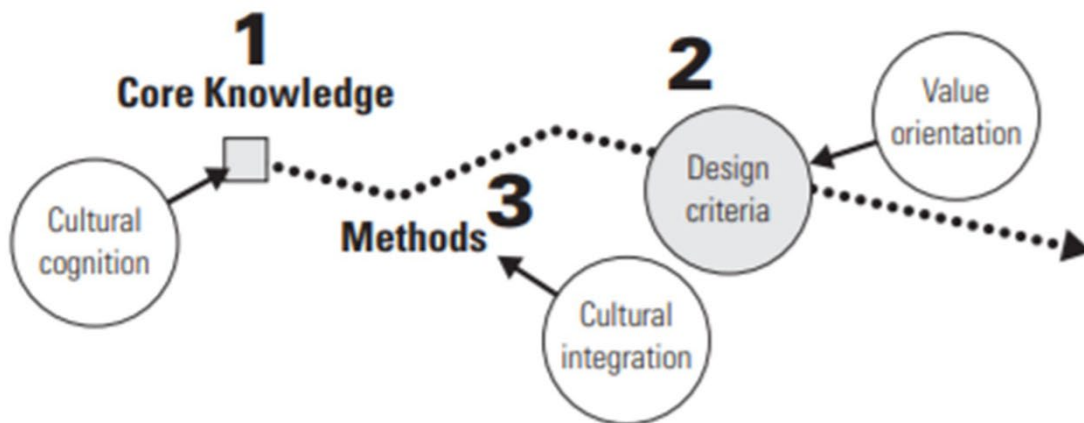


Figure 3 culture influences in design process by Leong (Leong and Clark, 2003, p.56)

Most designers would ignore the cultural influences in their design, but they will have to be affected by their group's culture. So, the result of the design process influenced passively by culture could be neglected. In this research we will only focus on the second aspect- the cultural influences on design process intentionally.

2.2.3.3 Cultural design framework

2.2.3.3.1 The “spatial perspective” of culture

Any culture has its spatial ability, and the cultural space has its hierarchical structure. Xing-Liang He (1992) explains the “spatial perspective” of culture in his book *The Worship of Chinese Gods of Nature*. The horizontal level can be called the “space culture layer”. According to the cultural expressive form, each cultural system or cultural cluster can be divided into upper, middle and lower layers of a three-layer structure, namely “surface layer”, “middle layer” and “deep layer”. Figure 4 shows the spatial perspective of culture. “Spatial perspective of culture” provides a manageable framework to visualize and capture the fluid concept of culture for designers and help to identify the research focus (Leong , Clark, 2003).

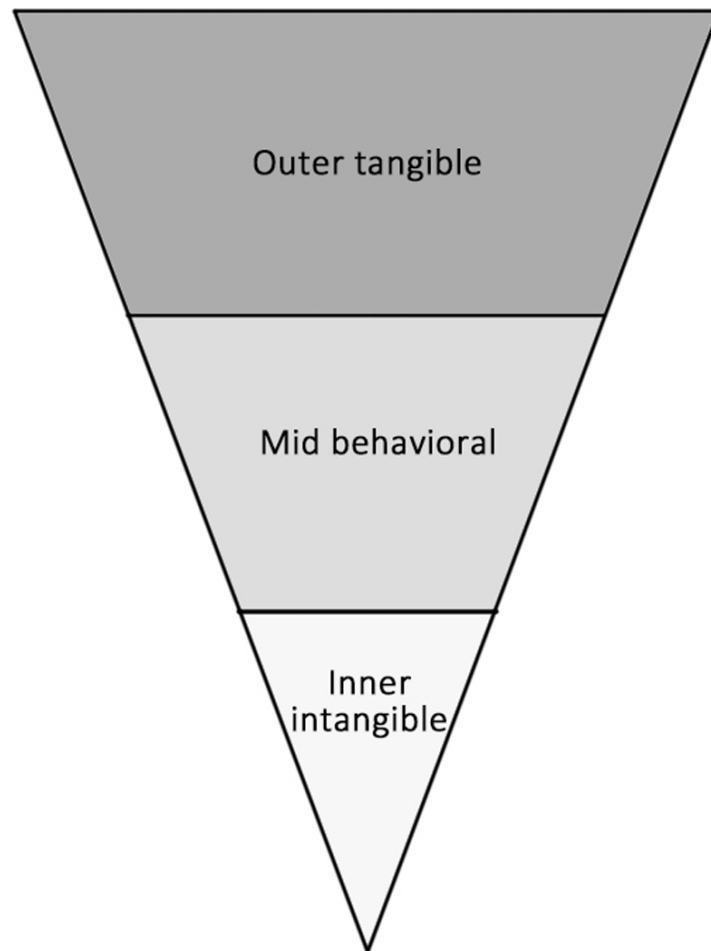


Figure 4 Spatial perspective of culture

The surface culture is expressed in the form of material or materialized objects. It is explicit, tangible, and visible; examples such as various costumes, houses, temples, religious sacred objects, idols, etc. all belong to this layer. The middle culture is expressed in human behavior or language, and is intangible but visible or audible, seen in examples such as various crafts and production activities, religious activities and ceremonies, various systems and regulations, and music, dance, all kinds of life rituals, living customs and taboos. The deep

culture is expressed in the ideology of human beings. It is implicit, intangible and not easy to detect. It is the religious concept, family concept, marriage concept, aesthetic concept, value concept, political concept hidden in the human mind. To fully understand the deep culture of a nation or a group, it is necessary to take a long time to study it. Although it is invisible, its various concepts and beliefs are reflected in the middle and superficial culture (He, 1992). To understand the cultural space has significant meaning for the designer, because the designer can quickly form the value orientation (design criteria) of a particular culture with the model of the “spatial perspective” of culture. Moreover, the model from Xing-Liang He is also enlightening. Several design frameworks were creatively based on this model, discussed in the next section.

2.2.3.3.2 Cultural design framework

There are several cultural design frameworks; however, in this research we would only discuss about the framework based on the framework from He’s model. There are two main frameworks.

Based on the model from Xing-Liang He, Rung-Tai Lin (2007) offers a framework for studying cultural objects. Figure 5 show the cultural design framework created by Lin. In his framework, culture can be classified into three layers:

- (1) physical or material culture-including food, garments, and transportation-related objects,
- (2) social or behavioral culture--including human relationships and social organization,
- (3) spiritual or ideal culture--including art and religion. (p. 46)

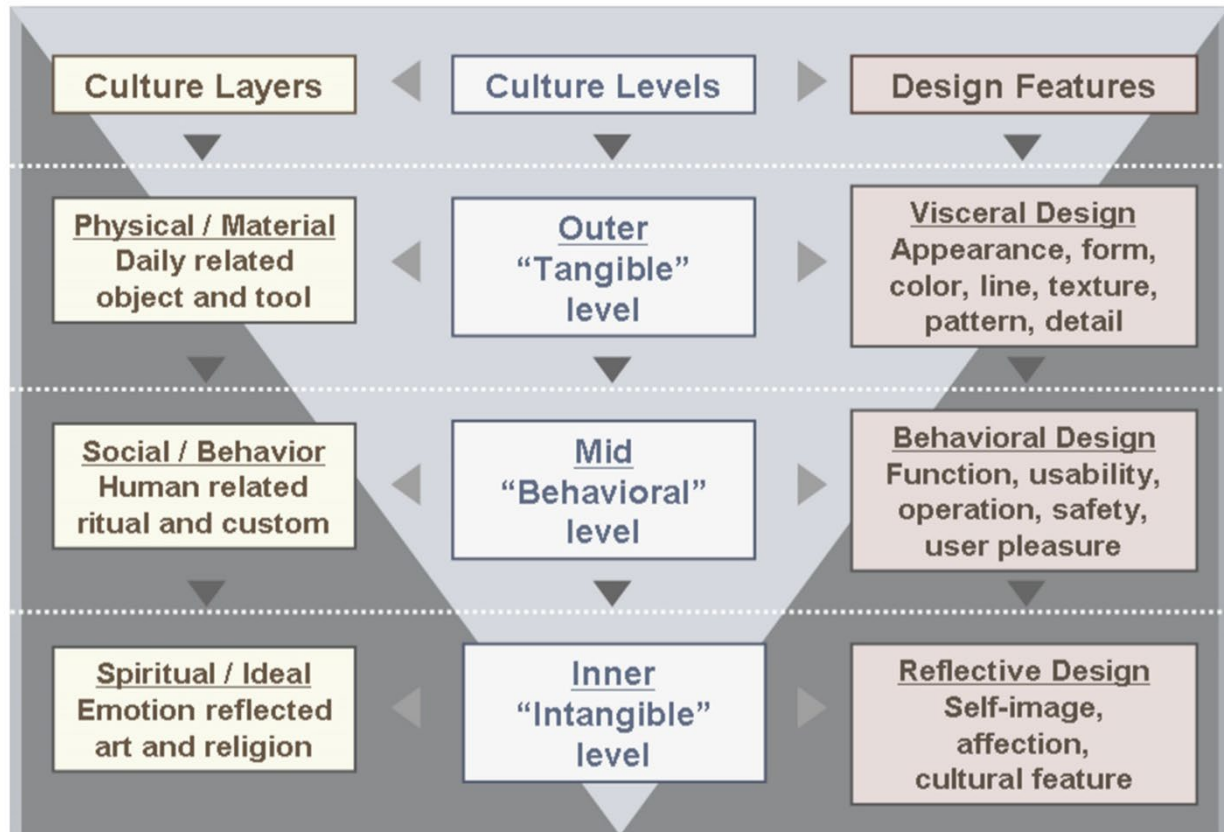


Figure 5 Cultural design framework by Lin (Lin, R.,2007, p.46)

These three layers of culture can be fitted into He’s three level of the spatial perspective of culture, given above (Lin, 2007). Where cultural objects can be incorporated into cultural design, three design features can be identified, as follows:

- (1) the inner level, containing special content such as stories, emotions, and cultural features,
- (2) the mid-level, dealing with function, operational concerns, usability, and safety,
- (3) the outer level, dealing with color, texture, form, decoration, surface pattern, line quality, and detail. (p. 46)

The model from Lin provides designers a method to extract design elements from products and consistently apply cultural factors into products.

Another framework based on the spatial perspective of culture is the “matrix” spatial structure of culture created by Benny Ding Leong (Leong & Clark, 2003). Since the “cultural space” framework alone is not adequate, Leong developed a matrix model of the cultural space model.

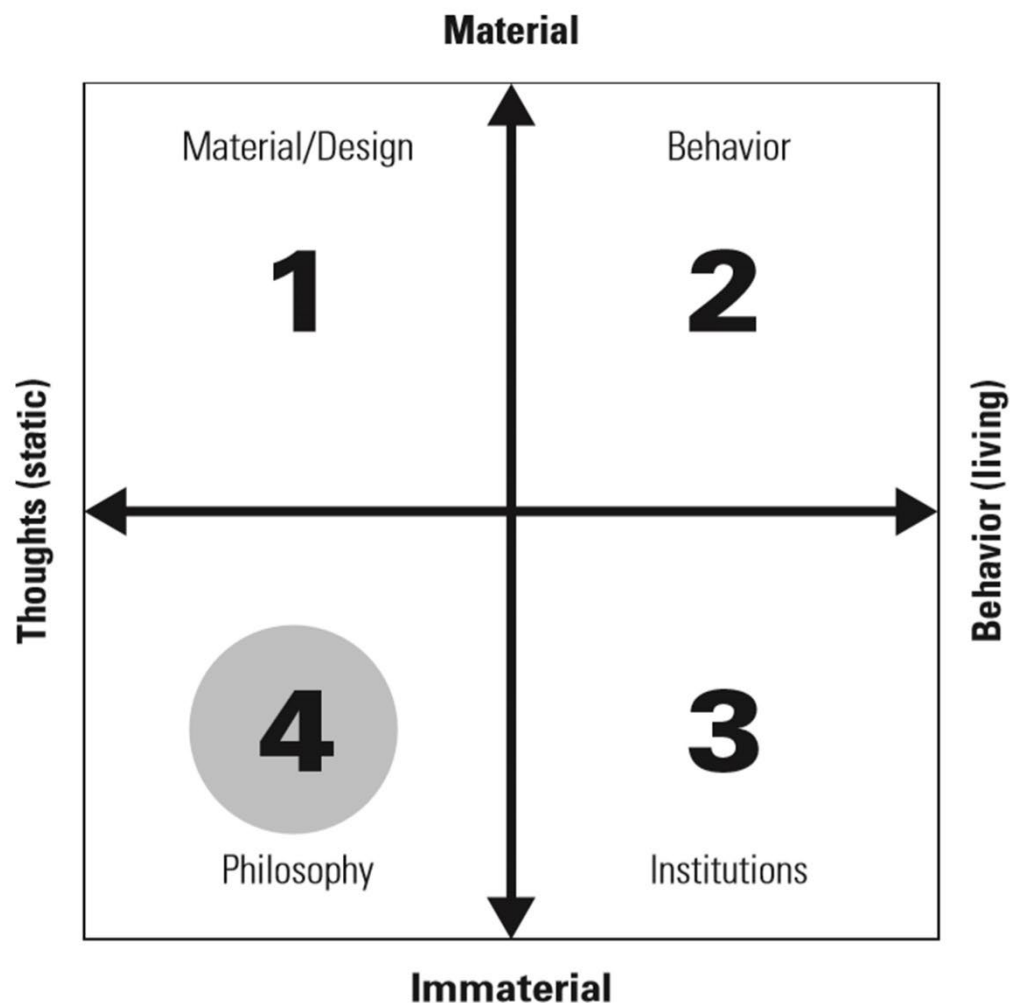


Figure 6 Matrix model from Leong (Leong and Clark, 2003, p.56)

Figure 6 shows the matrix model from Leong. Leong and Clark (2003) indicate that the matrix model is a more elaborate and precise tool, constructed on a vertical axis from the

material to the immaterial, and a horizontal one from behavior to thought to form four quadrants of cultural space that equate with the four general axes of the research:

- 1 Material/design, style (a particular physical form, or generated from a certain philosophy or ideology),
- 2 Behavior, the individual acts and social interactions affected by using artifacts,
- 3 Institutions, customs (behavior passed through forms of regulation or traditions),
- 4 Philosophy or ideology, (structured thoughts, such as philosophical concepts, accumulated over time). (p. 56)

The matrix model from Leong offers a better way to classify all culturally expressive forms, and it provides sufficient tools for directing the focus of the research.

2.2.4 Extension of product life and sustainability

Due to the environmental issues we are facing nowadays, as a designer, one of our responsibilities in design is to extend the product life since longer-lived product save more resources and generate less waste (Keoleian & Menerey, 1994). Cooper & Mayers (2000) provide the case of a washing machine where “earlier research found that the average age of the 2.5 million washing machines, dishwashers and tumble driers discarded in Britain each year was 9 years, which created 170,000 tonnes of waste. This could eventually be reduced by 60,000 tonnes annually if average life-spans were to increase by 50%, from 9 years to 14 years”. Therefore, we can conclude that if a product’s lifespan is increased, the product’s eco-efficiency ratio increases; the product is more sustainable (Piper-Kaiser, 2014). For example, if a plastic bottle is designed to be used for ten years and go back to recycle, but the customer only uses it for four years and throws it away, in this situation, we could say that the bottle’ sustainability is

not strong enough. Therefore, the extension of the product's use can enhance the sustainability of the product.

2.2.5 Culture as attachment in product

Firstly, we need to know the definition of product attachment. Mugge, Schoormans, and Schifferstein (2008) stated, "the definition of product attachment suggests that when an experiencing attachment to a product, a strong relationship or tie exists between the individual on the one hand and the object on the other" (p. 426). They also imply the importance of the product attachment for the user, "People may experience relatively strong emotional bonds to their most favorite or special possessions, whereas other products are less significant to them" (p. 426). Stefano Marzano (1999) has indicted the necessity of product attachment in his book, and he made an example here. We may cherish a book that belonged to our grandmother- not so much because of its contents, but because, for us, it is somehow part of her. Such objects not only serve a practical function, but they also carry memories, which makes it not easy for their owners to throw them away.

Secondly, we have to know how the user can form a product attachment to a certain product. Myers (1985) stated, "A person's attachment to special possessions is a dynamic process. This process involves, first, the object; second, the individual and her or his situation and history; and finally, the interaction of the two, an individual's investment in a special possession" (p. 562). According to definition of culture, we can understand that culture is a collective phenomenon, and culture influences the way people think, feel and react. It is not hard to understand that culture will affect and form unique individual situation and history compare to others. Furthermore, Stefano Marzano (1999) also implied that in order to add an attachment in

product designer should consider the personal value and the cultural value in the product. Therefore, culture as an attachment in product forms a strong relationship between user and product.

2.2.6 Semiotics analysis in culture

As we have discussed above, we know culture is very complicated and could be vast in research, some cultural elements after we extracted could not be utilized in design directly. We need to use semiotics analysis to obtain more details hidden under the cultural elements. According to Sebeok (2001) “The phenomenon that distinguishes life forms from inanimate objects is semiosis. This can be defined simply as the instinctive capacity of all living organisms to produce and understand signs.”(p. 1)

Hall (1990) also implies that culture hides much more than it reveals, and semiotics help people to reveal the meaning hidden behind the culture. By analyzing the hidden information under the cultural elements, we could understand the character of the culture. Which can be utilized in future design process explicitly.

Chandler (2013) indicates that semiotics is comprised of three branches: syntactics, semantics, and pragmatics.

semantics: the relationship of signs to what they stand for;

syntactics (or syntax): the formal or structural relations between signs;

pragmatics: the relation of signs to interpreters

The reason we could use semiotics to analysis the cultural elements is because it not only could be applied in linguistics, but also other areas. Indeed, at first semiotics only applied to linguistics, with the further understanding of semiotics, semiotics has gradually expanded to

other fields (Morley, 2014) According to Hodge and Kress (2010) Everything in a culture could been treated as way to communicate, organized in ways similar to language. Therefore, semiotics includes not only linguistics, but also other parts including culture.

It is necessary to interpret three branches of semiotics into the way can analysis culture elements explicitly.

“1. Semantics - The relationship between signs and the things to which they refer or their meaning means: How does it mean what it means?

2. Syntactics - The relations among signs in formal structures means: What does something mean?

3. Pragmatics – The relations between signs and the effects they have on the people who use them means: Why does it mean what it means?” (Morley, 2014, p. 6)

2.3 Value Perception

2.3.1 Concept of Value Perception

In *Value Analysis in Design*, Flower (1990) defines value as: A product must fulfill a user’s need or want in order to have value. The most fundamental concept of modern value analysis is represented by the following basic equation (p. 19):

$$\text{Value} = \frac{\text{Worth}}{\text{Cost}}$$

According to the definition of product value, the value of the product forms from the need and want from users. Thus, the value of the product is the key point to decide if the product meets the need from users and if customers want to keep the product for a long time or not.

The concept of product value also provides designer an opportunity to assess the design quality. “The concept of design quality can be defined as a value judgment as a result of the interaction between a product and an individual in the context of a value system of the group” (Volker, 2011, p. 34). Since the value of product to users is based on the needs or wants of user, it is not hard to understand that the evaluation of a product is depends on the users’ value perception. So, when a user perceives a higher quality in one product and a lower quality in another product, the user will accept the product with higher quality, because they perceive higher value in product.

On the other hand, value perception also has great influence on product life extension; it is clear that users who perceive high quality of product would want to keep it longer.

One important aspect which is ignored by the designer is that the value perception of users will have to influenced by culture. People make value judgments when they evaluate an object concerning their different cultural background (Volker, 2010). According to Collins (1971) value judgments should always take into account all the cultural aspects involved in the judgment process. Therefore, users with different culture backgrounds will form their unique value perceptions according to their various growing environments and cultural cognition. And the cultural influences on user’s value perceptions also can be certified by Hofstede’s 2010 theory that culture is software in people’s mind. Culture is a collective phenomenon, and culture influences the way people think, feel and react, so culture will also influence the way people from their value perception of the product. For example, in both Asian countries and America

individuals use knife and fork in their daily life, but people in Asian countries have different value perception of knife and fork from the people in the USA, based on their different cooking cultures and eating habits. Therefore, there are so many products that are famous in their original area, but not prevalent in other areas.

Since culture can influence the way that users form their value perceptions, the culture will have to affect the main factors which influence the users' value perceptions. There are four main factors that could influence the value perception of users. "In the product design area, the product properties, such as form, function, and human factor, will influence the consumers' value perception. Besides, in the consumer aspect, the context will significantly affect the value judgment for individual groups as well because the perception of products is reflected from the personalities of consumers themselves" (Xin, 2016, p. 10).

2.3.2 The form and aesthetic influence

The aesthetic value of a product pertains to the pleasure derived from seeing the product, before the utility (Holbrook, 1980). The user could consider the look of a product in their own way and in their own purpose. This means if the product alternatives are similar in functioning and price, the users will choose the one that the appeals the most to them aesthetically. Aesthetic responses are primarily emotional or feeling responses, and as such they are very personal (Bamossy, Scammon, Johnston, 1983). The aesthetic standard of people will be influenced greatly by culture; aesthetic also is a cultural expressive form drawn from culture universals, so the aesthetic standard is different in various cultural areas.

"Aesthetics of design are combination of a number of different elements that collectively create the shape and the feeling that particular shape presents." (Niku, 2009, p. 307). There are

some main elements that work together in creating the particular perception that they project to the customers: form, color, line and shape, texture, material

2.3.2.1 The Form of Product

One of the most important deciding factors for selecting a product, especially for consumer products, is the aesthetics of the product. Aside from brand name loyalties or word of mouth, the first thing that attracts a customer to a product is the way it looks.(Niku, 2009).

However, the definition of form of the product is very abstract and complicated. Form is shape translated into three -dimensional volume (Stoops, Samuelson, 1990). Niku (2009) defines form of a as the collection of the shapes or arrangement of the different parts of an object. For example, Niku states that “the form of an airplane is the collection of the shapes of the fuselage, the wings, the rudder, and the engines in a particular arrangement.”(p. 308)

Additionally, Niku (2009) also mentioned that the form of a product has been likened to the interface between the inputs and outputs of two systems, one technical, another biological. For example, the inputs to a stereo are the signals, the volume level, the tone, and other commands by the user. The outputs of the stereo are the sound, its level, and its qualities, but also the appearance of the stereo. The components of the stereo constitute part of its form (the shape), and its function constitutes another aspect of the form. This is why form and its elements are such an important aspect of the aesthetics of the product. (p. 308)

According to Coates (2003) purposes, every product is supposed to have an perfect form, which once attained will tend to be considered attractive by everyone. “However, the consumers’ subjective experiences are also important and contribute to aesthetic impressions. For example, prior experience will influence the perception of product typicality and novelty.” (Crilly,

Moultrie, Clarkson, 2004, p. 556) The visual appeal of objects is also influenced by socio-cultural, socio-economic, historical and other cultural factors. That's why the ideals and standards to which one culture aspires may not be appreciated by other cultures.

Therefore, from all we have discussed above, we can find out that culture not only can influence user's aesthetic standard, but also the preference of a certain form of a product. And aesthetics and product forms are very important factors that affect user's value perception.

2.3.2.2 Color

2.3.2.2.1 Color Characteristics

According to Niku (2009), colors are specified by three qualities:

1. Hue, which is the name of the color such as red, green, blue, brown.
2. Saturation (intensity, brilliance, purity, strength) which is the color's brightness or dullness. The best way to change saturation without changing the value of the color (see below for value) is by adding gray to the color. As the gray intensity increases, the saturation decreases. The maximum saturation level of a color is equal to the intensity of the color as white light leaves a prism. Neon colors are high in intensity (low in grey) and therefore are very bright.
3. Value, which is quality of darkness or brightness or amount of light reflected from the color. Achromatic colors, black, white, and all grays, have zero saturation, but different values. Similarly, for any given hue, as more white is added to the color, its value decreases. (p. 317 - 318)

Those three characteristics work together to form the properties of color.

2.3.2.2.2 Visual Effects of Colors

“Colors have many psychological and visual effects, both positive and negative” (Niku, 2009, p. 319). He implies that certain colors may be preferred by different people. The visual effects of color are very important to users.

Furthermore, Xin (2016) also cites the same statement about perception of color in his thesis. People describe the perception of color by cold or warm. The blue or green color to some people means peaceful or makes them feel clam; they are cool colors because they remind people of the image of winter or autumn. In contrast, the red, orange, and yellow colors normally evoke the memory of fire or sunshine to most people, so they are warm colors. The perception of colors is different for different individuals. Therefore, we can deduce that color is an important factor to affect user’s value perception of a certain product and that different people will form different preferences in color. Niku (2009) provides a Table to indicate the differences in color preferences between men, children, and women. Table 4 shows the differences in color preferences

Color Preferences	For men: Blue, red, violet, green, orange, yellow For children: Orange, red, blue, green, violet, yellow For women: Red, blue, violet, green, orange, yellow
-------------------	--

Table 4 Differences in color preferences (Niku, 2009, p. 319)

Colors have psychological associations and effects so that they can influence user’s preferences in color. Various colors will provide users different psychological perceptions, according to different individuals. Specifically, red color will remind people of fire, white color will remind people of snow, and green will remind people of trees and grass. (Niku, 2009) Table 5 is the table of color’s psychological effects

Color	Mood Created	Sample Association
Red	Stimulating; positive	Fire, danger, blood, stop, hot, left
Yellow	Cheerful, warm, outgoing	Sun, caution
Orange	Like red	Heat
Yellow green	Neutral	
Green	Restful, cool, serene	Nature, vegetation, go
Blue	Opposite of red, cool, subduing	Sky, water
Purple	Solemnity	Royalty, mourning
White	Neutral to positive effects	Snow, marriage, purity, (death in China)
Gray	Neutral, contemplation	Overcast
Black	Neutral, sorrow	Death, darkness

Table 5 Color's psychological effects (Niku, 2009, p. 320)

On the other hand, Aslam (2006) implies that the physical world has no colors. There are only light waves of different wavelengths. It is left to the retinal cones of the normal human eye to distinguish among such bands of light and make this world a rainbow for us. Therefore, there are several other factors that could influence the color perception such as prior knowledge, social learning and associations and other elements.(Kosslyn & Thompson 2003) Aslam (2006) also indicates there are various elements could affect the color perception.

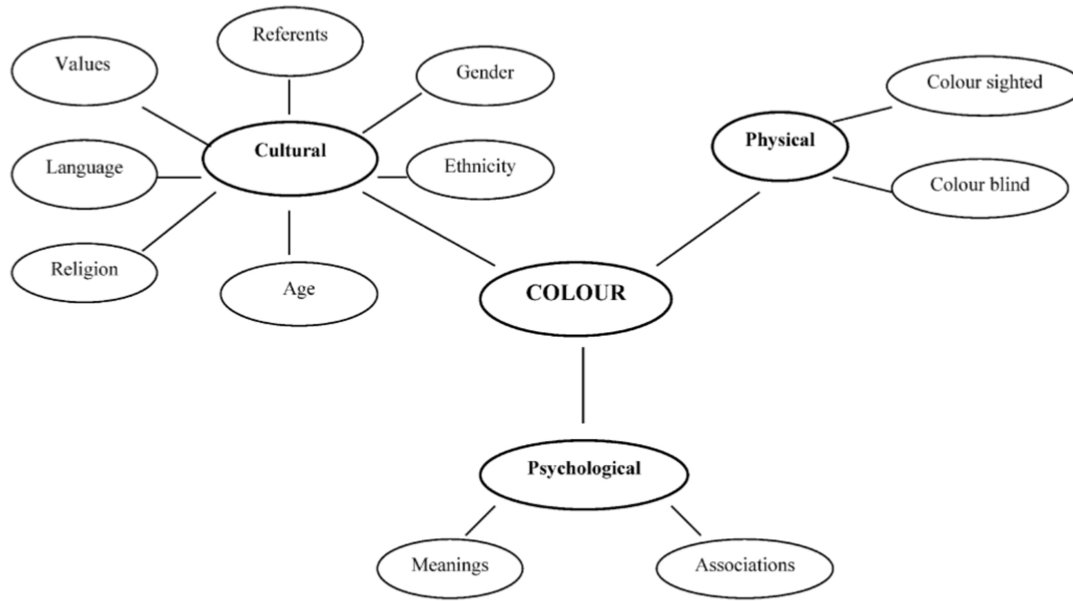


Figure 7 the elements could influence color perception (Aslam, 2006, p.18)

The figure 7 illustrates the influences from culture in color perception is dramatic. There are also physical aspect and psychological aspect could affect the color perception of user, but this thesis will only discuss cultural influences.

“Cultures differ in their aesthetic expressions as colors represent different meanings and aesthetic appeals in different cultures” (Aslam , 2006, p. 18). Niku (2009) also mentioned that most of the color effects are different for various people. Not everyone reacts to colors or is affected by colors the same way. The cultural value of colors is also different. For example, in Western cultures, red is a sign of danger, left, and communism, as well as love, while yellow is cowardly. In Asian cultures, yellow and red are signs of life and happiness. Aslam (2006) indicates color have different effects on different people with various cultural backgrounds. Table 6 shows the color effects on different culture

Colour	Country–Culture cluster								
	Anglo-Saxon	Germanic	Latin	Nordic	Slavic	Chinese	Japanese	Korean	ASEAN
White	Purity	–	–	–	–	Death	Death	Death	Death
	Happiness	–	–	–	–	Mourning	Mourning	Mourning	Mourning
Blue	High quality	Warm	–	Cold	–	High quality	High quality	High quality	Cold
	Corporate	Feminine	–	Masculine	–	Trustworthy	Trustworthy	Trustworthy	Evil
	Masculine	–	–	–	–	–	–	–	(Malaysia)
Green	Envy	–	Envy	–	–	Pure	Love	Pure	Danger
	Good taste	–	–	–	–	Reliable	Happy	Adventure	Disease
	–	–	–	–	–	–	–	–	(Malaysia)
Yellow	Happy	Envy	Envy	–	Envy	Pure	Envy	Happiness	–
	Jealousy	Jealousy	Infidelity	–	–	Good taste	Good taste	Good taste	–
	–	–	–	–	–	Royal	–	–	–
	–	–	–	–	–	Authority	–	–	–
Red	Masculine	Fear	Masculine	Positive	Fear	Love	Love	Love	–
	Love	Anger	–	–	Anger	Happiness	Anger	Adventure	–
	Lust	Jealousy	–	–	Jealousy	Lucky	Jealousy	Good taste	–
	Fear	–	–	–	–	–	–	–	–
	Anger	–	–	–	–	–	–	–	–
Purple	Authority	–	–	–	Anger	Expensive	Expensive	Expensive	–
	Power	–	–	–	Envy	Love	Sin	Love	–
	–	–	–	–	Jealousy	–	Fear	–	–
Black	Expensive	Fear	Fear	–	Fear	Expensive	Expensive	Expensive	–
	Fear	Anger	Anger	–	Anger	Powerful	Powerful	Powerful	–
	Grief	Grief	Grief	–	–	–	–	–	–

Table 6 Color effects on different culture (Aslam, 2006, p.19)

Therefore, from all we have discussed above, the color of product is one of the most important factors to influence user's value perception. And the culture has great effect on color effects; different people will have various color perception corresponding to different cultural backgrounds.

2.3.2.3 Line and Shape

The definition of line, given by Niku (2009), is a mathematical entity with characteristics such as length, direction, and shape (straight, curved, skew lines, etc.), or as an aesthetic component with potent emotional value. “Aesthetic lines are created intentionally as a geometric entity by drawing a line for emphasis, attention, direction, or a similar purpose, or are the result of variations in color, texture, surface, contrast, and materials.” (p. 314)

Grave (1952) also indicates that each line has a specific character and is employed as an expressive symbol:

1.To most people the straight line suggests rigidity and precision. It is positive, direct, tense, stiff, uncompromising, harsh, hard, unyielding.

2.The slightly curved or undulating line is loose and flexible. Because of harmonic transitions in the change of direction, it has flowing continuity. Its slow, lazy movement is passive, gentle, feminine, soft, and voluptuous. But the excessive use of this line creates an aimless, vague, or wandering effect.

3.The more vigorously curved line changes direction rapidly. This curve is active and forceful.

4.The arc or segment of a circle has an equal and constant change of direction. Because of this repetition, it is the most unified of curves but also the most monotonous and uninteresting, because of lack of variety. The spiraling curves seen in living, growing things are more dynamic.

5.The zigzag, jagged, or crooked line, with its sudden, abrupt change of direction, is nervous and jerky. The line is excited, erratic; it suggests electrical energy or lightning, agitated activity or conflict, battle, and violence. (p. 202)

Therefore, Grave's (1952) assessment shows that the line can represent the different feeling of people. Niku (2009) also mentions something similar, implying that whether intentionally drawn or the result of other variations, lines can be very powerful emotional elements. He indicates with the figure, shown below in Figure 8, that most people will feel a sense of calm or sadness in 1, aimlessness or broken heartedness in 2, playfulness or growth in 3, and anger in 4 (Niku, 2009, p. 314). That's how people perceive different lines, and it also explain why lines of a product could have influences in user's value perception.

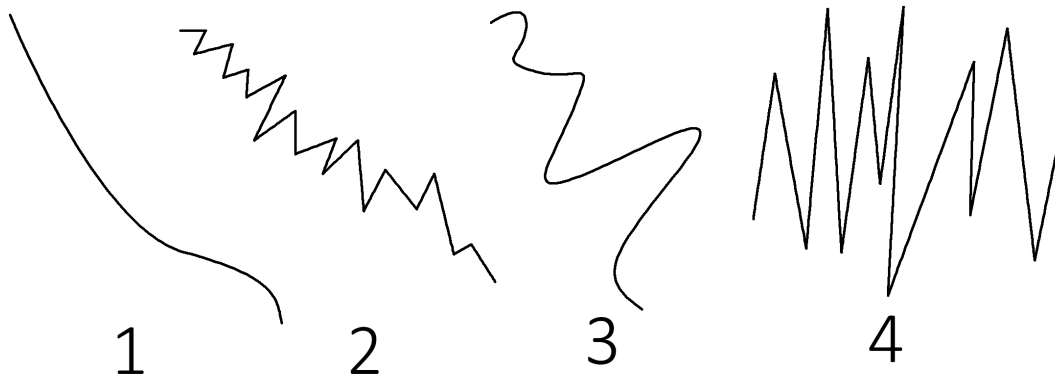


Figure 8 Different perception of people to lines by Niku (Niku, 2009, p. 314)

Additionally, he implies each line may induce a particular feeling that is subjective, which mean different people have different perceptions of those line and people can sense various feelings in one certain line. Because of this subjectivity, as with color, culture will have influences in user's perception of lines.

2.3.2.4 Texture

Texture is another important element as color, form, and lines. "Texture refers to the surface of any object, natural or manufactured. Surface texture reveals what an object is made of" (Stoops & Samuelson, 1990, p. 65). They indicate that texture may be perceived in two different but closely related ways: tactile and visual. Texture is not only been seen by eyes, but also sense by touch. "Thus, by association of visual experiences with tactile experiences, things look, as well as feel, wet or dry, rough or smooth" (Grave, 1952, p. 221).

In the book *Shaping Space*, the authors Zelanski and Fisher (1995) summarize the texture into three kind:, natural texture, worked texture, and visual texture, explained below:

Natural texture: natural texture is the materials exactly as they come from nature.

Worked texture: the surface of material may be manipulated, or worked, by an artist to create a great variety of textural effects. Materials may be craved, blasted, polished, ground, hammered, built up, or woven together for a number of different reasons.

Visual texture: some work presents an optically perceived visual texture but does not correspond with actual texture of the material. A most important way in which visual texture have been used is to make the objects more visually pleasing or acceptable. (p. 135-143)

Stoops and Samuelson (1990) also emphasize the importance of the texture in design. Texture is useful in enriching design surfaces, stimulating tactile awareness, and enhancing emotional response. Texture could help people to form corresponding emotion. Bevin (1994) also mentions the influence texture has on user's value perception in his book:

The ultimate in modern interiors in the 1930's was the room with the streamlined" look, with smooth bare walls and chromium and plastic furniture curved to fit the body. One of the recommendations for such rooms was that the concrete floors could be hosed down instead of swept or vacuumed, thus simplifying upkeep. However, as people lived in these models of efficiency they began to feel something missing. There was a sterility about such complete bareness and smoothness a lack of warmth and comfort, even though the plastic chairs were scientifically designed to support the body better than the old ones with soft cushions. (p. 106)

Therefore, this example shows that the influence of texture to user's value perception is dramatic. And what is more, the perception of texture will also be influenced by culture according to the theory of Hofstede (2005). "The emotional perception of textures, like the symbolism of colors or other forms, brings forth different feelings by evoking the familiar

memories or experiences of people” (Xin, 2016, p. 35), and culture plays an important role in this process.

2.3.2.5 Material

“There is an exceedingly large array of material choices available to the designer, from natural materials such as wood to man-made ones such as plastics, and from common materials like cement and steel to exotic superalloys and biomaterials” (Niku, 2009, p.330). There are numerous materials existing in this world and there is no way to list all the name or the properties of them in thesis. However, there is a summary of some common material properties that can be used to classify materials for selection according to Niku (2009): proportional strength, elastic strength, and ultimate strength, hardness, toughness and fracture toughness, machinability, creep, thermal properties, electrical and magnetic properties.

After knowing how to classify the materials, we need to know how to select material. Flurschein (2014) provides designers a checklist for material selection:

Function: A consideration of what a product must do will give general guidance on the class of materials which will be appropriate.

Economic background: Including the costs that may influence both manufacturing processes and materials, such as work costs, raw material costs, frequency of replacement, etc.

Production quantities and methods: The quantity of products to be produced in batches per year will affect the economic methods of production and hence materials.

Basic structural requirements: Balancing the design requirements for the engineering, ergonomic and aesthetics aspects for performance, for reliability, and for mechanical structural

needs against production quantities, processes and their consequential cost is the central dilemma in material selection.

Marketing: The designer must assess customer expectations, and if possible produce a product that exceeds these, but not too far.

Safety: Safety is fundamental, and material selection should always comply with the relevant standards and take into account foreseeable risks.

Appearance: Appearance is an important aspect of interface materials, since it is affected by the immediate visible surface of components and by the forms in which the components can be manufactured.

Control: There may be requirements in this field relevant to material selection, for example appropriate manual contact friction grip levels, impact resilience, or suitability for graphics display by forming the material or by superimposing a graphics process.

Corrosion resistance: It's a major criterion for selection of materials, affecting performance, appearance, life, safety and maintenance.

Weight: It can be an important factor, more especially with all forms of transport (p. 175-177)

On the other hand, designers also could build the emotional bond between user and product through the material of product, so material is another important factor to influence user's value perception. "Materials have two overlapping roles: that of providing technical functionality and that of creating product personality" (Ashby & Johnson, 2004, p. 5). Besides providing technical functionality, creating product personality is an independent element that affects user's value perception. Therefore, all material have their own characteristics, which will be preferred by certain customers for different reasons. And culture is one factor could influence

user's preference of material. For example Jade in Chinese culture, Jade is one of most favorite material in Chinese culture it play important role in Chines history and can be comparable with the gold and diamond in western countries.

Furthermore, Dittmar (1992) states that possessions symbolize not only the personal qualities of individuals, but also the groups they belong to and their social standing. This shows that behavior is not only a personal phenomenon, but also a collective phenomenon, which could be affected by people's different culture backgrounds.

2.3.3 Function

The definition of function in the book *Exploring requirements: Quality before design* is defined as "Functions are the 'what' of a product, describing what the product is to accomplish" (Gause & Weinberg, 2007, p. 149). "Everything should serve some purpose, have some use, or perform some function. The primary function is the characteristics that makes a product or system work or do the job intended. Secondary functions contribute to the degree or quality to which that job is accomplished" (Hubel & Lussow, 1984, p. 103). The reasons users purchase a product is because of the function, if the product can meet the need or users want. For example, if an individual wants to drink water outside, they will buy the product where basic function is containing water, and would buy a bottle or container and not brick or pen for sure. In sum, the function is another factor that influences user's value perception.

There is a method called Quality Function Development (QFD) which can be used to identify customer requirements and preferences and integrate them into the list of design specifications, requirements, and definition (Niku, 2009, p. 123). The method can be used in many situations, such as improving an old product, developing a new product, and competing with a competitor's product. However, the main function of the method is to figure out what

users want the product to be, so that designers can determine the basic function and secondary function of product.

QFD is a methodology that is accomplished with the application of a table called the Product QFD Planning Matrix. Due to the shape of the matrix, it is also referred to as the house of quality. Figure shows the basic components of this matrix. The following is a description of these areas (Niku, 2009) shown in Figure 9:

Area 1, in the left side of the table, is used to list customer wants and needs as WHATs.

Area 2, is used to quantify each WHAT with a weight factor that specifies the importance of each customer desire or need.

Area 3, is used to list product specifications and features as HOWs and may be qualified as More is better, Nominal is best, and Less is better.

Area 4, is used for benchmarking the present product as well as competitor's product.

Area 5, is the relationship matrix which details the relationships between the WHATs and the HOWs.

Area 6, is used to denote interactions, correlations, trade-offs, or compromises between different product specifications and features.

Area 7, is used for engineering targets and benchmarks. (p. 124-126)

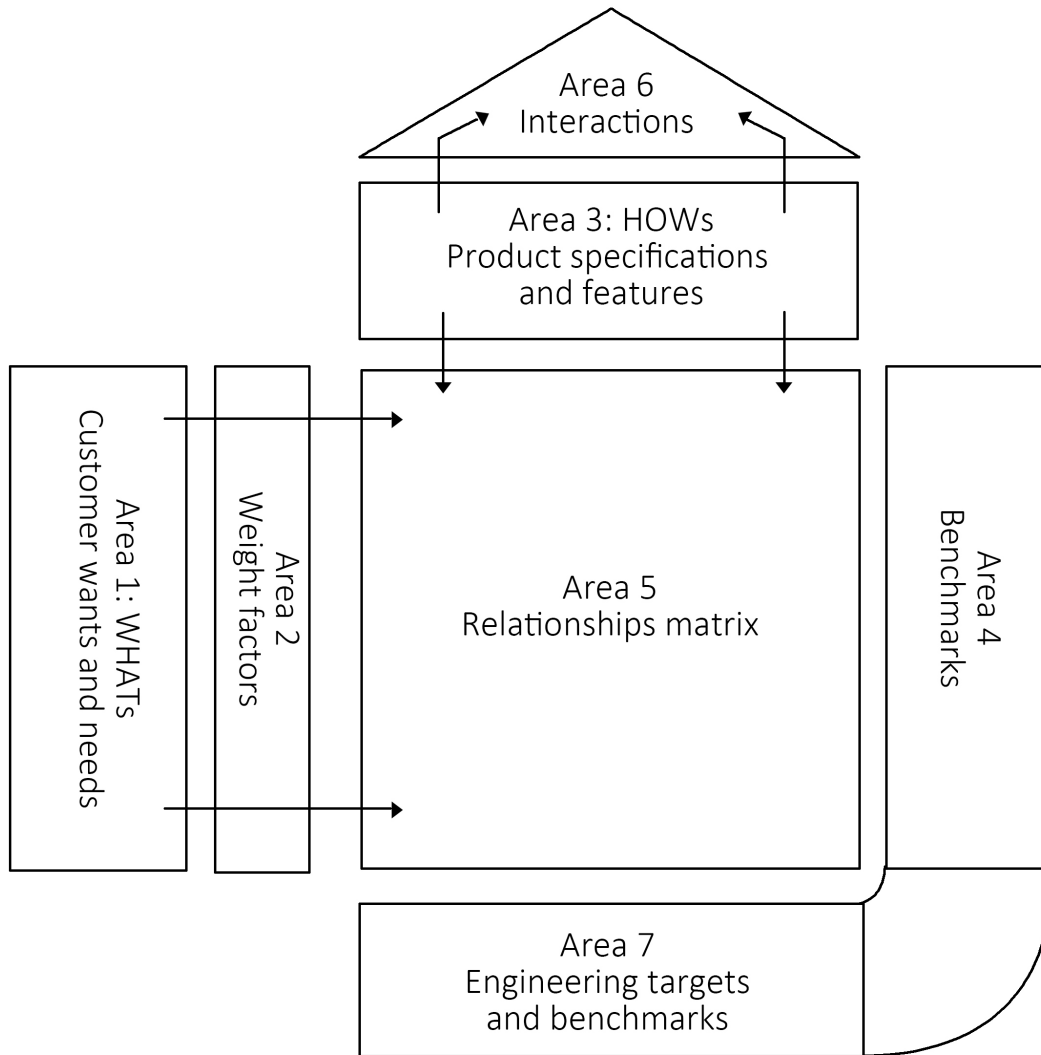


Figure 9 Quality Function Development (Niku, 2009, p. 125)

In general, QFD product planning matrix is formulated by following these steps according to Niku (2009):

1. Identify the real customers.
2. Collect information about customer wants, needs, desires, and preferences.
3. Assign priorities (importance, weight factor) to each requirement based on customer feedback, customer psychology, or estimates.
4. List the design specifications and features of your product.

5. Benchmarking your competition. Determine how well each requirement is satisfied with the current product (if any) and by competitors.

6. Determine the relevancy of each feature to each customer requirement.

7. Determine interactions and compromises. You must determine whether fulfilling each specification may have a positive or negative effect on the other specification.

8. Set engineering target and benchmarks. You should look at the benchmarks, your competition, the degree of difficulty, and the summations of weight factors multiplied by relevancy factors, in order to draw conclusions about what should be done, what target you should strive to achieve, and what specifications you must set for your product. (p.128-130)

According to the culture difference summarized by Hofstede (2005), all cultures have different core values, and then members of a culture form different symbols, heroes, and rituals. People with different cultural background will have different behavior and living habits, and therefore they will have different needs and wants in same product. The major difference is the function of product. For example, a knife is a very common utensil appearing on American dining table; Americans use a knife and fork to cut steak pizza and other food. Knives common in Western societies is flexible and small. However, the knife in Asian countries have different shapes and most of them are very big and heavy so that people could use them to cut raw meat and uncooked vegetables, even bone. Culture could influence the function of a product greatly because of the differences in user's expectation.

2.3.4 The human factors

2.3.4.1 Definition of human factors

It's necessary for designers to understand what human factors is. "Human factors and ergonomics are concerned with adapting products to people, based upon their physiological and psychological capacities and limitations." (Stanton, 2004, p. 1). The definition of human factors by Niku (2009) is "human factors, also known as ergonomics is the study of the measurements, capabilities, and limitations of the human body and how the humans and machines interact with each other" (p. 254).

We can see that human factors are the tool for designers to improve the performance of the product not only from physiological aspect but also psychological aspect. Meanwhile, the human factor also would influence the value perception of user. "In the current work, the main purpose is to help designers control the value perception of consumers. The performance of interactions between products and consumers will obviously influence the perceived value" (Xin, 2016, p. 47) So designers must be aware of human factors principles.

2.3.4.2 Physiological Characteristics of Human

One of the most important elements of physiological characteristics of human factors is anthropometric data, according to Niku (2009), which "is the collection of the measured physical dimensions, capabilities, and limitation of the human body, including the strength of the human musculoskeletal system under different conditions and configurations." (p. 255). Anthropometric data is a helpful tool for designers to decide the appropriate dimensions of products and find the range of dimensions in which consumers can operate a product comfortably and safely.

There a number of different approaches that can be taken in accommodating human body size in design based on anthropometric design strategies (Burgess, 1989):

“Designing for the Median: This also means designing for the average or mean size of a user population. Cabinets, tables, and other furniture, for example, might be simply too costly to design for a complete range of user sizes from the extremely small to the extremely large.

Designing for Extremes: This design strategy is commonly used. The upper and lower limits are accommodated; thus, the height of a door designed for the largest body size would accommodate all smaller sizes.

An Adjustability Strategy: This is, perhaps, the best design approach and should be used whenever possible. It simply provides for an adjustable range of body sizes, such as seat height, helmet diameters, etc. In military equipment design, the range between the 5th and 9th percentiles are generally used. This avoids overly-costly adjustments while providing for the most convenient use by 90 percent of the population.

A Full-Range Strategy: Designing for the accommodation of the complete range of population body sizes may sometimes be possible and desirable. In fact, such a design strategy may be particularly pertinent where survival operations are involved, as in the case of handholds and outside dimensions of escape chutes and hatches“(p. 36-37)

It’s universal thought that people in different geographic location have different physical characteristics, such as height, body size. Baten and Blum (2012) imply that the height of human is different in world regions, Figure 10 below shows the differences.

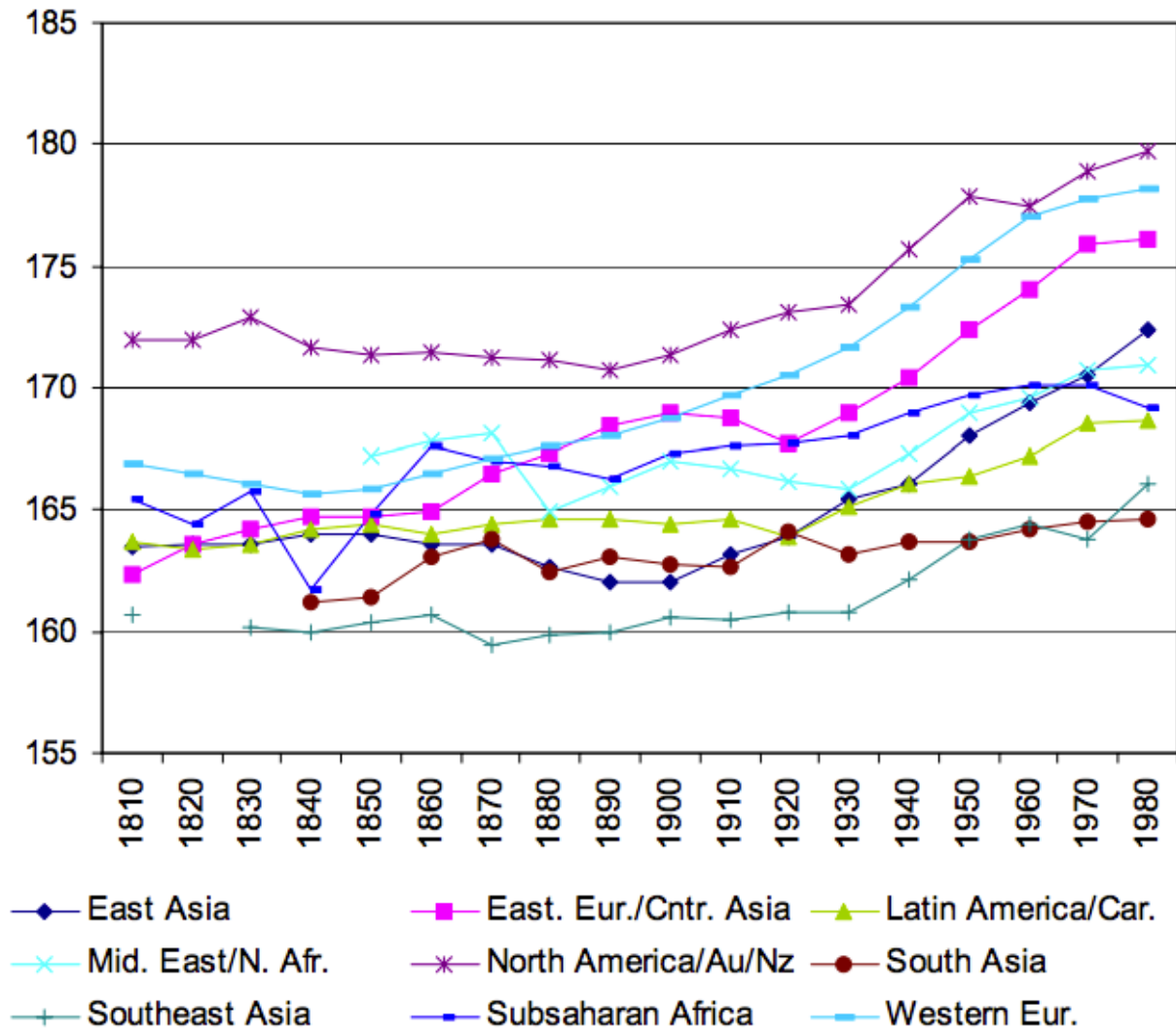


Figure 10 Different height of people in different culture area (Baten & Blum, 2012, p. 74)

From the chart we can find out people in North America have the highest height in every period. It can explain the phenomenon why American people prefer Jeeps or bigger size car, and Asian people would drive smaller size cars. Since people have different physiological characteristics, they will form different requirements for certain product based on human factors. Human factor then becomes an important element to influence user's value perception.

Human body character is determined by a combination of genetics and environmental factors and other factors in both the sciences and social sciences. As a designer, those differences should be taken into account in design.

2.3.4.3 Psychological Characteristics of Humans

Psychological characteristics of human in design area could be interpreted as the psychological reaction of the consumer. According to Niku (2009), “Psychological factors include learning curves, boredom, mental fatigue, attention span, fear, and other stressors. These factors can play a significant role in the way a product is perceived or understood, and consequently, the way it is used.” (p. 294)

“Stressors: Stressors are factors that create a stressful situation. They include danger, fear, anxiety, competition, crowding, and information overload. Some stressors can be positive, at least to a certain degree, while others are negative” (Niku, 2009, p.294). People will react differently to different situation according to their unique culture background, especially when it comes to fear or dangerous situation. For example, the people in China will decorate their house with red elements in New Year; however, people in Western countries will never use too much red in their interior design because it will remind them of blood and death.

“Learning Curves, Boredom, Mental Fatigue, and Attention Span: Humans can learn from experience. Consequently, as they perform the same or a similar function more often, they become more experienced and more productive.” (Niku, 2009, p. 296) The figure shows how learning follows an asymptotic curve shown in Fig 11. As time increases and operations become easier to implement, it becomes less challenging and boring to users. Repeating the operation can lead to boredom and mental fatigue. On the other side, if the function is too complicated, the

consumer will feel tired and careless. For designers, the most important thing is to learn to find the right balance between the difficulty of operation and how much learning is needed. (Niku, 2009).

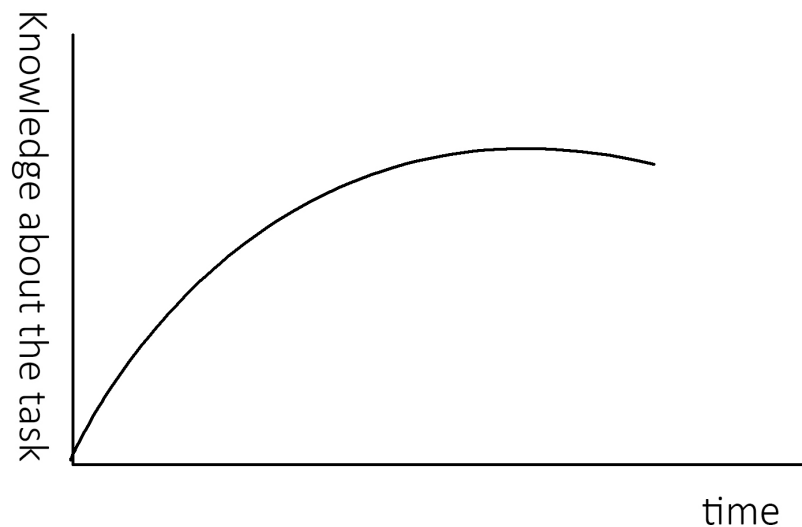


Figure 11 Learning follows asymptotic curve (Niku, 2009, p. 296)

2.3.5 Contextual Differences

One of the most important factors to affect the user's value perception is contextual differences. When consumers decide to purchase a product, the contextual information or cultural context variety will influence the evaluation of the product. (Xin, 2016) "The culture, background, and experiences of the consumer are influential in determining their response to products. The designers and consumers of a given product are often separated by time, place or social group" (Crilly, Moultrie, Clarkson, 2004, p.554). Thus, culture in different context play an important role in influence user's value perception to product.

Design preference may be largely moderated by cultural agreements on "what looks good...what materials are to be valued...what is worth aspiring towards and how aspirations can

be reinforced with material goods” (Crilly, Moultrie, & Clarkson, 2004, p. 572). Culture will not only shape user’s taste and establish general trends, but also influence fashion. (Xin, 2016) For example, it is rare for American users to buy red decorations to decorate their house, on the contrary, most Asian users would like to use red color object to fill their house, especially for holidays or weddings.

According to research from Engel, Blackwell, and Miniard (1990), consumers will be influenced by cultural contextual differences when they assess product is because two aspects of their culture, core values of culture and other values of culture.

Core values are a group of values that are fundamental to understanding the behavior of people. Moreover, “core value defines how products are used in society” (Engel, Blackwell, Miniard, 1990, p. 67). Their example in the book *Consumer Behavior* indicates that core values not only determine what foods should be eaten but they also determine with what other foods are they appropriate, how they are prepared, and the time of day to eat them (Engel, Blackwell & Miniard, 1990). Because of the different core values between Chinese culture and American culture, people eat different kinds of foods in breakfast in a different way. This concept is similar to the theory from Hofstede (2005) that implies the culture difference in two cultures’ core values, which are the hardest to change, followed by ritual, hero, and symbols.

Other values are formed because most of the countries cannot stand alone with any overlapping with other countries, which mean any country has to have interaction with others, even in a country as large as America. “The USA reflects diverse values, however, because America is so young compared to Asian and European countries. The United States culture also reflects many national origins” (Engel, Blackwell, Miniard, 1990, p. 68) The different cultural

values reflected in design can be the variety of aesthetic preferences, fashion trends, and function needs (Xin, 2016, p. 61).

2.4 Sustainable Design

2.4.1 Definition of Sustainable Design

Sustainable design is a broad concept, and it is known by different names such as ecological design, green design, green architecture, eco-effective, holistic and environmentally friendly design, according to McLennan & Berkebile (2004), which all should encompass a similar meaning. McLennan defines “sustainable design is a design philosophy that seeks to maximize the quality of the built environment while minimizing or eliminating negative impact to the natural environment.”(McLennan, & Berkebile, 2004, p.4) Therefore, sustainable design is an approach to design and we should never stop emphasizing the importance of it. And it could be applied to any kinds of objects, from large to small.

Bergman (2012) believes the beginning of sustainable design, captured in the phrase “Reduce, Reuse, Recycle,” has evolved considerably from the 1960s, Also, he implies that most of the designers who have included the three R-type thinking may feel that their products are sustainable enough. That is incorrect because they consider the design issues in isolation instead of holistically. For many other people, the sustainable design movement started in the early seventies as a response to the oil crisis. Others believe it was started with coinciding with the publishing of Rachael Carson’s landmark book, *Silent Spring*. According to the study of McLennan & Berkebile (2004), all of these beliefs are correct; “each action creates a reaction, building somewhat imperceptibly until one day it becomes apparent.” (McLennan & Berkebile 2004, p.10)

2.4.2 Sustainable product and product life cycle

According to Belz and Peattie (2013), the definition of sustainable product has six characteristics:

“Customer satisfaction: any products or services that do not meet customer needs will not survive in the market in a long term.

Dual focus: compared with purely environmental products, sustainable products focus both on ecological and social significance.

Life-cycle orientation: sustainable product is constantly environmental-friendly during its entire life. That is, from the moment the raw materials are extracted to the moment the final product is disposed of, there must be no permanent damage to the environment.

Significant improvements: sustainable products have to contribute to dealing with socio-ecological problems on a global level or provide measurable improvements in socio-ecological product performance.

Continuous improvement: since the state of knowledge, technologies and societal expectation keep on developing, so sustainable products should also be continuously improved regarding social and environmental variation.

Competing offers: sustainable products may still lag behind competing offers; therefore, the competing offers may serve as a benchmark regarding social and ecological performance.” (p. 176)

From the definition we can find out life cycle orientation is one of the most important standards to determine if the product is sustainable. The product life cycle can be organized into follow stages according to Keoleian, & Menerey (1994):

“raw material acquisition, bulk material processing, engineered and specialty materials production, manufacturing and assembly, use and service, retirement, disposal

Figure 12 is a general flow diagram of the product life cycle. As this figure shows, a product life cycle is circular. Designing and using products consumes resources and converts them into residuals that accumulate in the earth and biosphere.” (p. 13)

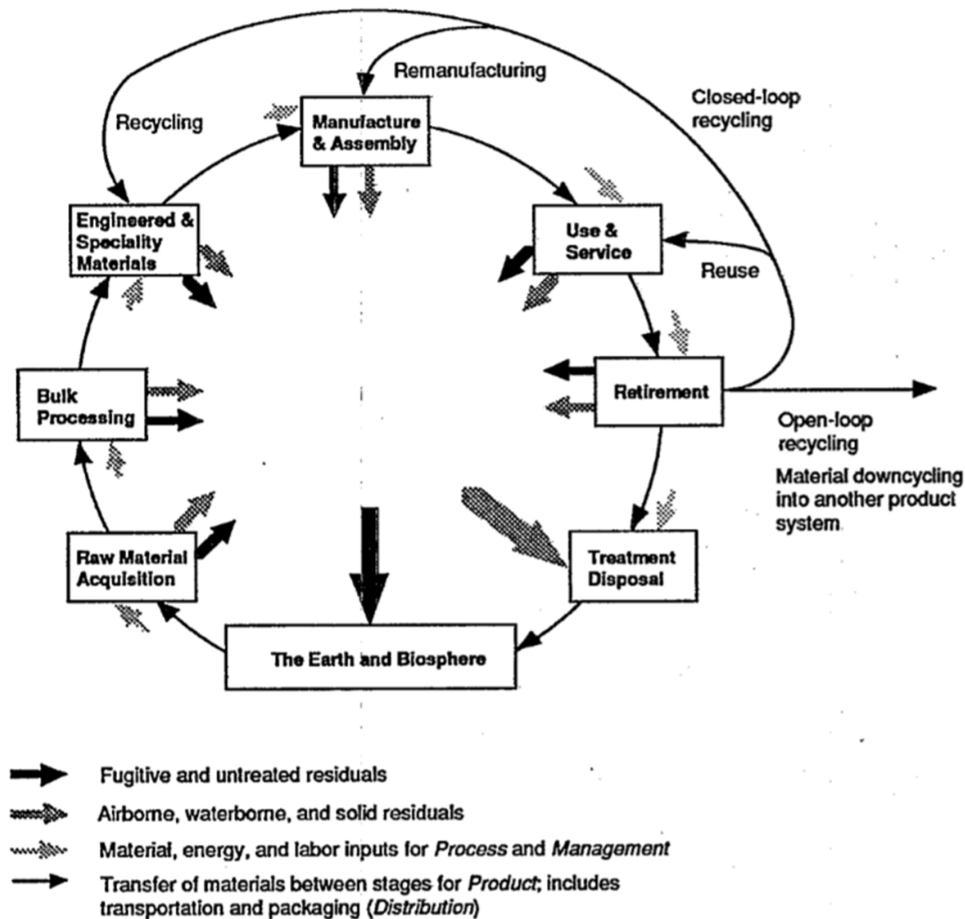


Figure 12 Product life cycle (Keoleian, & Menerey, 1994, p. 648)

2.4.3 Two approaches of sustainable design

2.4.3.1 Cradle to Grave

“The life of the product is examined from cradle to grave; that is, from the origin of its raw materials to the manipulation of these materials during manufacturing, to the consumption of energy and resources during its useful life, to the impact of its eventual end of life” (Bergman, 2012, p. 17). Figure 13 shows the product life from birth to death (Cradle to Grave). At each phase of product life, there are material and energy inputs that will generate environmental impacts.

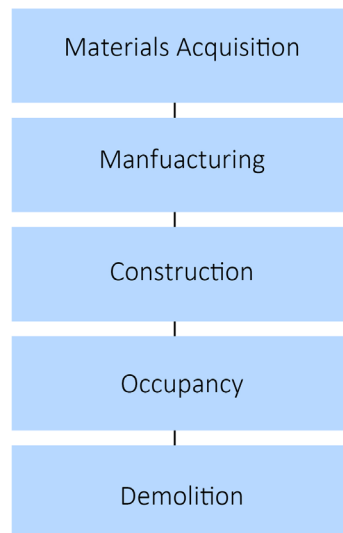


Figure 13 Cradle to Grave model (Bergman, 2012, p.17)

Life Cycle Assessment is an approach developed based on cradle-to-grave for assessing product systems. “LCA evaluates all stages of a product’s life from the perspective that they are interdependent, meaning that one operation leads to the next”(Windham, 2007, p. 45)

However, “the cradle to grave approach, while more encompassing than the three Rs, still has limitations.” (Bergman, 2012, p. 17) He implies that the use of the word grave implies that buildings and product have a linear life span.

2.4.3.2 Cradle to Cradle

The idea of cradle to cradle was popularized by McDonough and Braungart (2002) in their book *Cradle to Cradle: Remaking the way we make things*. McDonough and Braungart (2009) classify everything into two primary categories which we might consider as waste: biological nutrients and technical nutrients. “Biological nutrients are materials that, after we are done with them, can be safely returned to the earth and become part of cycle. Technical nutrients are materials that do not easily break down when returned to the earth and therefore need to be kept in cycles of usage-they need to be recycled” (Bergman, 2012, p. 19). Figure 14 shows how cradle to cradle works.

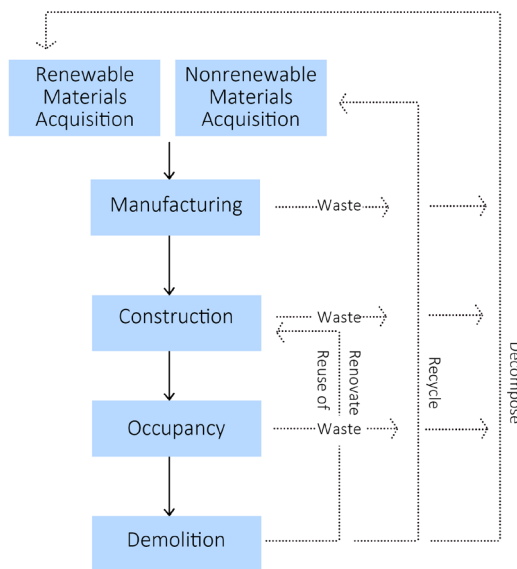


Figure 14 Cradle to Cradle model (Bergman, 2012, p.19)

“In the cradle-to-cradle life cycle of a product, all waste materials, including those resulting at the end of life, return to either biological or technical nutrient cycles, or are reincorporated into later steps in the life cycle.” (Bergman, 2012, p. 19)

2.4.4 OKALA

Okala means life sustaining energy in the Hopi language. And an “Okala practitioner is organized for working designers in all design disciplines, to provide practical information and methods for design product, service, and systems with low impacts on ecological health and human health” (White, Pierre, Belletire, 2013, p. 1).

Okala’s most important attribution is it provides a design strategy based on product life cycle called The Ecodesign Strategy Wheel. “The Okala Ecodesign Strategy Wheel clusters strategies according to the stages of the life-cycle of the product. Designers can use many of these strategies or focus on just a few” (White, Pierre & Belletire, 2013, p. 5). The wheel, shown in Figure 15, provides designers a useful tool to explore areas of product development in every stage of product life(White, Pierre, Belletire, 2013).

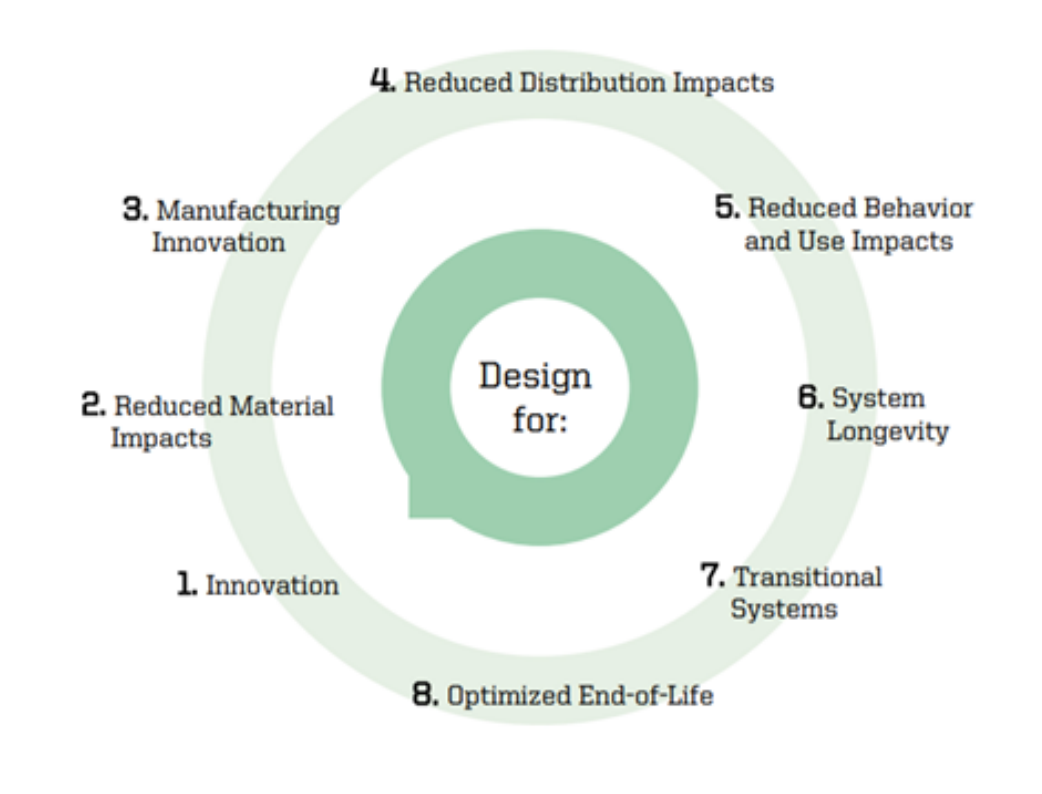


Figure 15 Ecodesign strategy wheel (White, Pierre, Belletire, 2013)

The eight key categories are listed below as well as the more specific strategies that fall under the main categories (White, Pierre, Belletire, 2013):

“1. Innovation

Rethink how to provide the benefit

Design flexibility for technological change

Provide product as service

Serve needs provided by associated products

Share among multiple users

Design to mimic biological systems

Use living organisms in product system

Create opportunity for local supply chain

2. Reduced Material Impacts

Avoid materials that damage human or ecological health

Avoid materials that deplete natural resources

Minimize quantity of materials

Use recycled or reclaimed materials

Use renewable resources

Use materials from reliable certifiers

Use waste byproducts

3. Manufacturing Innovation

Minimize manufacturing waste

Design for production quality control

Minimize energy use in production

Use carbon-neutral or renewable energy sources

Minimize number of production steps

Minimize number of components/ materials

Seek to eliminate toxic emissions

4. Reduced Distribution Impacts

Reduce product and packaging weight

Reduce product and packaging volume

Develop reusable packaging systems

Use lowest-impact transport system

Source or use local materials and production

5. Reduced Behavior and Use Impacts

Design to encourage low-consumption behavior

Reduce energy during use

Reduce material consumption during use

Reduce water consumption during use

Seek to eliminate toxic emissions during use

Design for carbon-neutral or renewable energy

6. System Longevity

Design for durability

Foster emotional connection to product

Design for maintenance and easy repair

Design for reuse and exchange of products

Create timeless aesthetic appeal

7. Transitional Systems

Design upgradable products

Design for second life with different function

Design for reuse of components

8. Optimized End-of-Life

Design for fast manual or automated disassembly

Design recycling business model

Use recyclable non-toxic materials

Provide ability to biodegrade

Integrate methods for used product collection

Design for safe disposal” (p.5-7)

Besides the OKALA The Ecodesign Strategy Wheel, there are other design strategies for sustainability exist. However, this thesis chooses the OKALA The Ecodesign Strategy Wheel as our sustainable design methodology because the OKALA design strategy wheel is developed based on the product life cycle. We have already known the importance of product life cycle, Keoleian and Menerey (1994) emphasized the necessary of product life cycle as “The product

life cycle provides a logical framework for sustainable design because it considers the full range of environmental consequences and other stakeholder interests associated with a product” p. 648). To evaluate the sustainability of the product, the designer also needs to consider other product development aspects in every stage of product life. The Ecodesign Strategy Wheel is the most holistic strategy, which includes every aspect of the product in product life so far. Figure 16 shows how The Ecodesign Strategy Wheel develops from Product system life cycle.

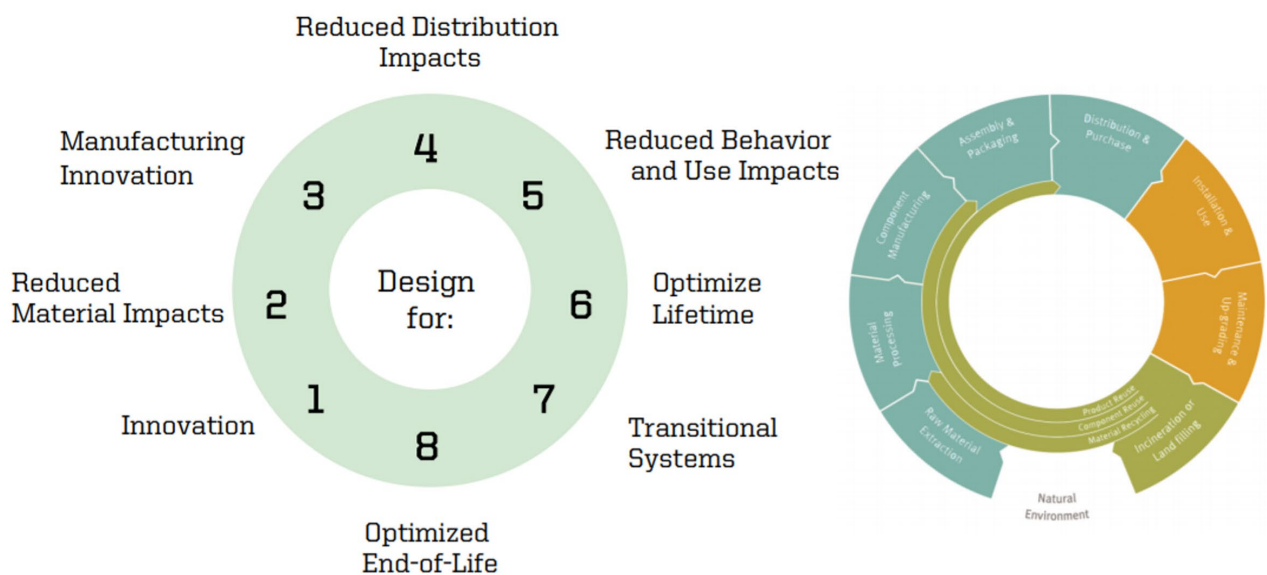


Figure 16 Ecodesign strategy wheel based on product life cycle (White, Pierre, Belletire, 2013,)

2.5 Conclusion

In the literature view, this thesis mainly analyzes culture’s characteristics and how culture could influence the user’s value perception of a product, and the sustainable design strategy based on the product life cycle. The guidelines will be determined on the basis of all the

literature in Chapter 2, and the design guideline to direct designers to design with culture elements to enhance the sustainability of their design will be given in Chapter 3.

Chapter 3

Guideline

3.1 Extract cultural elements

My final design method involves two steps, extract cultural elements and apply cultural elements in design.

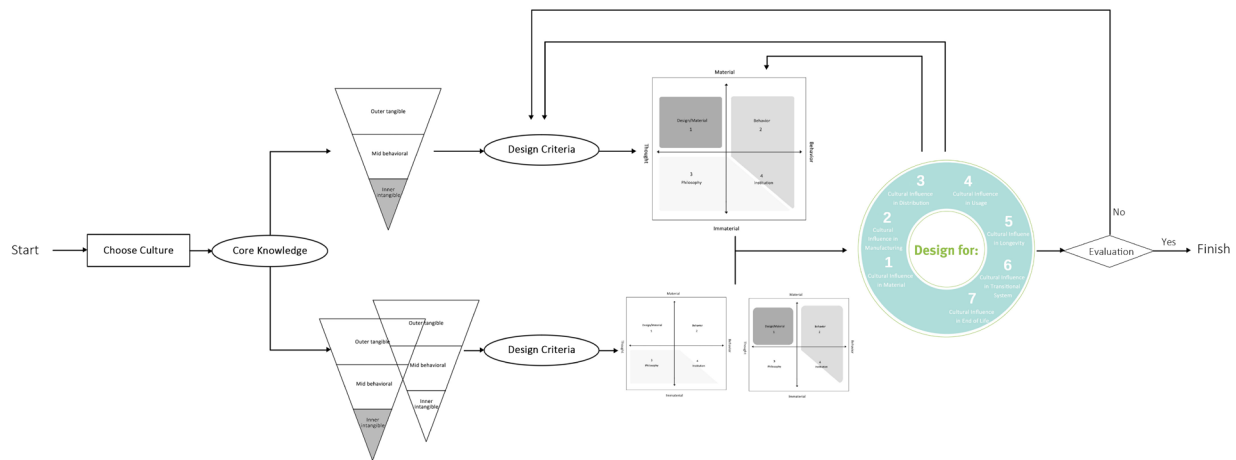


Figure 17 Final design method

As we know from Chapter 2, the culture will influence the design process passively or intentionally. According to the summary from Benny Ding Leong (2003), there are three critical components in intentional cultural design process: core knowledge, design criteria, and methods. Figure shows the sequence.

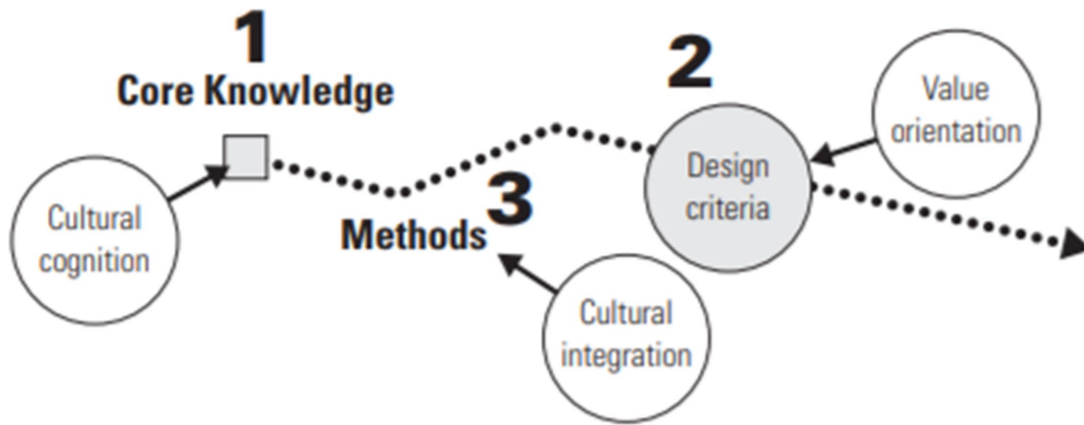


Figure 3 culture influences in design process by Leong (Leong and Clark, 2003, p.56)

Therefore, in order to extract the cultural elements, we need to choose a particular culture as the target culture. Also, designers need to have a basic understanding of the chosen culture, so that they could generate the cultural design criteria based on the core knowledge of the chosen culture. In this process, designers could use “spatial perspective of culture” framework from He (1992). According to Chapter 2 He (1992)’s “spatial perspective of culture” provided a flexible framework to visualize and capture the fluid concept of culture, and it could help designers to identify the research focus. For example, in a Chinese product design project, with the utilizing of spatial perspective of culture framework, designers could visualize the complicated Chinese culture, and then can concentrate research on three levels and generate the design criteria.

However, in real life, not every culture nowadays can form alone without effect from other cultures. Some specific cultures are the result of the hybridization of a particular culture with the contemporary Western or Eastern culture. That situation could happen due to migration, colonization, and other reasons. In this situation, we need to use He’s “spatial perspective of culture” framework again. We could overlap two frameworks from the host culture and guest culture. Figure 17 below shows the “spatial perspective of culture” and the culture space framework for hybridization culture.

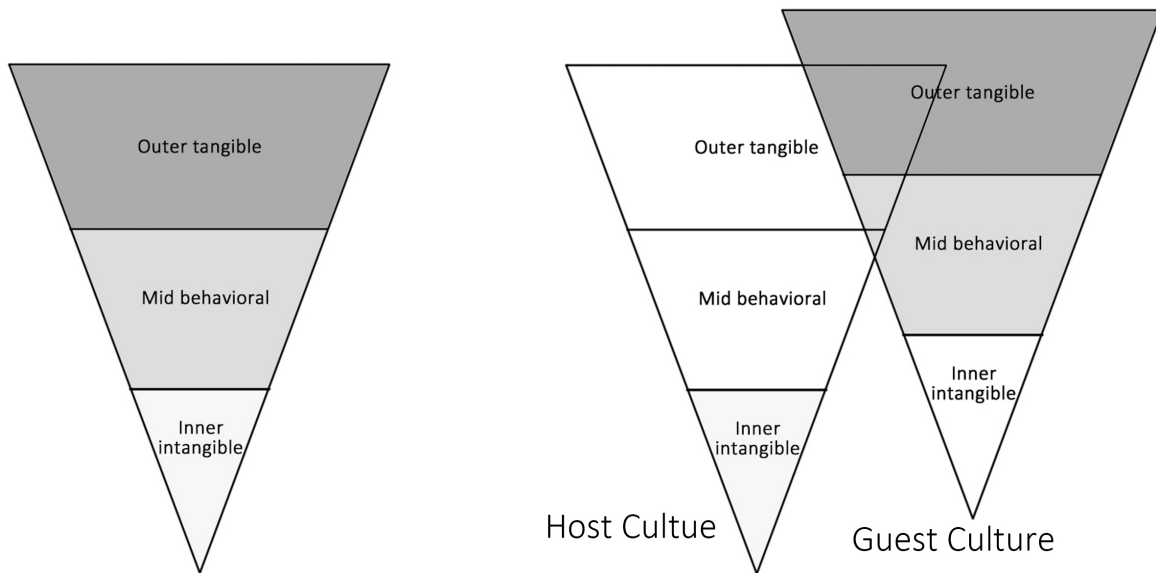


Figure 18 Culture space and the culture space framework for hybridization culture

With design criteria based on the chosen culture, the next step is the most important step in the design process. The designer needs to extract cultural elements from the chosen culture through the design criteria. However, cultural elements in the research stage are potentially so vast and complex that it is important to have a clear sense of direction. Moreover, the culture space framework from He (1992) provides an insufficient tool to extract elements. Therefore, we need to use more elaborated and embracive tool to direct research. The Matrix Model developed by Leong (2003) could replace He (1992)'s framework in this step. Leong (2003) constructed a vertical axis from the material to the immaterial, and a horizontal one from behavior to thought to form four quadrants of cultural space that equate with the four general axes of the research:

1. Material/design, style (a particular physical form, or generated from a certain philosophy or ideology),
2. Behavior, the individual acts and social interactions affected by using artifacts,
3. Institutions, customs (behavior passed through forms of regulation or traditions), and

4. Philosophy or ideology, (structured thoughts, such as philosophical concepts, accumulated over time). The Things East West design research was initiated to particularly investigate the quadrant of philosophy within the matrix. (Leong & Clark, 2003, p. 55-56)

According to Chapter 2, there are hundreds of cultural expressive forms; those are the resource we could extract cultural elements from. What we need to do is to reclassify them with Matrix Model, so that they can be placed in a clear direction. Each universal should have their certain place in quadrant, since they have various characteristics. However, some of the cultural universals are too abstract to utilize in the future design process, so in this step, we only classify the universals which involve in at least one quadrant. (It is possible for some cultural universals could involve several quadrants). Figure 18 shows how to classify those universals.

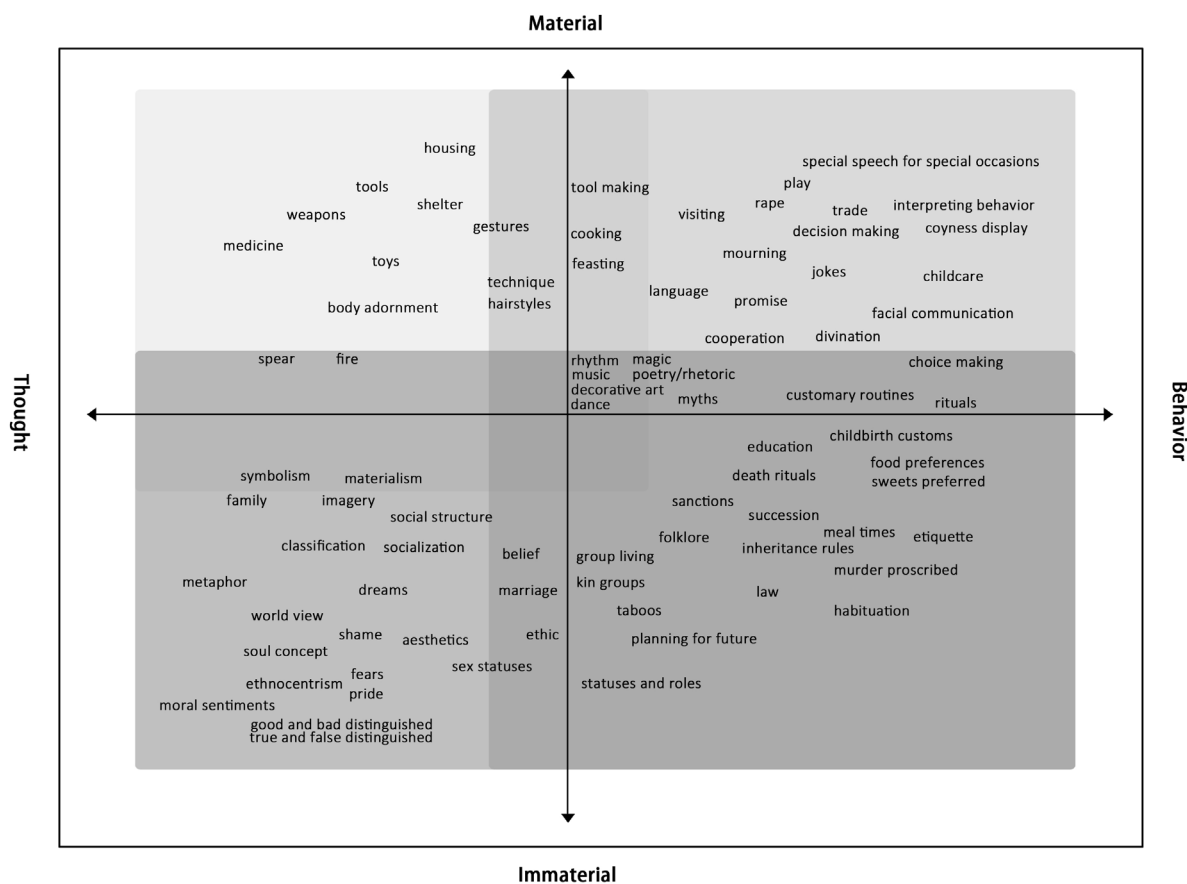


Figure 19 Reclassify the cultural elements in matrix model

According to the characteristic of culture space framework and Matrix Model, there is a relationship between those two frameworks which could connect those two together: The material/ design part in Matrix Model corresponds to the outer layer of culture space framework, the behavior part and part of institution in Matrix Model corresponds to the mid layer of culture space, the philosophy part and part of institution in Matrix Model corresponds to the inner layer of culture space. Figure 19 shows the relationship between the culture space and Matrix Model. In this process, the designer can choose the cultural elements according to their preference and the design criteria. The best situation that adding cultural elements in product suggests for designers to use cultural elements including in the four layers of culture space, but the choice might be flexible according to different conditions.

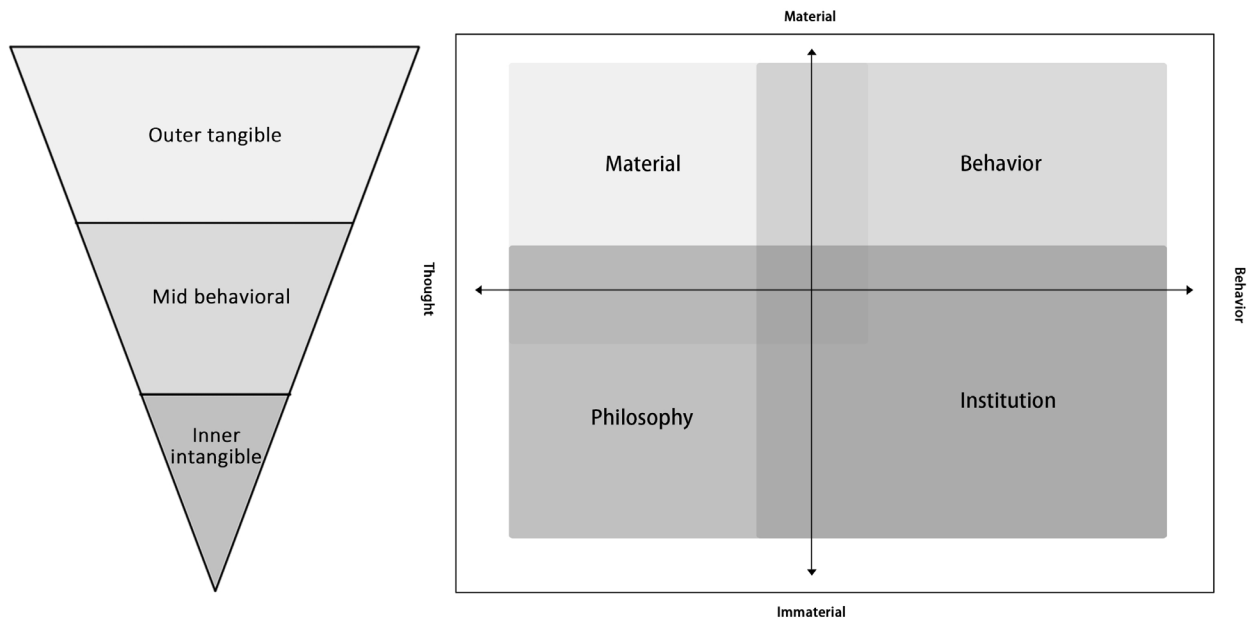


Figure 20 Relationship between the culture space and Matrix Model

Since some elements we extracted from could be too broad and abstract, we need use semiotic analysis to analyze them into the way we could use it in future design. With the three

question: What does something means in chosen culture? How does it mean what it means in chosen culture? Why does it mean what it means in chosen culture? In here, I will pick “family” from philosophy in Chinese culture as example.

First, what does family means in Chinese culture? In Chinese culture family means a group of people who are related to each other with strong emotional bond. Second, how does family mean what family means in Chinese culture? In Chinese culture it reflected as parents have strong tie to their children even after children grow up, and all family member eat food in one plate doesn't separate food, laws required children support their parents when they are old, etc. Last, why does family mean what family means in Chinese culture? Because Chinese culture is communal than individualistic. Therefore, we could find out the hidden information through culture elements in this way. And translate them into the way we could utilize to design.

3.2 Apply cultural elements in design

After extracting the cultural elements in the research stage, the next step for the designer is to apply those elements to the design. The final approach will have two separate part sustainable design approach and cultural design approach.

For the sustainable design approach, there are several sustainable design strategies available to designers nowadays. This paper will choose the Okala Ecodesign strategy wheel as the fundamental design strategy because the strategy is developed from the product life cycle. Moreover, it is the strategy which considers all aspects in every stage of the product life cycle most holistically so far.

According to Chapter 2, we verify that culture plays an essential role in the extension of product lifespan in order to enhance the sustainability of the product. Base on the OKALA

product life cycle, there are eight stages in the product life span. For the sake of user can perceive the cultural values as product attachment in the product so that they will form a tight emotional tie to the product, there is a need to introduce product value perception in every stage of product life cycles. Because every phase of the product in the life cycle would form or change the influence factors which can affect the result of the user's value perception. Based on the research in Chapter 2, users' value perception of a product could be influenced by culture. Thus, considering the cultural effects on different influence factors is adding cultural value in the product so that the users could perceive the cultural elements inside the product.

According to product life cycle, there are eight phases of a product from raw material extraction to incineration or landfilling. Figure 20 shows the eight phases of product life cycle.

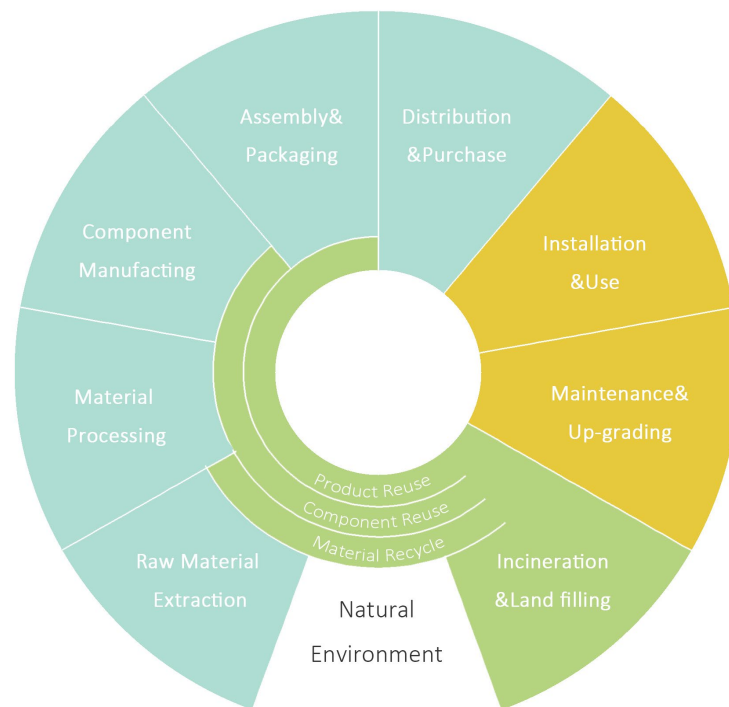


Figure 21 Product life cycle in Okala (White, Pierre, Belletire, 2013, p.2)

As we have discussed in Chapter 2, there are four main influence elements that could determine the user's value perception to a product: Form, Function, Human factors, and

Contextual differences. And product in the different phases of the life cycle has various affects in some of those influence factors. Therefore, I break those four factors down and reclassify them corresponding to every phase of product life cycle. Figure 21 shows what elements could be influenced by each phase of the product life cycle.

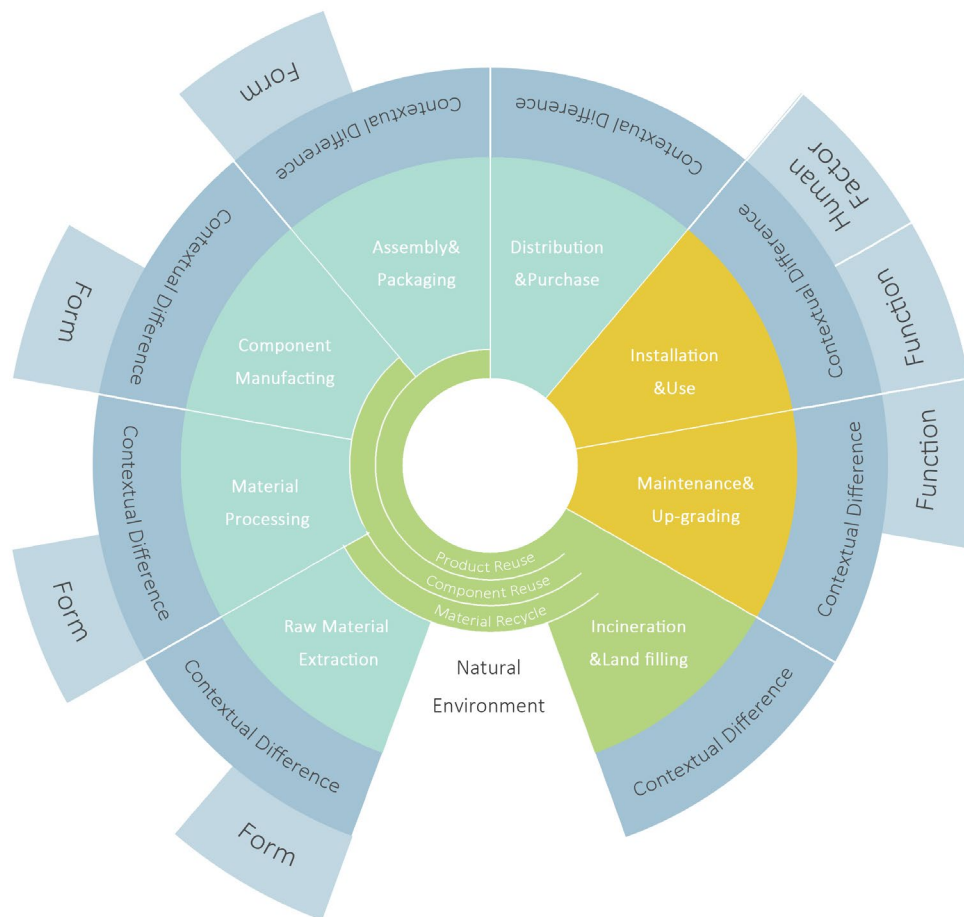


Figure 22 Elements could be influenced by each phase of the product life cycle

For example, in first phase, raw material extraction, the product will decide which material should be used and what cultural contextual information about material consumers will obtain, which will influence user's perception of form and the contextual difference perceived by

users. The first phase should include the form and contextual difference. Thus, the whole cycle could be interpreted as:

Raw material extraction: Form, Contextual difference.

Material processing: Form, Contextual difference.

Component manufacturing: Form, Contextual difference.

Assembly & packing: Form, Contextual difference.

Distribution & purchase: Form, Contextual difference.

Installation & use: Contextual difference, function, and human factor.

Maintenance & up grading: Contextual difference, function.

Incineration & land filling: Contextual difference.

Because every phase in product life cycle involves at least one influence element of value perception and culture has positive influence on those elements, we can generate final cultural design approach based on product life cycle with connection to value perception. Figure 22 shows the final cultural design approach. There are seven categories:

1. Design for the cultural influence in material
2. Design for cultural influence in manufacturing
3. Design for cultural influence in distribution
4. Design for cultural influence in usage
5. Design for cultural influence in longevity
6. Design for cultural influence in transitional system
7. Design for the cultural influence in the end of life

Category 1 matches to phase 1-2 in product life cycle, category 2 matches to phase 3-4, category 3 matches to phase 5, category 4 matches to phase 6, category 5 matches to phase 6, category 6 matches to phase 7, and category 7 matches phase 8.

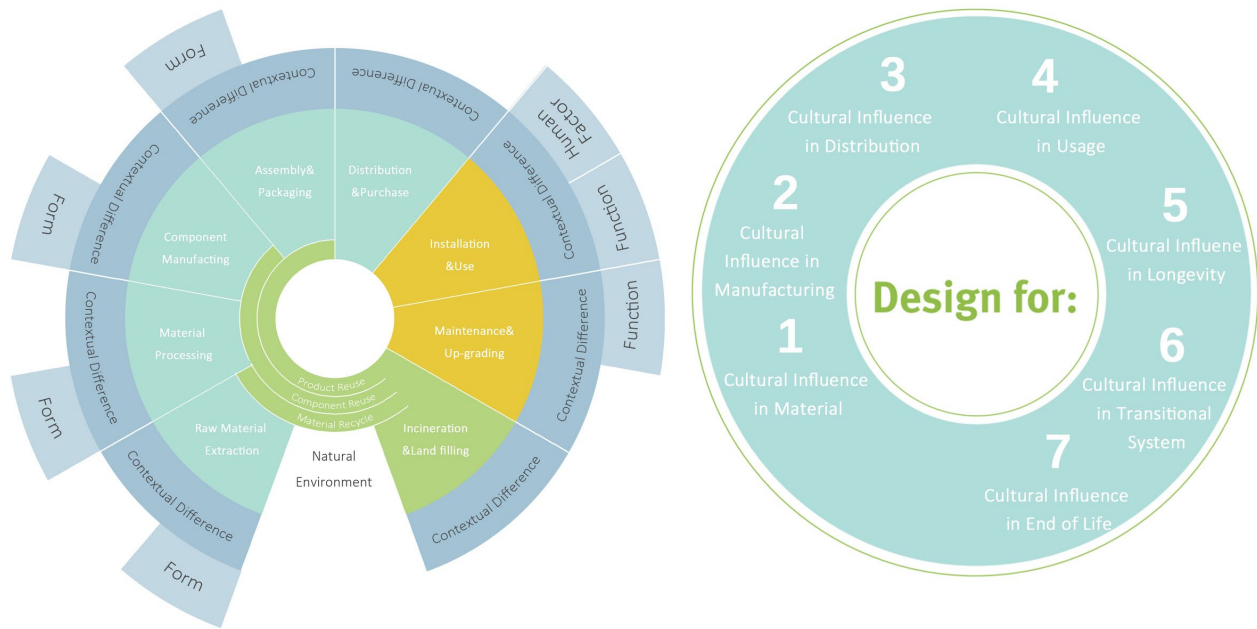


Figure 23 Cultural design approach

Because each factor (form, function, human factor and the contextual differences) which can determine the value perception would be influenced by culture and is represented differently, every category should include more detailed design strategies based on the four main influence factors in Chapter 2. This is presented as:

1. Design for the cultural influence in material:

- Consider the typical material are used in the chosen culture
- Consider the typical material processing in the chosen culture
- Consider the special characteristics of the material in the chosen culture
- Consider the preference of material in the chosen culture

2. Design for cultural influence in manufacturing:

- Consider the typical manufacturing technique in the chosen culture
- Consider the typical package and assembly method in the chosen culture
- Consider the form of product according to the certain aesthetic in the chosen culture
- Consider the color preference in the chosen culture
- Consider the special emotional character of the line in the chosen culture
- Consider the special texture perception of users in the chosen culture.

3. Design for cultural influence in distribution:

- Consider the typical distribution and purchase way in chosen culture.

4. Design for cultural influence in usage:

- Consider the typical usage of the product in the chosen culture
- Consider the special users want, need, and preference in the chosen culture
- Consider the physical characteristics of users in the chosen culture
- Consider the special learning curves, boredom, mental fatigue and attention span of users in chosen culture.

5. Design for cultural influence in longevity:

- Consider the typical maintenance method in chosen culture.

6. Design for cultural influence in transitional system:

- Consider the typical upgrade method or method to convert product to a second life in chosen culture
- Consider the special function of product could transform itself to a second life in chosen culture.

7. Design for the cultural influence at the end of life:

- Consider the typical way to end the product life in chosen culture.

Designers need to apply all the cultural elements extracted earlier in the design process to this cultural design strategy so then the product output could include those cultural elements.

Figure 23 shows the detail cultural design strategy.

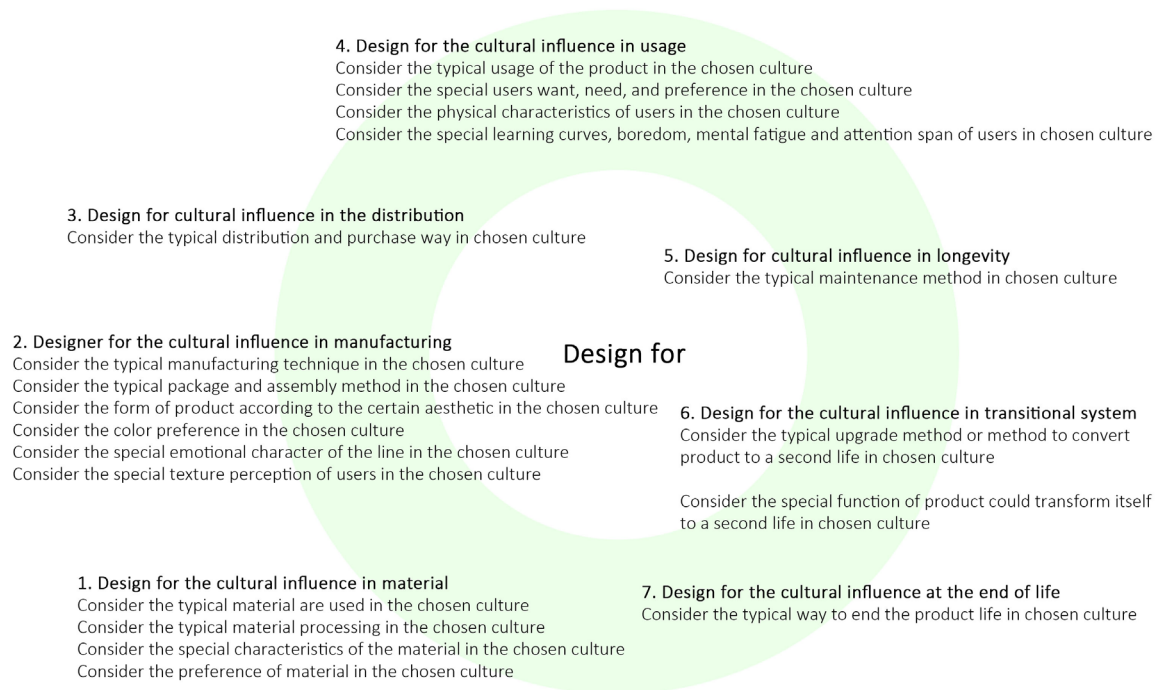


Figure 24 Detail cultural design strategy

There is no requirement or standard how many strategies designers should use at least so that their product is enough to contain cultural elements. However here we can utilize the cultural design wheel to test several successful cultural products, to check how many strategies

they involved averagely so that we can get a number to suggest designers use through the cultural design strategy. There are three typical cases.

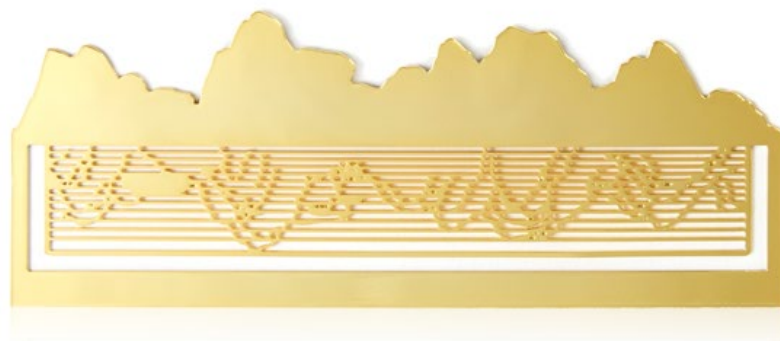
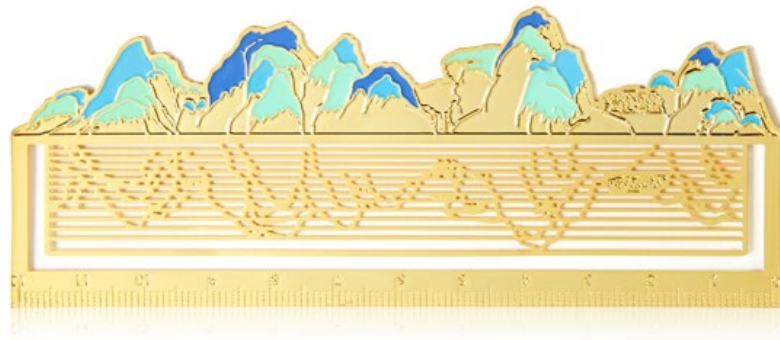


Figure 25 Qianlijiangshan ruler (Qianlijiangshan ruler Taobao)

This is the ruler called *Qianlijiangshan ruler*. Which is inspired by traditional Chinese landscape painting. The mountain form of the ruler from landscape painting is matching to the strategy: Consider the form of product according to the certain aesthetics in chosen culture. The certain craving technique on copper in Chinese culture is matching to the strategy: Consider the typical manufacturing technique in chosen culture. The typical copper usage in material I

matching to the strategy: Consider the typical material are used in chosen culture. Figure 24 shows Qianlijiangshan ruler.



Figure 26 Fuji

The tea cup was called Fuji, it is a very typical Japanese style tea cup. The fuji mountain form and pattern on the cup is extracted from Japanese aircraft which is matching to the strategy: Consider the form of product according to the certain aesthetics in chosen culture. The certain porcelain using to make tea cup is special clay and create by local manufacturing method is matching strategy: Consider the typical material are used in chosen culture. And the plain design style of cup is based on special Japanese tea culture is matching strategy: Consider the typical usage of product in chosen culture. Figure 25 shows Fuji



Figure 27 Wedgwood (Wedgwood Prestige Floral Eden Collection)

The Wedgwood tea pot have strong England cultural design style. The flower pattern on the collection is inspired from the garden of Royal Horticultural Society is matching to the strategy: Consider the form of product according to the certain aesthetics in chosen culture. The special manufacture method which adding bone powder in clay is matching to the strategy: Consider the typical manufacturing technique in chosen culture. The special sets such as plate and milk pot in collection due to England certain low tea culture is matching to the strategy: Consider the typical usage of product in chosen culture. Figure 26 shows Wedgwood

Based on the analysis of three cases, we could find out all those products involved three strategies.

Since both the final cultural design approach in this paper and Okala Ecodesign strategy wheel is developed based on product life cycle, every phase in two approaches matches to each other. Because phase 1 in Okala ecodesign strategy is not created based on life cycle, Okala ecodesign strategy has one phase more than the final cultural design approach. Designers can use two strategies at the same time to ensure the design both considers the sustainable design aspect and cultural design aspect. Figure 27 shows how two strategies match with each other.



Figure 28 Sustainable design and cultural design

3.3 Conclusion

The approach to utilize cultural elements to enhance the sustainability of the product includes two parts: extraction of cultural elements, applying cultural elements in the design approach.

With the approach, the designers will make their physical model to complete the design process. The product designed with this approach will involve cultural elements from the chosen culture by designers.

Chapter 4

Design Application

4.1 Introduction

This chapter will focus on two aspects. One is extracting cultural elements from a certain culture; another one is applying cultural elements in final product design. The approach has developed in the previous chapter, so in this chapter, we will utilize the approach to design desk organizers with Chinese cultural elements.

4.2 Extracting cultural elements

After we select Chinese culture as the target culture, it's necessary to understand Chinese stationary culture in order to generate design criteria. With the basic understanding of Chinese stationary culture, we can create Figure 28 below, which is based on the culture space framework in order to generate design criteria.

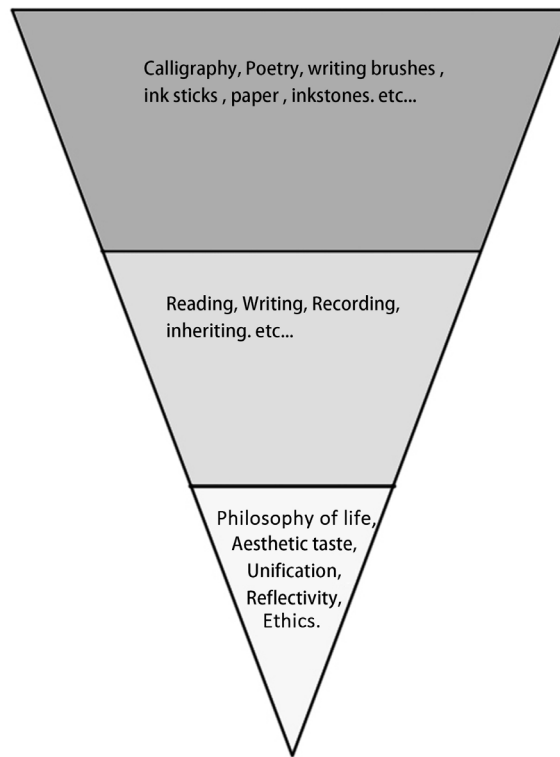


Figure 29 Generating design criteria with culture space

According to the culture space framework of Chinese stationary culture, we visualize the intangible culture concept into three layers. With the concentrating on inner we could create the initial design criteria: Chinese desk organizers are not only the practical tool, but the object which can represent the particular aesthetic taste of Chinese. Chinese desk organizers also have a reflectivity, which reflects the particular philosophy of life and specific ethics. That is why the final desk organizers design should meet the requirements that match the special aesthetic taste of Chinese and conform to the Chinese philosophy of life and ethics.

It is common that different designers create different design criteria due to different comprehending ability, the material they use to study culture and other reasons. Moreover, the design criteria based on the culture space framework only include cultural aspects. So, the final

design criteria will have to take all other aspects into account, such as a financial requirement from the client, the needs of users, etc.

With the design criteria, we could extract cultural elements from the Matrix culture space framework. A thing that needs to be mentioned is that countless cultural elements exist and there is no research or article that could involve all cultural elements even the list from Donald Brown (1991). So, designers could reclassify the cultural elements and add more elements based on the research on their own with the Matrix culture space framework. In this chapter, I will use the cultural elements provided by Donald Brown (1991) as an example.

Based on the Matrix culture framework from Chapter 3, we could select cultural elements through the framework. Figure 29 shows reclassifying the cultural elements with matrix culture space.

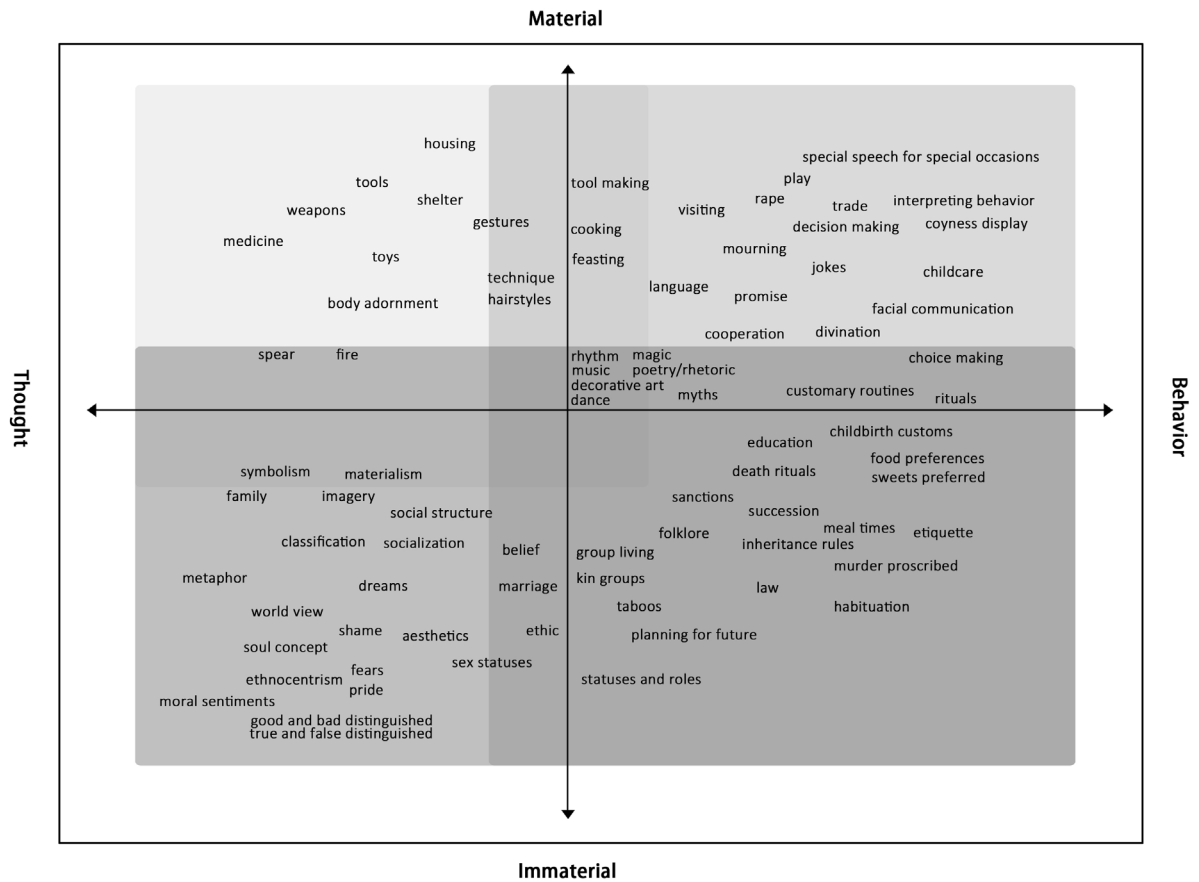


Figure 30 Reclassifying the cultural elements with matrix culture space

According to the design criteria, three cultural elements, technique, decorative art, and family could be extracted from the framework that Figure 30 shows, selecting culture elements as follows:

In technique, there are several traditional techniques involved. In this chapter lacquering will be selected. Because lacquering originated in ancient China, it reflects the aesthetic taste of Chinese culture perfectly; it represents one of the greatest Chinese cultural achievements.

In decorative art, Chinese painting will be selected due to the special expressiveness which represents the philosophy of life to Chinese culture and the emotion conveyed by artist holistically.

In habituation, Using Chinese ink brush will be selected because it is the most typical behavior to represent Chinese culture, and this type of expression has been widely practiced in China.

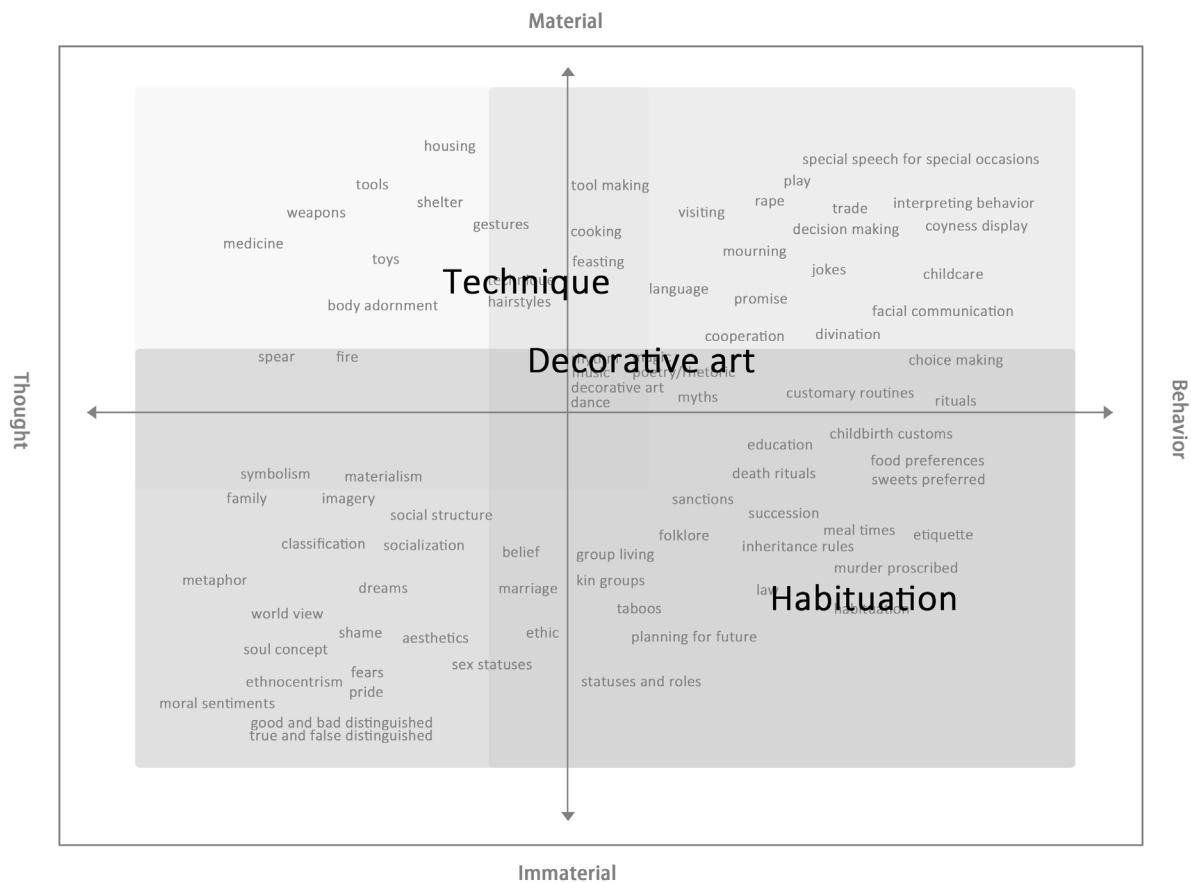


Figure 31 Selecting culture elements

Since the elements extracted from Matrix framework are too vast and abstract to understand. In order to utilize those in later design, using semiotic analysis to analyze them is very important and necessary.

Lacquering:

What: Lacquerware are objects decoratively covered with lacquer. Lacquerware includes small or large containers, tableware, a variety of small objects carried by people, and larger objects such as furniture and even coffins painted with lacquer. Lacquering in China have long history and sophisticated lacquer process techniques developed became a highly artistic craft. (Lacquerware Wikipedia)

How: In China there are several techniques to lacquer object.

- Monochrome lacquer and lacquer painting: Monochrome lacquer (red or black) and lacquer painting (*miao-ch'i*) are the simplest and oldest lacquer techniques in China, and fragments of red or black lacquer coated vessels and containers been found in graves dating from the mid- to late Shang period.
- Carved lacquer: By far the most important lacquer technique invented in China is carved lacquer. The flat parts of the carved reliefs were painted red and the raised areas were black. Alternating red and black lacquer in rhythmic designs is also characteristic of the oldest examples of genuine carved lacquer in China.
- Engraved, inlaid and filled lacquer: Han period developed the technique of engraving designs into the covering coats of lacquer with needle-like gouges. This technique was called *chui-hua* (needle painting). In the Tang people use of sheets of gold or silver made in various shapes, such as birds, animals, and flowers. The cut-outs were affixed onto the surface of the lacquerware, after which new layers of lacquer were applied, dried, and then ground away, so the surface could be polished to reveal the golden or silvery patterns beneath. This was done by a technique known as *p'ing-t'o* (shallow scooping). In Sung period the designs were etched into black, red or, less

frequently, green lacquer. They were then filled with gold leaf. This technique called *ch'iang-chin-yin* (decorating with gold and silver) In the classic *t'ien-ch'i* technique, flat depressions were scooped out in usually red or red-brown lacquer that was not quite hardened. These depressions were then filled in with different-coloured lacquers. Subsequent polishing frequently caused the colours to blend and produced soft, sfumato-like contours. The outer and inner contours of the sketch-like pictures were then carefully engraved and powdered gold was rubbed into the markings.

- Mother-of-pearl lacquer: A technique that possess mother-of-pearl and other materials inlaid in a red lacquer coating. The design was 'lifted out' of the base of many coats, and the thickly cut pieces of mother-of-pearl were glued into the depressions. Subsequent layers of transparent lacquer were then carefully polished away to create a smooth surface. Frequently, a thin layer of transparent lacquer was left to protect the incrustated container walls. (Kopplin, 2002, p.28-45)

Why: The reason why lacquerware in China represent a highly artistic craft is because of the various shapes, colours, lines and decorations of lacquered utensils in China both being considered as the reflection of the artistic sensitivity of Chinese culture since neolithic age. (Kopplin, 2002) Figure 31 shows a lacquer square dish from Qing dynasty, Kangxi era (1662–1722)



Figure 32 Square dish (Lacquerware Wikipedia)

Chinese painting:

What: Chinese painting is one of the oldest continuous artistic traditions in the world. is done with a brush dipped in black ink or coloured pigments; oils are not used. As with calligraphy, the most popular materials on which paintings are made are paper and silk. The finished work can be mounted on scrolls, such as hanging scrolls or handscrolls. Traditional painting can also be done on album sheets, walls, lacquerware, folding screens, and other media. (Chinese painting Wikipedia)

How: The concept of Chinese painting is comprised of three themes of painting., figure, landscape and Bird-and-flower. And landscape painting was regarded as the highest form of Chinese painting, and generally still is. (Chinese painting Wikipedia) Bird-and-flower painting is a kind of Chinese painting named after its subject matter. Normally, most bird-and-flower paintings belong to the scholar-artist style of Chinese painting. (Bird-and-flower Wikipedia) The most of theme of Bird-and-flower painting is Three Friends of Winter, also known as Suihan Sanyou, is an art motif that comprises the pine, bamboo, and plum. Because pine, bamboo, and plum—are grouped together in the context of winter because they all flourish at that season unlike many other plants. Together they symbolize steadfastness, perseverance, and resilience. They are highly regarded in Confucianism and as such represent the scholar-gentleman's ideal. (Three Friends of Winter Wikipedia)

Why: The reason Chinese painting is important and it can last decades is because of its special expressive form to allow artistic to freely express their feelings and to capture the inner spirit of their subject instead of describing its outward appearance which correspond to their philosophy of life and attitude of ethics. (Chinese painting Wikipedia) Figure 32 shows "Clustering Chinese Plum Blossoms" by Ming painter Chen Lu



Figure 33 "Clustering Chinese Plum Blossoms" (Prunus mume Wikipedia)

Chinese ink brush:

What: The tool used in Chinese calligraphy as well as Japanese calligraphy, and Korean calligraphy which have roots in Chinese calligraphy. They are also used in Chinese painting and other brush painting styles. (Ink brush Wikipedia)

How: According to different usage Chinese ink brush could be classified as different hair size and different hair length.

Hair size: generally classified as either big, medium, or small; most calligraphy is written with a medium-sized brush. The smallest brushes are used for very small pieces and for fashioning designs for seals. While medium size brushes are the most widely used, wielded by a skilled artist a medium brush can produce a variety of thicknesses of line from very thin to fairly thick. The largest brushes are used only for very large pieces.

Hair length: generally classified by hair length for thickness of handle as either long, medium, short; most calligraphy is written with a medium-length hair brush. The long hair brush are more keep to hold an ink than the short hair brushes as their length. So, it used for continuous long stroke line scripting (Ink brush Wikipedia)

Together with the inkstone, inkstick and Xuan paper, these four writing implements also been called as Four Treasures of the Study. Chinese always use ink brush with other treasures of Four Treasures of the Study and others implements also are required such as brush-holder, brush-hanger, paperweights, the brush-rinsing pot, and the seal and seal-ink. For painting, Chinese pigments are also used. (Four Treasures of the Study Wikipedia)

Why: The ink brush is the tool create to expressive different information or emotion according to different people in Ancient China, certain kinds of brushes are more suited to certain script styles and individuals than others. (Ink brush Wikipedia) Figure 33 shows Chinese ink brush and four treasures of the study



Figure 34 Chinese ink brush and four treasures of the study

4.3 Applying cultural elements

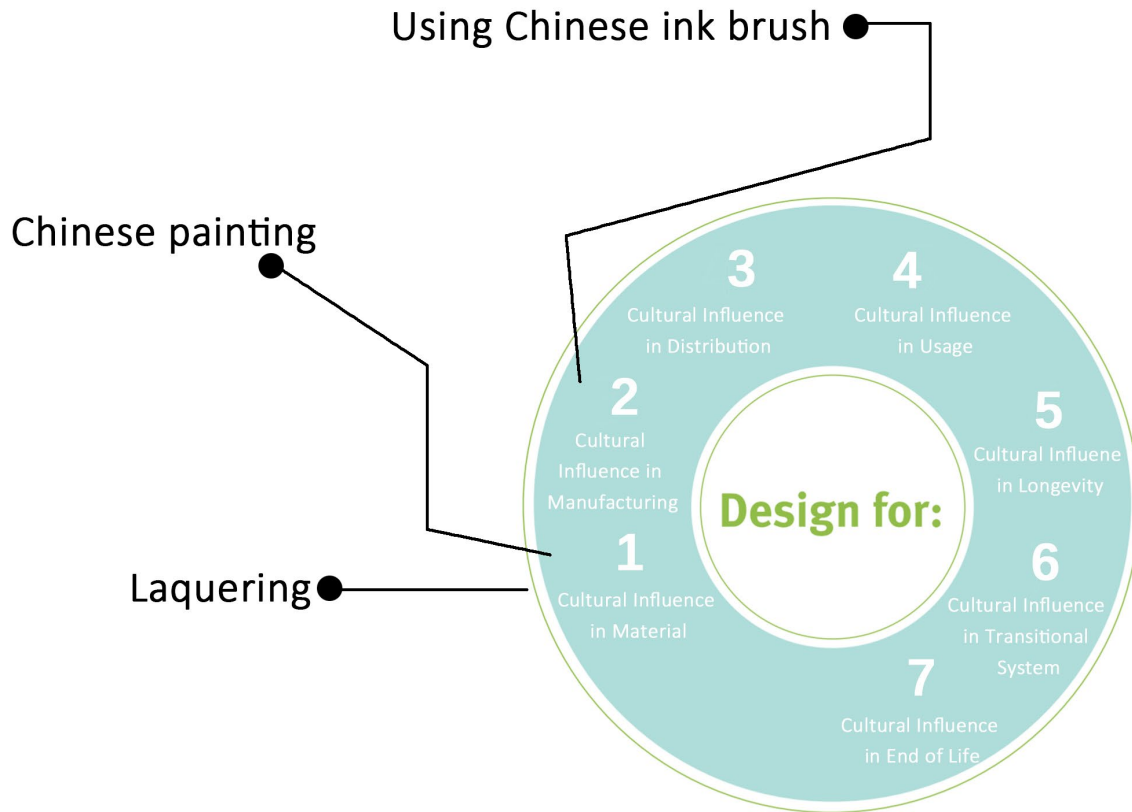


Figure 35 Applying cultural elements in cultural design

After analyzing the cultural elements extracted from Chinese culture, the next step is to apply those elements into cultural design strategy. According to the analysis, both three elements could be applied in the final design. Figure 34 shows how to apply cultural elements in cultural design. More detail interpretation will be explained below.

p'ing-t'o technique from traditional lacquering could be applied to cultural design strategy according to the consideration in second stage: Consider the typical manufacturing technique in chosen culture. Because p'ing-t'o is the most typical lacquering technique in China and it represent the special aesthetic taste of Chinese culture.

Plum form from Chinese painting Bird-and-flower painting could be applied to cultural design strategy according to the consideration in second stage: Consider the form of product according to the certain aesthetics in chosen culture. Because of the plum is the most common

theme appear in Chinese painting and plum have special cultural significance in Chinese painting. What is more, the cultural symbolism of plum is steadfastness, perseverance, and resilience which are preferred in Chinese culture.

Utilizing Chinese ink brush could be applied to cultural design strategy according to the consideration in third stage: Consider the typical usage of product in chosen culture. Because in Chinese culture people have special habituation of using Chinese ink brush.

According to the Chapter 3, when designers apply cultural elements to design, they also need to consider the strategies in Ecodesign strategy wheel. In Chinese desk organizers design, two of strategies will be focus on. 1 Avoid materials that deplete natural resources. 2 Design to encourage low-consumption behavior. Figure 35 shows the strategies will be focused on in Ecodesign strategy wheel.

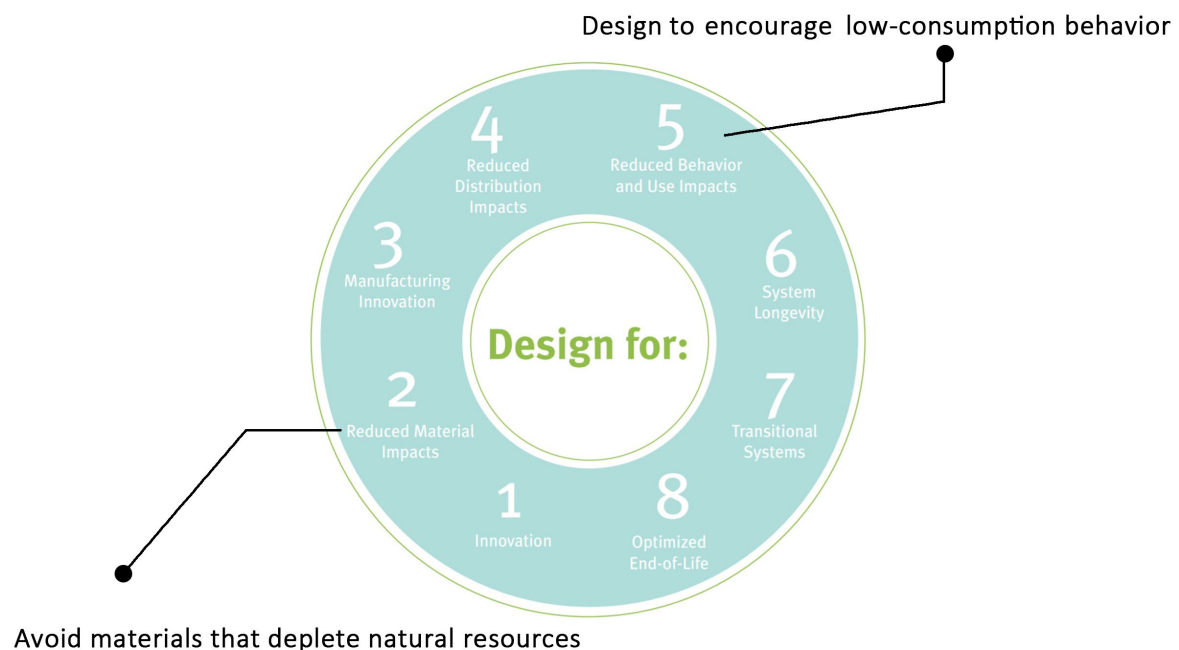


Figure 36 Two strategies in Ecodesign strategy wheel

Therefore, in final design p'ing-t'o lacquering technique will be the manufacturing method and major technique for desk organizers design, the pistil of the flower will be used the golden sheet and glued to the desk organizers before applying red and pink lacquer. As shown in figure 36

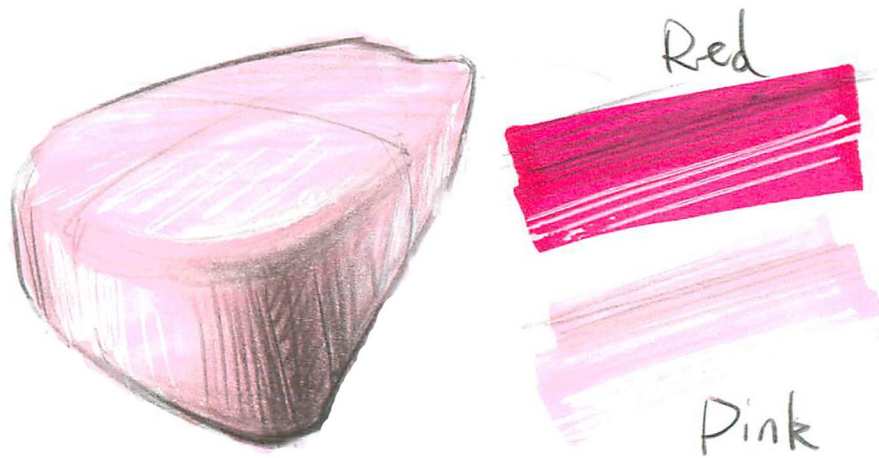


Figure 37 Utilizing lacquering technique

The final form of product will be utilized plum shape and extracted plum pistil shape as the form of the business card holder. The different sets in stationery with different function is making into petal separately. As shown in figure 37

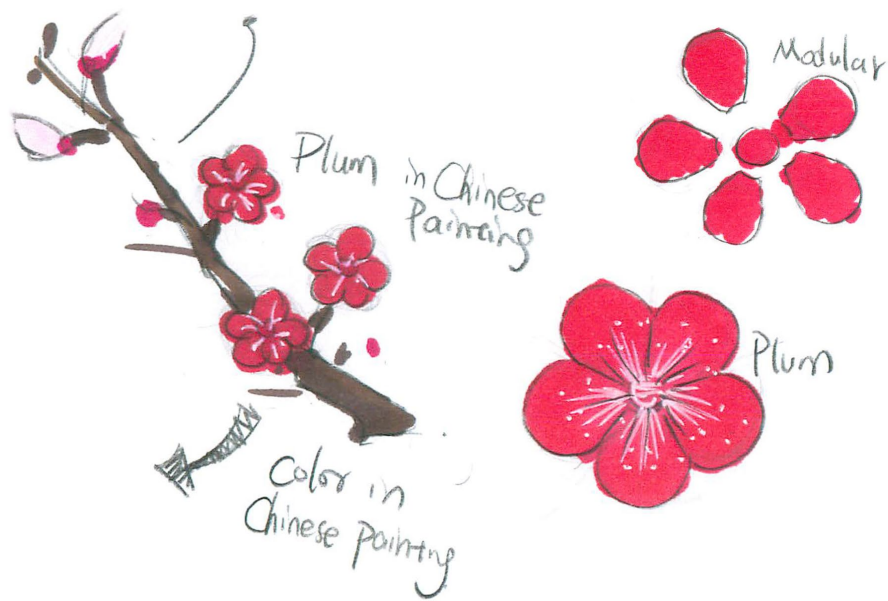


Figure 38 Plum form

The usage of the product will have to consider the special need of users using ink brush and others implements with ink brush. The special ink brush holder is designed for the place to store ink brush because ink brush and regular pen have to store separately. As shown in figure 38

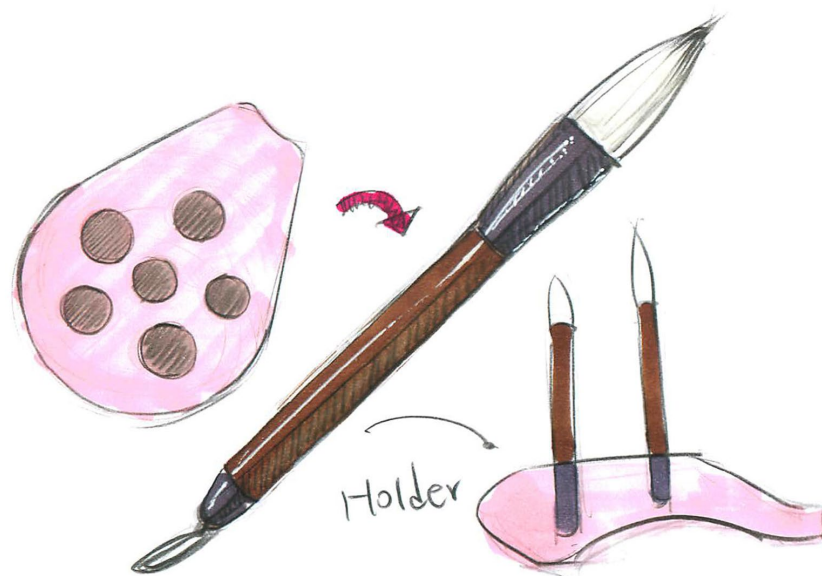


Figure 39 Special place to store ink brush

The material to create lacquer will be taken from *Toxicodendron vernicifluum* in China, and it is the traditional sources where Chinese people get lacquer. Since the lacquer comes from *Toxicodendron vernicifluum* and it will replenish fast, it won't cause depletion of natural source. As shown in figure 39

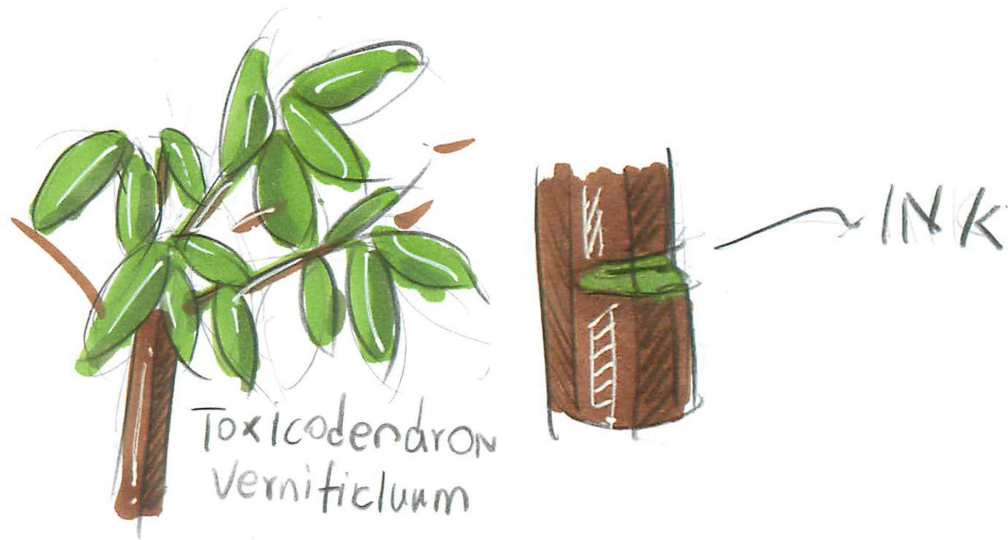


Figure 40 lacquer resources

The single petal on the top is designed to be multiple functions. It could be the regular container to carry stationery; it also could be the inkstone to place store ink. So that consumer does not need to buy other containers to carry ink, it saves the energy and material to make addition container. As shown in figure 40

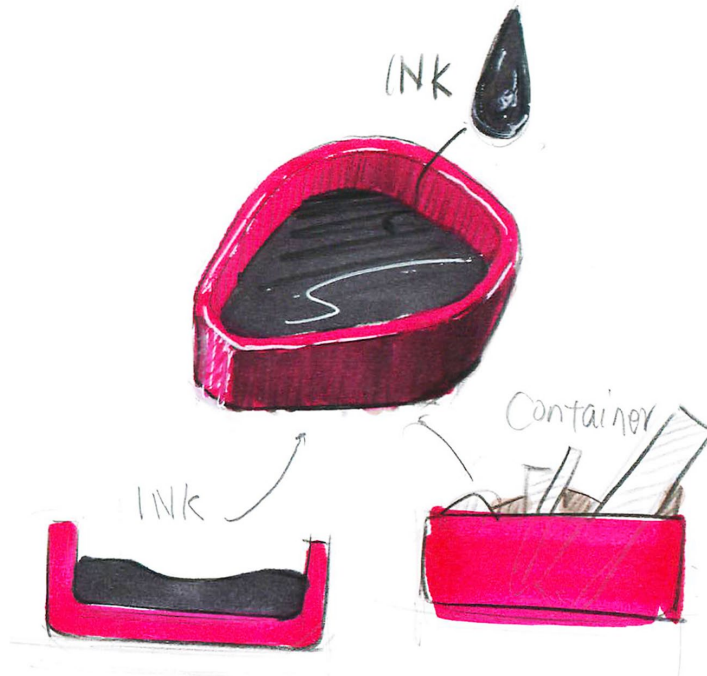


Figure 41 Saving energy and material

4.4 Final model

The final sketch of desk organizers will be shown below

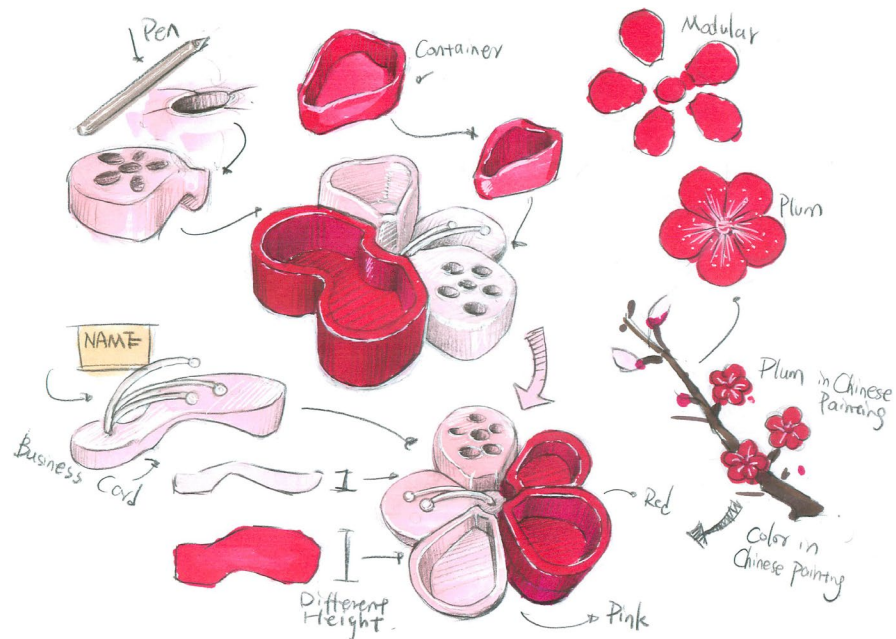


Figure 42 Final sketches

Based on the final sketch, the CAD model will be created in solidwork.

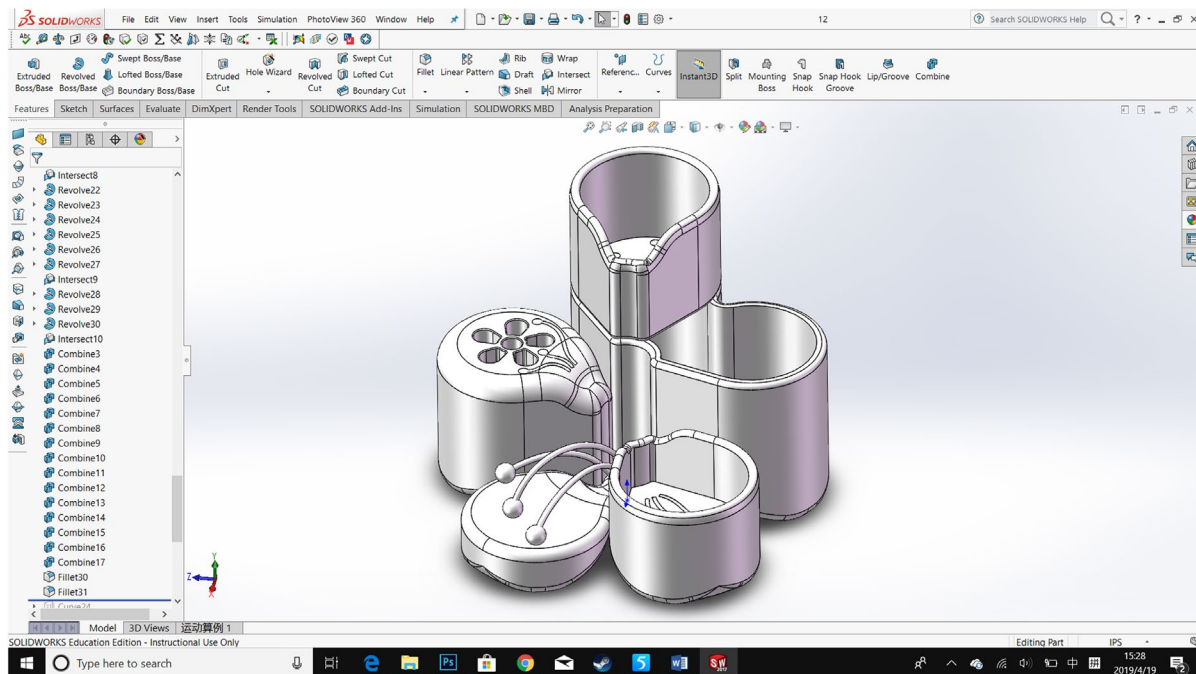


Figure 43 Final CAD Model1



Figure 44 Final CAD Model2

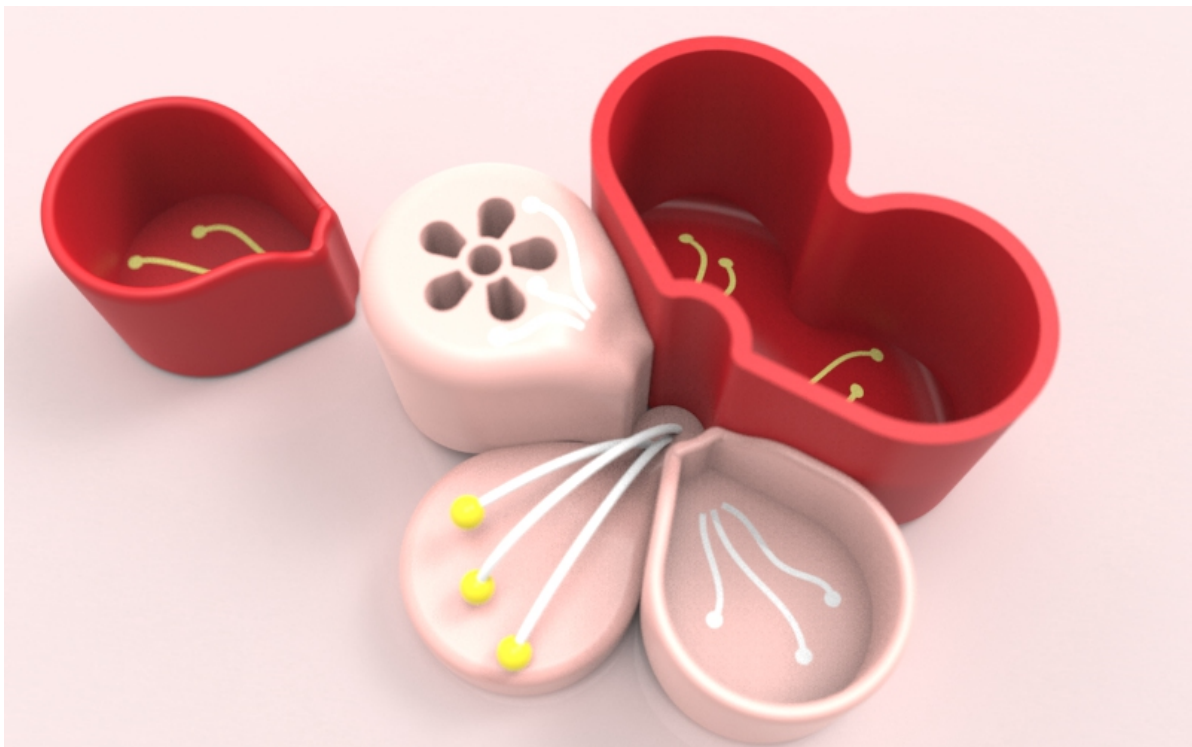


Figure 45 Final CAD Model3

The final model of desk organizers will be shown below



Figure 46 Final Model1



Figure 47 Final Model2

On one hand, from the final model we can find out the golden pistils on the desk organizer are affixed on the surface by golden sheet which is made by typical Chinese lacquering technique p'ing-t'o. Since p'ing-t'o is one of the most famous and typical Chinese lacquering techniques, users could perceive the Chinese culture directly. Furthermore, the whole form inspiration of desk organizer is coming from plum. As one of the most common objects show up in Bird-and-flower painting, plum has very important identity in Chinese culture. Not only because it represents steadfastness, perseverance, and resilience but also it is the most familiar flower to Chinese people. With the certain place to store the ink brush the writing tool have longest history, the desk organizer is suitable to the Chinese user who have the habit to write Chinese calligraphy and Chinese painting.

Therefore, user can perceive the Chinese culture value in this desk organizer through its typical Chinese manufacturing techniques, typical preference form in Chinese culture and typical usage of ink brush in Chinese culture.

On another hand, utilizing the local lacquer from *Toxicodendron vernicifluum* cut down the transportation cost and the waste generated in the distribution process which avoids the other materials that deplete natural resources. The container designed to be used as both storage for office supplies and a container to store ink, saving the energy to produce extra containers and materials, which encourages users to have low consumption behavior.



Figure 48 Final Model3

Chapter 5

Conclusion

5.1 Conclusion

The approach of designers to utilize cultural elements to enhance the sustainability of the product can be divided into two sections. How to extract cultural elements from cultural universals and how to apply those cultural elements in product design.

In the first section designers need to generate design criteria based on the core knowledge of selected culture and extract the cultural elements based on the design criteria. If it is necessary, designers will also need to analyze the cultural elements with semiotics analysis method so that to find out the hidden information behind the culture.

In the second section, designers will utilize the cultural elements extracted from the first section into cultural design strategy and consider the Okala Ecodesign strategy wheel as well at the same time so that the product will contain the cultural value and extend the product lifespan to achieve the final goal: enhancing the sustainability of the product.

The cultural design strategy involves 21 detail strategies or considerations which based on the combination of product life cycle and product value perception. There are no need to make the regulation how many strategy or consideration designers should apply at least to their design to ensure users can perceive cultural value from design. However, with the evaluation of exciting products, most of them involve at least three strategies or considerations.

5.2 Recommendations and Further Study

The design approach provides designers an opportunity to utilize culture to enhance the sustainability of the product. However, the culture we discussed in this thesis is geographical

culture. According to the layers of culture, there still have other layers of culture does not mention in this thesis. The other layers of culture can be studied further. A new approach could be developed base on further study.

Moreover, the cultural elements in products benefit the sustainability of products in environmental, social, economic, and cultural aspects. This paper only specifies environmental sustainability areas. The other three fields are potential value in academic research too.

References

- Accountability Can Reverse Plastic Pollution Crisis, says WWF Report. (2019, March 05). Retrieved from <https://www.worldwildlife.org/press-releases/accountability-can-reverse-plastic-pollution-crisis-says-wwf-report>
- Ashby, M. F., & Johnson, K. (2014). *Materials and design: The art and science of material selection in product design*. Amsterdam: Elsevier.
- Aslam, M. M. (2006). Are You Selling the Right Colour? A Cross-cultural Review of Colour as a Marketing Cue. *Journal of Marketing Communications*, 12(1), 15-30. doi:10.1080/13527260500247827
- Bamossy, G., Scammon, Debra L. & Johnston, M. (1983) A Preliminary Investigation of the Reliability and Validity of an Aesthetic Judgment Test
- Baten, J., & Blum, M. (2012). Growing Tall but Unequal: New Findings and New Background Evidence on Anthropometric Welfare in 156 Countries, 1810–1989. *Economic History of Developing Regions*, 27(Sup1). doi:10.1080/20780389.2012.657489
- Belz, F., & Peattie, K. (2013). *Sustainability marketing: A global perspective*. Chichester: Wiley
- Bergman, D. (2012). *Sustainable design: A critical guide*. New York: Princeton Architectural Press.
- Bevlin, M. E. (1994). *Design through discovery: An introduction to art and design*. Belmont, CA: Wadsworth/Thomson Learning.
- Bird-and-flower painting. (2019, March 03). Retrieved April 29, 2019, from https://en.wikipedia.org/wiki/Bird-and-flower_painting
- Braungart, M., & McDonough, W. (2009). *Cradle to cradle*. London: Vintage
- Brown, D. E. (1991). *Human universals*. Philadelphia: Temple University Press
- Burgess, J. H. (1989). *Human factors in industrial design: The designers companion*. Blue Ridge Summit, PA: TAB Professional and Reference Books.
- Chandler, D. (2018). *Semiotics: The basics*. New York, NY: Routledge
- Chinese painting. (2019, April 14). Retrieved April 29, 2019, from https://en.wikipedia.org/wiki/Chinese_painting
- Coates, D. (2003). *Watches tell more than time: Product design, information, and the quest for elegance*. New York: McGraw-Hill.

- Collins, P. (1971). Architectural judgement. London: Faber and Faber.
- Cooper, T., & Mayers, K. (2000). Prospects for household appliances. Sheffield: Sheffield Hallam University.
- Crilly, N., Moultrie, J., & Clarkson, P. (2004). Seeing things: Consumer response to the visual domain in product design. *Design Studies*, 25(6), 547-577. doi:10.1016/j.destud.2004.03.001
- Dittmar, H. (1992). The social psychology of material possessions: To have is to be. Hemel Hempstead, Hertfordshire: Harvester Wheatsheaf.
- Emerson, R. W. (1836). *Nature*. Boston, MA.
- Engel, J. F., & Blackwell, R. D. (1990). *Consumer behavior*. Chicago.
- Flurscheim, C. H. (2014). *Industrial Design in Engineering a marriage of techniques*. Berlin: Springer Berlin.
- Four Treasures of the Study. (2019, March 22). Retrieved April 29, 2019, from https://en.wikipedia.org/wiki/Four_Treasures_of_the_Study
- Fowler, T. C. (1990). *Value analysis in design*. New York, NY: VanNostrand Reinhold.
- Gause, D. C., & Weinberg, G. M. (2007). *Exploring requirements quality before design*. New York, NY: Dorset House Publ.
- Gautam, V., and Blessing, L., 2007, "Cultural Influences on the Design Processes," International Conference on Engineering Design, Paris.
- Graham, S. (1957). *American culture: An analysis of its development and present characteristics*. New York: Harper.
- Graves, M. E. (1952). *The art of color and design*. New York: McGraw-Hill.
- Hall, E. T. (1990). *The silent language*. New-York: Anchor Books.
- He, X. (1992). *Zhongguo zi ran shen yu zi ran chong bai*. Shanghai: Shanghai san lian shu dian.
- Hodge, R., & Kress, G. (2010). *Social semiotics*. Cambridge: Polity.
- Hofstede, G., & Hofstede, G. (2005). *Cultures and organizations: Software of the mind*. New York, NY: McGraw-Hill.
- Holbrook, Morris B. (1980). Some Preliminary Notes on Research in Consumer Esthetics. In: *Advances in Consumer Research*. Columbia University

Hubel, V., & Lussow, D. B. (1984). Focus on designing. Toronto: McGraw-Hill Ryerson.

Ink brush. (2019, April 27). Retrieved April 29, 2019, from https://en.wikipedia.org/wiki/Ink_brush

Keoleian, G., & Menerey, D. (1994). Life cycle design guidance manual: Environmental requirements and the product system. Cincinnati, OH: US Environmental Protection Agency, Risk Reduction Engineering Laboratory.

Kopplin, M. (2002). Lacquerware in Asia, today and yesterday. Paris: UNESCO.

Kosslyn, S. M., & Thompson, W. L. (2003). When is early visual cortex activated during visual mental imagery? *Psychological Bulletin*, 129(5), 723-746. doi:10.1037/0033-2909.129.5.723

Lacquerware. (2019, March 31). Retrieved April 29, 2019, from <https://en.wikipedia.org/wiki/Lacquerware>

Leong, B. D., & Clark, H. (2003). Culture-Based Knowledge Towards New Design Thinking and Practice—A Dialogue. *Design Issues*, 19(3), 48-58. doi:10.1162/074793603768290838

Li, X. (2016) Design Guidelines for Product that Influence Consumers' Value Perception. Auburn University

Lin, R. (2007). Transforming Taiwan Aboriginal Cultural Features into Modern Product Design: A Case Study of a Cross-cultural Product Design Model. *International Journal of Design*, 1(2). Retrieved April 29, 2019, from <http://www.ijdesign.org/index.php/IJDesign/article/view/46/26>

Living Planet Report 2016. (n.d.). Retrieved from <https://www.worldwildlife.org/pages/living-planet-report-2016>

Marzano, S. (1999). Creating value by design. London: Lund Humphries.

McDonough, W., & Braungart, M. (2013). The upcycle: Beyond sustainability - designing for abundance. New York: North Point Press.

McLennan, J. F., & Berkebile, B. (2004). The philosophy of sustainable design: The future of architecture. Kansas City: EcoTone.

Morley, M. P (2014). Culture in Design: The Analysis of Culture through Semiotics and its role in the Automotive Industry. Auburn University.

Mugge, R., Schoormans, J. P., & Schifferstein, H. N. (2008). Product Attachment: Design Strategies To Stimulate The Emotional Bonding To Products. *Product Experience*, 425–440. San Diego, CA: Elsevier.

- Myers, E. (1985). Phenomenological analysis of the importance of special possessions: An exploratory study. *Advances in Consumer Research*, 12
- Niku, S. B. (2009). *Creative design of products and systems*. Hoboken, NJ: Wiley.
- Pinker, S. (2002). *The Blank slate: The modern denial of human nature*. London: Penguin Books.
- Piper-Kaiser, D. J. (2014). *Product Attachment and Sustainability: A Transitional Method to Extend Product Lifespan*. Auburn University.
- Prunus mume. (2019, April 28). Retrieved April 30, 2019, from https://en.wikipedia.org/wiki/Prunus_mume
- Qianlijiangshan ruler. (n.d.). Retrieved April 30, 2019, from https://item.taobao.com/item.htm?spm=a1z10.1-c.w5003-15232064949.8.d46f355enlqLRm&id=554306915976&scene=taobao_shop
- Scupin, R., & Decorse, C. R. (2016). *Anthropology: A global perspective*. Boston: Pearson
- Sebeok, T. A. (2001). *Signs: An introduction to semiotics*. Toronto: University of Toronto Press.
- Sitarz, D. (1994). *Agenda 21: The Earth Summit strategy to save our planet*. Boulder, CO: EarthPress.
- Stahel, W. R. (1998). *Business Strategies for a Sustainable Society. Technology, Innovation and Policy (ISI) Innovation and Sustainable Development*. doi:10.1007/978-3-642-93639-5_5
- Stanton, N. (2004). *Human factors in consumer products*. London: Taylor & Francis.
- Stoops, J. D., & Samuelson, J. (1990). *Design dialogue*. Worcester, MA: Davis Publications.
- Thomas, A. (2003). *Psychologie interkulturellen Handelns*. Göttingen: Hogrefe Verl. für Psychologie.
- Three Friends of Winter. (2019, April 29). Retrieved April 29, 2019, from https://en.wikipedia.org/wiki/Three_Friends_of_Winter
- Volker, L. (2011). *Deciding about design quality: Value judgement of architectural design and decision making by public clients in the context of European tendering regulation*. Leiden: Sidestone.
- Wedgwood Prestige Floral Eden Collection. (n.d.). Retrieved April 30, 2019, from <https://www.wedgwood.com/collections/wedgwood-prestige-floral-eden>
- White, P., Pierre, L. S., & Belletire, S. (2013). *Okala practitioner: Integrating ecological design*. Phoenix, AZ, USA: IDSA.

Windham Jerrod Bradley (2007) sustainable design methodology for industrial designers within an organization with no environmental policy Auburn University

Zelanski, P., & Fisher, M. P. (1995). Shaping space: The dynamics of three-dimensional design. Australia: Thomson Wadsworth

祝！世界遺産登録 有田焼【富士山ペアシリーズ】 . (n.d.). Retrieved April 30, 2019, from <http://klastyling.com/2013/07/7011/>