

An Approach to Design Small Living Space for Young People

by

Meng Chen

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Industrial Design

Auburn, Alabama
August 3, 2019

Keywords: Small Space, Young People, Need, Satisfaction, Space Design

Copyright 2019 by Meng Chen

Approved by

Tin-Man Lau, Chair, Professor of Industrial Design
Jerrod Windham, Associate Professor of Industrial Design
Rusty Lay, Associate Professor of Industrial Design

Abstract

Due to the increasing population and urbanization, a small residence has become a good choice for many people, especially for the young people who have just entered the society in big cities. However, due to the limited space and the lack of rational design, many young residents have to give up some of their needs, which causes inconvenience and dissatisfaction in their daily lives.

This thesis is aimed at developing a highly user-participatory and goal-oriented approach for designers to design small living space that can accommodate both basic and optimal needs of users. By analyzing and managing their needs, the approach helps designers to improve users' satisfaction, and furthermore, to achieve the goal of individualized space design.

Acknowledgements

I would like to thank my major professor Tin-Man Lau for his kindness and support throughout my master's study. Without his serious attitude and high standard, I will not make this far on this approach. Also, thanks to Professor Jerrod Windham and Professor Rusty Lay for being always willing to give me great suggestions on this thesis. The experience of the past summer gives me the patience and confidence that I lost before and will encourage me to go further on the way of learning, thinking and designing.

I would like to thank Beth Topping for her kindness and great help with the logic, flow, and grammar of this thesis.

I would like to thank Chad Bailey for helping me laser-cut with high efficiency and high quality.

I would like to thank Haoyi Wei and Sijie Cheng for accompanying me this whole summer and giving me inspirations and advices on this thesis. I would like to thank my roommate Yangmo Zhu for her great help and tolerance.

Finally, I would like to express my gratitude to my parents, Erdong Chen and Yanmei Dai, and all my friends for always being my best support.

Table of Contents

Abstract	ii
Acknowledgements.....	iii
List of Figures.....	x
List of Tables.....	xiv
Chapter 1 Introduction	1
1.1 Problem Statement	1
1.2 Need of Study.....	4
1.3 Objectives of Study	5
1.4 Assumptions.....	6
1.5 Scope and Limitations	6
1.6 Procedure and Methodology.....	7
1.7 Anticipated Outcomes	8
Chapter 2 Literature Review	9
2.1 Whom to Design for?.....	9
2.1.1 Psychological Characteristic of Young Adults.....	9
2.1.1.1 Erik Erikson’s Stages Theory	9
2.1.1.2 Fidelity and Love	10
2.1.1.3 Transitional Period.....	11
2.1.2 Socio-economic Status of Young Adults	13
2.1.2.1 Home Leaving.....	13

2.1.2.2 Entering Career and Work.....	15
2.1.2.2.1 Career and Personality	15
2.1.2.2.2 Work-Life Balance.....	17
2.1.3 Target Group.....	18
2.2 What to design?	18
2.2.1 About Small Residence	19
2.2.1.1 Social Consideration	19
2.2.1.2 Economic Consideration	20
2.2.1.3 Environmental Consideration	21
2.2.2 Standard of “Small”	23
2.2.2.1 Average House Size by Country.....	23
2.2.2.2 Average Floor Space per Person by Country	24
2.2.2.3 Average Floor Space per Person by Cities	25
2.2.2.4 Regulated Space Size for Each Room.....	25
2.2.2.5 Le Corbusier’s Cabanon.....	26
2.2.2.6 The Range.....	28
2.2.3 Problems of Small Homes	28
2.2.3.1 Negative Psychological Feelings	29
2.2.3.2 Functional Chaos.....	29
2.2.3.3 Unhealthy Residential Environment	30
2.2.3.4 Lack of Privacy.....	30

2.3 How to Design?	31
2.3.1 Needs Satisfaction Approach.....	31
2.3.1.1 What is Need Satisfaction Approach	31
2.3.1.2 Benefits.....	33
2.3.2 Theories of Needs	34
2.3.2.1 Maslow’s Hierarchy of Needs	34
2.3.2.2 Jordan’s Hierarchy of Consumer Needs.....	37
2.3.2.3 Lidwell et al. 's Hierarchy of Needs	38
2.3.2.4 An Expanded Hierarchy	40
2.3.2.5 Environmental Psychology Research.....	41
2.3.2.6 Walter Schaer’s Design Theory	42
2.3.2.7 Kano Model	44
2.3.3 Methodologies of Satisfaction	46
2.3.3.1 Conventional Solution.....	47
2.3.3.2 Furniture Solution	47
2.3.3.2.1 Multifunctional Furniture.....	49
2.3.3.2.2 Modular Furniture.....	50
2.3.3.3 Circulation Solution	51
Chapter 3 Design Approach	53
3.1 Overview	53
3.2 Open.....	55

3.3 Probe	55
3.3.1 Human Research	55
3.3.2 Need Research	57
3.3.2.1 Hierarchy	57
3.3.2.2 Needs Research Form.....	59
3.3.3 Preference Research	62
3.4 Support.....	64
3.4.1 Function Organizing.....	65
3.4.1.1 Frequency – Importance.....	65
3.4.1.1.1 Design Priority.....	65
3.4.1.1.2 Matrix.....	66
3.4.1.2 Arrange.....	69
3.4.1.2.1 Scale.....	70
3.4.1.2.2 Placement	72
3.4.1.2.3 Evaluation.....	73
3.4.1.2.4 Set up.....	78
3.4.1.3 Hide	78
3.4.1.4 Attach	83
3.4.1.5 Remove.....	85
3.4.2 Feature Developing	85
3.4.2.1 Relationship of Function and Feature	85

3.4.2.2 Four Kinds of Features	86
3.4.3 Space Refining	87
3.5 Close	88
Chapter 4 Design Application	89
4.1 Open	89
4.2 Probe	89
4.2.1 Human Research	90
4.2.2 Need Research	90
4.2.3 Preference Research	92
4.3 Support	93
4.3.1 Function Organizing	93
4.3.1.1 Frequency - Importance	93
4.3.1.1.1 Design Priority	93
4.3.1.1.2 Matrix	94
4.3.1.2 The Four Strategies	94
4.3.1.2.1 Arrange	97
4.3.1.2.2 Hide	99
4.3.1.2.3 Attach	100
4.3.1.2.1 Remove	100
4.3.2 Feature Developing	101
4.3.2.1 Reverse Feature	101

4.3.2.2 Performance Feature	102
4.3.2.3 Delight Feature.....	102
4.3.2.4 Indifferent Feature.....	103
4.3.3 Space Refining.....	104
4.4 Close	105
4.5 Design Concept	105
4.5.1 Digital Model and Renderings.....	105
4.5.2 Prototype Photos	113
Chapter 5 Conclusion.....	117
5.1 Conclusion.....	117
5.2 Further Development.....	117
References	118

List of Figures

Figure 1. 1 The Increasing Population of the World. (United Nations, 2014).....	1
Figure 1. 2 Development of average apartments size in the big cities. (Otet, 2016).....	2
Figure 1. 3 Chinese Urban Youth Housing Issue Research (Jie Zhang, 2016).....	4
Figure 2. 1 Average House Size by Country (Wilson, 2014)	23
Figure 2. 2 Average Floor Space per Person by Country (Wilson, 2014)	24
Figure 2. 3 Average Floor Space per Person by Cities	25
Figure 2. 4 20 m ² Apartment Consist of One Bedroom, Kitchen and Bathroom.....	26
Figure 2. 5 Le Corbusier's Cabanon	28
Figure 2. 6 Need Satisfaction Selling Basic Flow Diagram.....	32
Figure 2. 7 The Diagram of Step by Step Process of Need Satisfaction Selling.....	32
Figure 2. 8 Maslow's Hierarchy of Needs Five-Stage Pyramid	34
Figure 2. 9 Maslow's Hierarchy of Needs Eight-Stage Pyramid.....	36
Figure 2. 10 Jordan's (2000) Hierarchy of Consumer Needs.....	37
Figure 2. 11 Lidwell et al. 's Hierarchy of Needs	39
Figure 2. 12 Needs Hierarchy for Small Living Space.....	41
Figure 2. 13 The Functions of an Artifact in Three Dimensions.....	43
Figure 2. 14 Human Function.....	44
Figure 2. 15 Kano Model Diagram (Munagavalasa, 2014)	45

Figure 2. 16 Main Furniture in a Small Apartment (Thøgersen, 2017).....	48
Figure 2. 17 Example of How Much Floor Space Furniture Occupy.....	48
Figure 2. 18 Example of Multifunctional Furniture	49
Figure 2. 19 Murphy Bed.....	50
Figure 2. 20 Example of Transformable Furniture.....	50
Figure 2. 21 Example of a Modular Couch (Thøgersen, 2017).....	51
Figure 2. 22 Types of Circulation.....	52
Figure 3. 1 Need – Satisfaction Design Approach	54
Figure 3. 2 Maslow’s (1970) 8-stage Model, Jordan’s (2000) Consumer Needs Hierarchy and William Lidwell’s (2003) theory.....	58
Figure 3. 3 Five-Level Needs and the Types.....	58
Figure 3. 4 Frequency-Importance Matrix	66
Figure 3. 5 Four-Quadrant Frequency-Importance Matrix	67
Figure 3. 6 The Four Strategies Flow Chart.....	68
Figure 3. 7 ‘Arrange’ Flow Chart.....	70
Figure 3. 8 User Ergonomic Dimension (Uzmandecoor.com, n.d.).....	71
Figure 3. 9 Example of Vertical Distribution (hzcdn.com, n.d.).....	73
Figure 3. 10 Soundproof Wall and Window (newenglandsoundproofing.com & eurotekwindows.com, n.d.).....	75
Figure 3. 11 Sound-absorbing Cork Wall(icorkfloor.com, n.d.).....	76
Figure 3. 12 Kitchen + Dining Space (hellomagazine.com, n.d.)	77

Figure 3. 13 Separate Desk and Dining Table Sharing the Bench (qq.com, 2019).....	77
Figure 3. 14 Foldable Bed, an Example of Temporal Distribution	79
Figure 3. 15 ‘Hide’ Flow Chart	80
Figure 3. 16 Example of Folding and Rotating (blessthisstuff.com, n.d.)	81
Figure 3. 17 Example of Sliding (esourcefurniture.com, n.d.).....	82
Figure 3. 18 Example of Twisting (godownsize.com, n.d.).....	82
Figure 3. 19 Example of Modularity (goodshomedesign.com, n.d.).....	83
Figure 3. 20 ‘Attach’ Flow Chart	84
Figure 3. 21 ‘Remove’ Flow Chart.....	85
Figure 4. 1 Space Floor Plan (zhihu.com, 2019).....	89
Figure 4. 2 Frequency-Importance Matrix	94
Figure 4. 3 Four-Quadrant Frequency-Importance Matrix	95
Figure 4. 4 Process of Arrange	98
Figure 4. 5 Process of Hide	99
Figure 4. 6 Process of Attach	100
Figure 4. 7 Reverse Feature Example.....	101
Figure 4. 8 Performance Feature Example.....	102
Figure 4. 9 Delight Feature Example.....	103
Figure 4. 10 Indifferent Feature Example.....	103
Figure 4. 11 Oriental Grilles (home.ifeng.com, 2016)	104
Figure 4. 12 Top View	105

Figure 4. 13 Overviews.....	106
Figure 4. 14 Entry.....	106
Figure 4. 15 Kitchen and Dining Area.....	107
Figure 4. 16 Bathroom.....	108
Figure 4. 17 Bathroom (with Human Scale).....	108
Figure 4. 18 Relaxing Area.....	109
Figure 4. 19 Stairs and Working Area.....	109
Figure 4. 20 Dressing Area.....	110
Figure 4. 21 Bedding Area.....	111
Figure 4. 22 Making-up Area and Bedside Table.....	111
Figure 4. 23 Television (Lying-on-bed View).....	112
Figure 4. 24 Partition.....	112
Figure 4. 25 Connection (for Laundry).....	112
Figure 4. 26 Prototyping Process.....	113
Figure 4. 27 Model Top View.....	114
Figure 4. 28 Model Over View.....	114
Figure 4. 29 Guest Bed Function (Hide).....	115
Figure 4. 30 Guesting Function (Hide).....	115
Figure 4. 31 Other Details.....	116

List of Tables

Table 2. 1 Erikson’s Stages of Psychosocial Development (McLeod, 2017).....	10
Table 2. 2 Regulated Space Size for Each Room in China.....	26
Table 2. 3 Function Areas Category	47
Table 3. 1 Human Research Form	56
Table 3. 2 Needs Research Form.....	60
Table 3. 3 Preference Research Form.....	62
Table 3. 4 Needs List for Each Strategy (Sample)	69
Table 3. 5 Four Kinds of Features	86
Table 4. 1 Human Research Form	90
Table 4. 2 Needs Research Form.....	91
Table 4. 3 Preference Research Form.....	92
Table 4. 4 Design Priority Form.....	93
Table 4. 5 Strategy Form.....	96
Table 4. 6 "Arrange" List.....	97
Table 4. 7 "Hide" List	99
Table 4. 8 "Attach" List	100
Table 4. 9 "Remove" List.....	100
Table 4. 10 Function Waitlist.....	101
Table 4. 11 Function Waitlist.....	105

Chapter 1 Introduction

1.1 Problem Statement

Today's society is affected by on-going growing population and urbanization (United Nations, 2014). This is resulting in an increasing demand of housing in cities, which has led to higher market prices and smaller apartments. Small residence is a result of the on-going growing population and the urban housing development. The marketing prices and the increasing urbanization forces people into less space. Small apartments have been the main choice in many metropolises for a long time, especially in Asia, such as Tokyo, Shanghai and Hong Kong, where the price of the smallest room is extremely high. In the United States, since the “Great Recession” hitting in 2008, an architectural and social movement is gaining popularity – “Tiny House Movement”, which advocates living simply in small homes. TV shows like *Tiny House*, *Big Living*, *Tiny House Nation* and *Tiny House Hunters* have glamorized the small-home lifestyle and helped gain appeal among those looking to live with less.

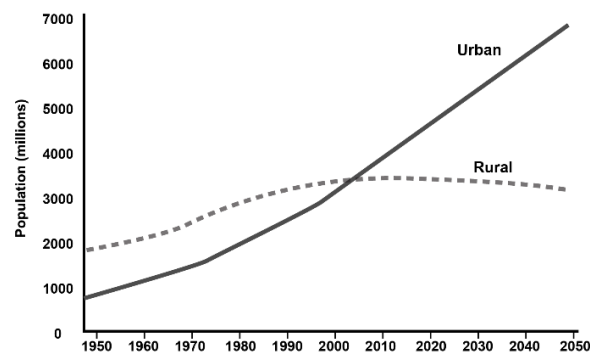


Figure 1. 1 The Increasing Population of the World. (United Nations, 2014)

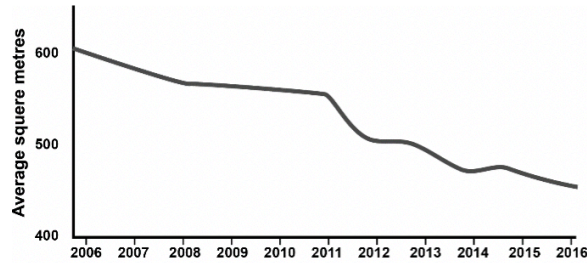


Figure 1. 2 Development of average apartments size in the big cities. (Otet, 2016)

For some people, a small residence is the sustainable and economic choice, and possibly the only. Single people who lead an independent existence and no longer live with their families, people who originally live in the country but work in the city and need a pied-a-terre there, young couples whose financial position does not allow them a larger place, and the elderly, used to urban lives, who have no large house ownership and whose children have left home, all manage to make comfortable homes within the restrictions of a small-sized living space.

Among those different groups of people who choose to live in small space, young people housing has become a phenomenal issue. In fact, the housing experiences of young people are a contemporary global concern; Peter K. Mackie (2016) from *International Journal of Housing Policy* mentioned that:

The housing experiences of young people have become a critical international issue, with young people's housing problems being reported widely in the media and an increasing concern of scholars. Many young people are being confined to tenures they would not typically choose to occupy, with transitions from the family home into independent living becoming increasingly delayed, protracted and complex (p. 137).

Thus, they conducted an empirical research in 2016, trying to present the housing issues facing young people in Europe and East Asia. The report generally aimed to seek and identify keys for improvement from a political and sociological viewpoint. This report also mentioned that to improve the suitability and availability of housing for young people, somehow small-sized

apartment and young people's housing issue could be related together and probably be partly solved through "space design".

It seems like "young people" is a term that only is defined with the age. However, as a great amount of young people move from their family of origin and into cities for better opportunities of education and employment, they are actually in a very special period of life. They are under the stress of achieving economic independence on their own efforts and building a new family in a new environment, and on a path of great resistance from the political, economic and cultural forces. Fortunately, unlike other age groups such as kids and elderly, young people are at the peak time of life, generally with no physical restriction. Based on these facts, small-sized apartment is both "available and suitable" for them.

However, is it just "available and suitable," or "comfortable"? Young people lead various lives. They are resting, working, studying, entertaining, socializing, trying everything they could to adapting in the environment. They have multiple needs in the limited space. As the price of good location and transportation, a small living space has many problems and barely meets the needs of young residents. When there is only limited space for daily needs, they may have to reduce some of their needs or even have basic needs only, as well as reducing their living quality and satisfaction. These are some problems:

- 1) Insufficient messy storage space;
- 2) Poor lighting and ventilation problems;
- 3) Unreasonable layout;
- 4) Ergonomically unfriendly;
- 5) Emotional negativity;
- 6) Privacy problem.

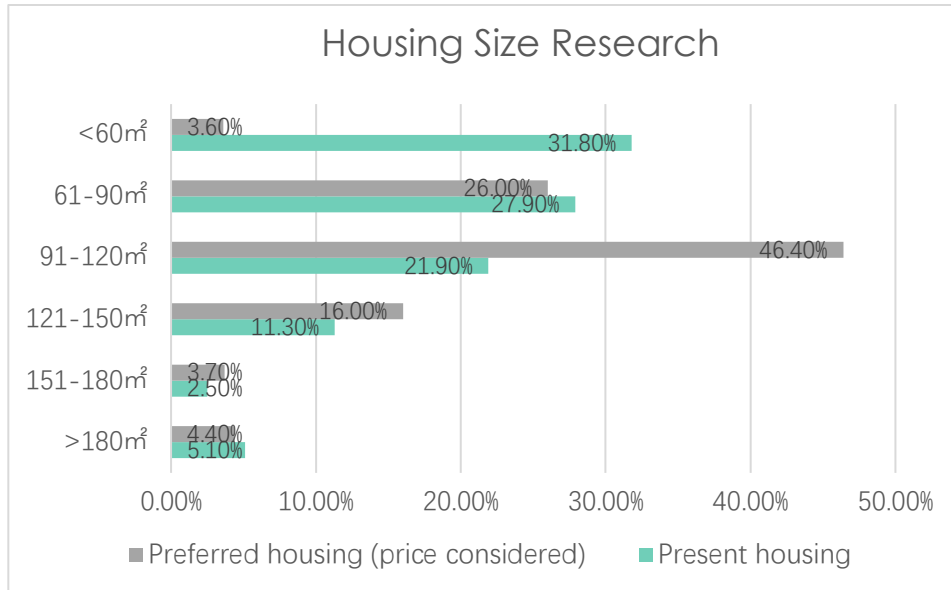


Figure 1. 3 Chinese Urban Youth Housing Issue Research (Jie Zhang, 2016)

This chart is made according to a Chinese website’s research on housing problem. More than half of residents live in space less than 90 m² (970 ft²) with their family. Some of them have built a new family while others are just unable to leave their original family and live independently. Meanwhile, many of them are eager to live in a larger space, which reflects that living in small space has produced a negative impact on their daily lives.

1.2 Need of Study

Many people struggle with the small size and meeting the level of their needs, but the truth is, according to Phoenix-based architect Jason Boyer (n.d.), "In 400 square feet we can do everything 1,000 square feet can do if designed right"(cited in Kulp, 2017, para.25).

"If designed right." Then how to design it right? When Googling the “small space”, articles like “80 Ways to Decorate A Small Living Room”, or “24 Small Space Living Ideas - Best Hacks for Small Homes” jump out. Given the admission that these advices do inspiration, the operability is doubted. The reason is that such advice lacks overall control, pertinence for

users and systematic thinking. If a small space is simply divided into separate functional areas or scattered ideas, then users will realize that it's going to be hard to do in practice and there will be innumerable problems coming one after another.

There is no doubt that small-sized space design is quite a challenge. There should be a methodology that makes the design process both “systematic and specific”, systematic that can take control of every factor involved in the space, and specific that it is aimed at “small-sized space”. Based on this prospective, the study will have three key tasks:

- 1) To help designers conduct needs research of users (young residents) in a methodical way;
- 2) To help resolve the conflicts between limited space and multiple needs;
- 3) To introduce some useful efficient ideas and solutions that can be widely applied in small living space design.

1.3 Objectives of Study

The objective of this thesis is to help self-designing residents and beginning designers solve the problems of small-size residential space, which could involve user research methods, idea inspiration and concept refining. It will also introduce the criteria of these kinds of design.

The following is a list of objectives this thesis study will involve:

- Identify size arrangement of residential space that this thesis would consider;
- Identify “young people” that this thesis is concerned about and research their residential needs from physical and psychological aspects;
- Research current problems of small dwellings, which can be a reference for designers to create targeted research schemes in specific cases
- Research existing design methods for small space design;

- Conduct a use study;
- Research cultural probes and cultural impact on residential space
- Study the theories that are relevant to user needs;
- Study environmental psychology that helps to design;
- Research system (society, community, neighborhood, etc.) that are relevant to residential space;
- Research relevant laws and rules;
- Develop checklist that help designers to know and organize users' needs;
- Develop recommendations for designing limited space;
- Create a flow chart that is specified by small-sized space;
- Redesign an existing small space to apply the guideline.

1.4 Assumptions

It is assumed that all the research, approaches, methods and data I found are correct.

It is assumed that young people living in small apartment are willing to improve their space and communicate their personal needs.

It is assumed that the issue of small living space could be resolved by reasonable design.

It is assumed that to solve their living space problems, the changes on their building structure are not allowed to be made.

1.5 Scope and Limitations

Scope of Study:

This study will introduce some knowledge of interior and architecture design. This study will cover some furniture design for solving small residential space problems. This thesis will be

set up as a guideline for beginning designers and self-designing users to work on small residential spaces. This study will cover the following:

1. Needs research
2. Space planning
3. Interior design methodology
4. Ergonomic research

Limitations of Study:

Location –This study will be conducted in Auburn, Alabama, where the size of housing is quite large in this small town whereas the study is basically for urban residents especially in big cities.

1. For the external condition variations, the architectural structure and layout could possibly hinder the design. For safety consideration, it cannot be changeable or adjustable in design.

2. For the activities at a national level, the official rules and some definitions that this thesis mentions can be different.

1.6 Procedure and Methodology

Procedure #1:

- Research on target users (young people).

Method:

- Do Library and internet research.
- Draw conclusion from the research.

Procedure #2:

- Define the design objectives (small space).

Method:

- Research on current situations of small space.
- Conclude to a range of space.

Procedure #3:

- Explore the theories that related to research section.

Method:

- Do library and internet research.
- Analyze the pros and cons.
- Combining and concluding.

Procedure #4:

- Existing solution research

Method:

- Do library and internet research.
- Evaluate the solutions.

1.7 Anticipated Outcomes

The primary outcome is to generate a needs-guided approach to help designers design small-sized living space that satisfies the users' needs as far as possible. The design will be expected to be more logical and direct than the unsystematic internet search results mentioned earlier that are accessible to many. An application of this guideline will be presented as well.

Chapter 2 Literature Review

In this chapter, three questions are to be answered by existing study, which are “Whom to design for?”, “What to design?” and “How to design?”. The first question “whom” is to typically introduce the target user of the designed space, in other words the client or habitants. “What to design?” is introduction and range of small living space. “How to design?” is about the methodologies relevant to the approach.

2.1 Whom to Design for?

At first, the target group of habitants needs to be clarified so that the characteristics of the group could be understood by designers. The guideline is aimed at the young people who are starting to lead independent lives in big cities. However, the term “young people” is an ambiguous concept. As the particularity of young people is mainly reflected in their psychological characteristics and socio-economic status, these two points will be focused on in this section.

2.1.1 Psychological Characteristic of Young Adults

2.1.1.1 Erik Erikson’s Stages Theory

Erikson's stages of psychosocial development, as articulated in the second half of the 20th century by Erik Erikson in collaboration with Joan Erikson, is a comprehensive psychoanalytic theory that identifies a series that a healthy developing individual should pass through from infancy to late adulthood. The series consists of eight stages, as the Table 2.1 shows.

Erikson's stage theory characterizes an individual advancing through the eight life stages as a function of negotiating his or her biological and sociocultural forces. Each stage is characterized by a psychosocial crisis of these two conflicting forces. If an individual does

indeed successfully reconcile these forces (favoring the first mentioned attribute in the crisis), he or she emerges from the stage with the corresponding virtue. The challenges of stages not successfully completed may be expected to return as problems in the future. However, mastery of a stage is not required to advance to the next stage. The outcome of one stage is not permanent and can be modified by later experiences (Crain, 2011).

Approximate Age	Virtues	Psychosocial crisis ^[3]	Significant relationship	Existential question ^[4]	Examples ^[4] [hide]
Infancy Under 2 years	Hope	Trust vs. Mistrust	Mother	Can I trust the world?	Feeding, abandonment
Toddlerhood 2–4 years	Will	Autonomy vs. Shame/Doubt	Parents	Is it okay to be me?	Toilet training, clothing themselves
Early childhood 5–8 years ^[5]	Purpose	Initiative vs. Guilt	Family	Is it okay for me to do, move, and act?	Exploring, using tools or making art
Middle Childhood 9–12 years ^[6]	Competence	Industry vs. Inferiority	Neighbors, School	Can I make it in the world of people and things?	School, sports
Adolescence 13–19 years ^[7]	Fidelity	Identity vs. Role Confusion	Peers, Role Model	Who am I? Who can I be?	Social relationships
Early adulthood 20–39 years ^[8]	Love	Intimacy vs. Isolation	Friends, Partners	Can I love?	Romantic relationships
Middle Adulthood 40–59 years ^[9]	Care	Generativity vs. Stagnation	Household, Workmates	Can I make my life count?	Work, parenthood
Late Adulthood 60 and above ^[10]	Wisdom	Ego Integrity vs. Despair	Mankind, My kind	Is it okay to have been me?	Reflection on life

Table 2. 1 Erikson’s Stages of Psychosocial Development (McLeod, 2017)

2.1.1.2 Fidelity and Love

The target group of this thesis is young people that are starting to lead independent urban lives. As the table above shows, they are mainly in the late 5th and entire 6th stages.

Fidelity: identity vs. role confusion (adolescence, 13–19 years)

Existential Question: Who Am I and What Can I Be?

At this stage, making the transition from childhood to adulthood is significant.

Adolescents ponder the roles they will play in the adult world. Where am I going in life? The adolescent is exploring and seeking for their own unique identity. This is done by looking at personal beliefs, goals, and values. The morality of the individual is also explored and

developed. Erikson proposed that most adolescents are able to have the sense of identity regarding who they are (Gross, 1987). Learning the roles that they provide in society is essential since the teen begins the desire to fit in to society. Fidelity is characterized by the ability to commit to others and acceptance of others even with differences. Identity crisis is the result of role confusion and can cause the adolescent to try out different lifestyles. They are also becoming more independent, and begin to look at the future in terms of career, relationships, families, housing, etc. The individual wants to belong to a society and fit in. (McLeod,2017).

Love: intimacy vs. isolation (early adulthood, 20–39 years)

Existential Question: Can I Love?

During this period, the major conflict centers on forming intimate, loving relationships with other people. The young adults begin to share themselves more intimately with others. We explore relationships leading toward longer-term commitments with someone other than a family member. Successful completion of this stage can result in happy relationships and a sense of commitment, safety, and care within a relationship. Avoiding intimacy, fearing commitment and relationships can lead to isolation, loneliness, and sometimes depression. Success in this stage will lead to the virtue of love (McLeod, 2017).

2.1.1.3 Transitional Period

As the childhood stages seem to produce the basic building blocks of identity, the stage of identity resolution is a time of preparation and rehearsal during which the individual defines who he is (and who he will not be) and makes initial commitments that circumscribe his identity. However, identity is not fully established until adulthood. The adult years are marked by turning the sense of identity outward to engage the common demands of adult life, to choose someone with whom to live and love, to select and to work within a career, and to more clearly shape and

live out one's values. Erikson divides adulthood into three stages, each of which has attendant tasks. Young adulthood poses the task of creating a relationship characterized by mutual devotion and chosen, active love. The young adult must decide whether to fuse some parts of his identity with those of another to create shared commitments (Widick, Parker, & Knefelkamp, 1978).

In the psychological sense, the adolescent/young adult is a "marginal man." He is still the child of his parents; but he no longer looks or thinks like a child. He has impulses, skills, interests, and social experiences which are qualitatively different from those of his childhood and perhaps those of his parents. Yet he is not an adult; an adolescent exists in what Erikson calls a "natural period of uprootedness"; he must pause, reflect, and make sense of himself if he is to manage the complexities of adulthood effectively. The individual must take his childhood self-images, assess his present assets and liabilities, define his future hopes, and actively synthesize an identity, a core self-concept which provides a sense of sameness and continuity (Widick, Parker, & Knefelkamp, 1978).

In conclusion, this theory emphasizes two significant problems among the period: self-identity and interpersonal relationship. Here "building relationship" can be regarded as "identifying and identified by someone else". The young people are trying to get the sense of identity and acceptance from both the inner and outer world during the transitional period. It is also a process to communicate themselves and the world outside the origin family, a two-way process which includes "self-expression" and "loneliness relief". As the space that the young adult can totally control by themselves and where closest relationships are built, the two factors should definitely reflect on living space design, to communicate personality and to provide the

feelings of a home. Erikson's psychologic theory helps designers to figure out the nature of their multiple needs.

2.1.2 Socio-economic Status of Young Adults

Early adulthood transitions consist of a series of status and role transitions such as completion of education, entry to the labor market, leaving the parental home, forming a couple, and entering parenthood. For contemporary young adults, this demographically dense period has been described as protracted and destructured. General demographic and sociological research on transitions to adulthood have especially focused on school to work transitions and family formation, with leaving the parental home to form a separate household being part of the latter transition event. Structural factors such as the welfare regime, the educational system, and the labor market have also been shown to condition transitions to adulthood, accounting for significant differences between countries.

2.1.2.1 Home Leaving

To explore the conceptions from their own of the transition to adulthood, there is a research with 486 American young adults aged 18-28. Participants indicated the characteristics necessary for a person to be considered an adult on a questionnaire containing 40 possible criteria. In both studies, the top criteria endorsed emphasized aspects of individualism, including "accept responsibility for the consequences of your actions", "decide on own beliefs and values independently of parents or other influences," and "establish a relationship with parents as an equal adult." In contrast, role transitions typically associated with research on the transition to adulthood, such as finishing education, entering the labor force, marriage, and parenthood, were rejected as criteria for adulthood by a large majority in both studies. The results suggest that the

current generation of young people in American society conceptualizes the transition to adulthood in intangible, gradual, psychological, and individualistic terms (Arnett, 1997).

Leaving the parental home is a critical step in the transition to adulthood, but also one that has become increasingly difficult to make. Scholars now generally acknowledge that the young generation is facing historically unprecedented social and technological changes and is making transitions to adulthood in significantly different ways than previous generations. To accommodate to these changes, the period for young people transitioning to adulthood has been apparently prolonged and been even harder than ever before. The outcomes of this prolonged period of transitioning toward independent adulthood depend only partially on individual choices, and the postponement of commitments to adult responsibilities rarely reflect individual capabilities (Druta, Limpens, Pinkster, & Ronald, 2018).

The reality that political, economic and cultural forces are now restricting young people's independence and weakening their own efforts makes an even further influence on housing issues, which appear to be a global issue as well. The *International Journal of Housing Policy* published a new editorial around the young's housing in Europe and East Asia and seeks to identify key areas for improvement in national housing policies. As this editorial summarizes, one of the main hindrances for young people to obtain housing independently is that governments and policies are not able to guarantee the equal opportunity for all young people to leave the family home and live independently (Mackie, 2016). Consequently, rather than improving their own capabilities, relying on parental support, whether financially or socially, has become more of a prerequisite for young people to pursue independent housing arrangements.

From the research above, we can see that contemporary young adults face a double bind. On the one hand, independence and individual responsibility are important markers of adulthood,

as their own conception and the society general awareness. On the other hand, the ability of young adults to attain independence is being increasingly and multiply constrained, which forces them to accept support from parents especially on housing. This contrast may lead to frustrations, and a sense of over-indebtedness. It is also an explanation of why increasingly young adults choose small-sized residential methods, although their parental financial ability may allow larger ones.

Another hint for designers is that, although some of the client may not claim so directly, there is latent financial requirement existing in most small-sized space cases. The designers should work on not only limited space but also limited budget.

2.1.2.2 Entering Career and Work

Entering into work and career is another critical issue facing young adults. On one hand, our society generally values work achievement and equates personal worth with one's success at a job or career. This is the most common way, though may not be the only, for young people to integrate in to the society and enhance social status. On the other hand, most people need to earn an income from work to assure their living financially.

2.1.2.2.1 Career and Personality

There is a well-accepted theory of career development that covers the entire lifespan. Donald Super (1980) has outlined five stages of career development:

- (a) growth (childhood);
- (b) exploration (adolescence);
- (c) establishment (young adulthood);
- (d) maintenance (middle adulthood);
- (e) disengagement (old age) (cited in Beaty, 2002, p.10).

The establishment stage begins in the early 20s and extends until the early 40s. It focuses on the process of putting one's career in place and providing for future growth potential. There are three sub-stages:

- (a) stability (staying in one's job);
- (b) consolidation (achieving security and recognition);
- (c) advancement (moving ahead in one's career) (Beaty, 2002, p.10).

Super's belief is that career is related to one's personality and is especially affected by an individual's self-concept. That is, the internal picture we have of ourselves is both shaped by and helps to shape our choice of job and career.

An interesting application of the congruence between personality and specific jobs/careers has been provided by John Holland. Holland's (1992) six personality typologies are: (a) social; (b) investigative; (c) realistic; (d) artistic; (e) enterprising; and (f) conventional. According to Holland, individuals have a configuration of typologies that can be linked to particular job types.

Instruments like the Self-Directed Search by Holland (1977) can be used to assess an individual's typology which in turn can be a suggestion for designers to roughly understand the personality of their young client. Although what we work on is residential space, which seems not closely related to career, it does have an internal hinge, which is personality. Based on increasingly free career choice, greater chances to change for an ideal career, and the consistent career influence to the young adults themselves, the information coming from one's career is surely helpful for designers. Meanwhile, due to the particularity of early adulthood, professional, social, and personal identities are not stable in the transition as a result of changing contexts. Thus, the design should avoid the error caused by this instability, so the thinking of typology and individualization should be combined together during the research on their user.

2.1.2.2.2 Work-Life Balance

In addition, another theory also provides the possible hinge of residential space and career. Concerning career identity, the change in context from higher education to work causes people to understand their work in a different way, find a new balance between their professional and personal life sphere, and change their view toward their professional responsibility through social interaction with others. The transition causes a misbalance in professional identity, which stabilizes when young adults hold a job for a considerable time. The misbalance occurs, because young adults want to meet the expectations of significant others at work, with the result that more energy is invested in their working life than in their personal life. Some young adults shape their identity by finding a balance between different aspects of life. They can explore their professional identity by negotiating between different life spheres until they find a balance that is satisfying for them. Some differences were found in the literature about how this challenging process evolves. Nyström (2009) stated that emerging adults go through a fixed sequence of identity development. They move from students who can easily switch between different domains of life to new employees who are mainly focused on work and mainly separate the work domain from personal and social aspects of life. Eventually they develop to a more experienced employee with self-confidence that has a sustainable professional identity in relation to the other life spheres, resulting in finding balance in their lives. Balance is found when their identity is developed around their main focus: When their main focus is on work their identity is ideally developed around work, while their identity is ideally developed around other life domains when young adults consider other domains as more important (Grosemans, Hannes, Neyens & Kyndt, 2018).

What role the residential space plays is the other end in this balance with working. It takes the task of relieving stress and tiredness from working. This can be simply regarded as the basic function, a place to have a rest, but a qualified space can be far more than that, such as entertaining and socializing. This theory also inspires how career reflects on personal space: It can be accordant to the features of career, or can be completely inverse to their working life, depending on which is expected and which works better as the balance.

2.1.3 Target Group

Based on the psychological theory and socio-economic research, the target group is defined by three criteria:

1. Formation of Residence. Young adults who have left their original family and have not set up a new family completely. This space is for singles and young couple who have no child yet.
2. Career Status. Young adults who have started their professional life already. They have achieved or are achieving the financial independence from their parental home.
3. Range of Age. Young adults at age of 18~39. The age is only provided as an optional and non-rigid criterion.

2.2 What to design?

Second, the question that what are the objects being designed needs to be answered. It seems to be easy to give the answer of 'small living space', but the understanding of it can vary a lot due to the different background. There will be two sections, the reasons and benefits of small residence and the standards of 'small', to help readers understand.

2.2.1 About Small Residence

2.2.1.1 Social Consideration

Urbanization refers to the population shift from rural areas to urban areas, the gradual increase in the proportion of people living in urban areas, and the ways in which each society adapts to this change. It is predominantly the process by which towns and cities are formed and become larger as more people begin living and working in central areas. The United Nations projected that half of the world's population would live in urban areas at the end of 2008. It is predicted that by 2050 about 64% of the developing world and 86% of the developed world will be urbanized. That is equivalent to approximately 3 billion urbanites by 2050, much of which will occur in Africa and Asia. Notably, the United Nations has also recently projected that nearly all global population growth from 2017 to 2030 will be by cities, with about 1.1 billion new urbanites over the next 13 years (Cohen, 2015).

With the process of urbanization, the problem is how to make cities accommodate more people with every aspect of living. “Housing” is absolutely one of the biggest ones. Consequently, small housing comes as an answer. In America, it is known as “Tiny House Movement”. In urban environments, tiny houses can house dense populations in limited space. In 2012, an experimental tiny house village, called Boneyard Studios, was built in Washington, D.C., to demonstrate the potential for tiny homes on wheels to provide a creative solution for urban infill. Japanese architect Denso Sugiura noted the increase in demand for micro-houses has coincided with the growing number of working families, who wish to move their households closer to city offices. Sugiura states that he has designed 135 micro-houses in the past 20 years. In areas like Tokyo, Japan—which is home to approximately 6,000 people per square

kilometer—"micro-houses" have become more common over the past 20 years (cited in Ford & Gomez-Lanier, 2017).

Tiny houses can provide an affordable tool for combating homelessness by getting people off the streets and into their own space, thus offering them both shelter and a measure of self-respect. In Eugene, Oregon, a micro-housing community called Opportunity Village has 30 tiny homes that provide shelter for citizens in need. Each tenant lives in an 80-square-foot space and shares a common kitchen, community space and bathrooms. The homes were built by volunteers using donated materials and \$100,000 in private donations (Ford & Gomez-Lanier, 2017).

2.2.1.2 Economic Consideration

Badanes (2004) in *The HOME House Project: The future of affordable housing* states that "The size of houses in America: We are building houses that are more efficient, but they are a lot bigger so everyone is going to cost a lot more. When a builder builds a house, there is not much incentive to keep the operating cost down-what they want to do is to keep the first cost down. Increasing the amount of square footage that the American family seems to need (which has doubled in one generation) has negated any gains that we have made in efficiency "(p. 90). He clearly describes the housing problem in America, which also greatly explains the reason of small dwelling in other countries or cities: to make housing efficient and affordable.

"The benefits of tiny homes are obvious," says George Chmael, the CEO of Council Fire, an Annapolis, Maryland-based consultancy that advises nonprofits, corporations, governments and communities on sustainable building practices. "There's reduced maintenance, a reduced financial burden and added movability and mobility for a change of circumstances." (cited in Naciri, 2017, Tiny Homes section, para. 2)

With many Americans spending one-third to more than half of their income on housing, living small uses significantly less of a paycheck or savings for putting a roof over one's head. According to a frequently-cited infographic from The Tiny Life, a website of resources devoted to living small, 68 percent of tiny house owners have no mortgage compared to 29.3 percent of all U.S. homeowners. The average cost of a standard-sized home in the United States is \$272,000 (plus an additional \$200,000 or so if the price comes with a 30-year mortgage at current interest rates). The average cost of a tiny house is \$23,000 if built by the homeowner. The price tag typically doubles if a builder is used (Kaufmann, 2015).

In addition, a small residence is also superior because of its efficiency as a periodic place to live, especially during the establishment of career and transitional stage of life. Hildner (2011) in *Small Houses: Contemporary Japanese Dwellings* says that Japanese clients are more open to unconventional and daring ideas also in part because they are not expecting a home for eternity. A Japanese home lasts on average only 25 years. The reason for this difference is that in Japan a house is supposed to satisfy primarily the needs of a moment and hence of a certain period of a lifetime. When the living situation changes, it is demolished and replaced with no great qualms. The lot, not the house, is considered the real value; that is where life plays out, where spaces are created"(p. 8). Thus, the small living space makes housing even chronologically economic.

2.2.1.3 Environmental Consideration

In the last few years, small residences have been promoted as a new, eco-friendly housing solution to combat the current waste of the housing industry. A smaller home requires less embodied energy to build, has lower heating and cooling needs, needs fewer furnishings, takes less time to maintain and requires less work to fund. Recently U.S. Environmental Protection Agency (EPA, 2009) reports cite health concerns over indoor pollutants, which may be two to

five times higher than outdoor levels. According to Lee, Allen, and Kim (2013), the origins of these indoor pollutants can be linked to “harmful gases or particles emitted from building materials, that is, flooring, paints and coatings, adhesives and sealants, wall coverings, and wood products” (p.1). This is an example of the need for interior designers to heighten their awareness and participation in matters relating to residential sustainability. Interior designers are responsible for selecting materials and finishes, and they have a direct influence on which toxins may or may not ultimately be introduced into their spaces. Volatile organic compounds (VOCs) are a major concern for many paints, varnishes, and finishes. The term VOC refers to a wide variety of carbon-containing chemicals (hence the “organic”) that easily evaporate or sublime into their surrounding environments (hence the “volatile”), even at room temperature and normal atmospheric pressure. VOCs can pose a major health hazard, and they can lead to nausea, dizziness, and headaches; irritation of the eyes, nose, and throat; and some VOCs, most notably formaldehyde, have been found to be carcinogenic (Ford & Gomez-Lanier, 2017).

In addition to the indoor pollutants, according to Ford & Gomez-Lanier (2017), excessive and unnecessary energy consumption by air-conditioning units and other appliances can also lead to negative environmental impact and deplete resources. Combined with the general increase in household consumption of energy for other electrical appliances, water, and gas that is used for heating (and petroleum gas used in suburban cars), there is a large area for improvement that interior designers are certainly poised to tackle through ecologically responsible design decisions. For example, the decision to specify energy-efficient appliances certified by a third-party verifier such as Energy Star, or designing fenestration (windows and their placement) to minimize the amount of heat trapped from sunlight are both within the purview of the interior designer.

2.2.2 Standard of “Small”

Kaufmann (2015) in *Tiny Houses Are Becoming a Big Deal* mentioned that: These so-called "Tiny Homes" measure, on average, from 100 to 400 square feet, but they can be as small as 80 square feet or as large as 700 square feet. Although these houses are small, they are big enough to include the needed amenities of a home. There's a sleeping area, a bathroom, a modern kitchen, storage and spots for eating and entertaining. While most tiny home owners live alone, the structures can be built to accommodate couples and even families. The concept of “small” actually varies to a great extent due to the different cultural and economic background. Readers of all over the world may not agree on the concept of “small”. In order to clarify the range of space that this thesis talks about, several sets of data will be introduced here.

2.2.2.1 Average House Size by Country

The following Figure 2.1 made by Lindsay Wilson (2014) illustrates how big the average new home is around the world, including data for both houses and flats.

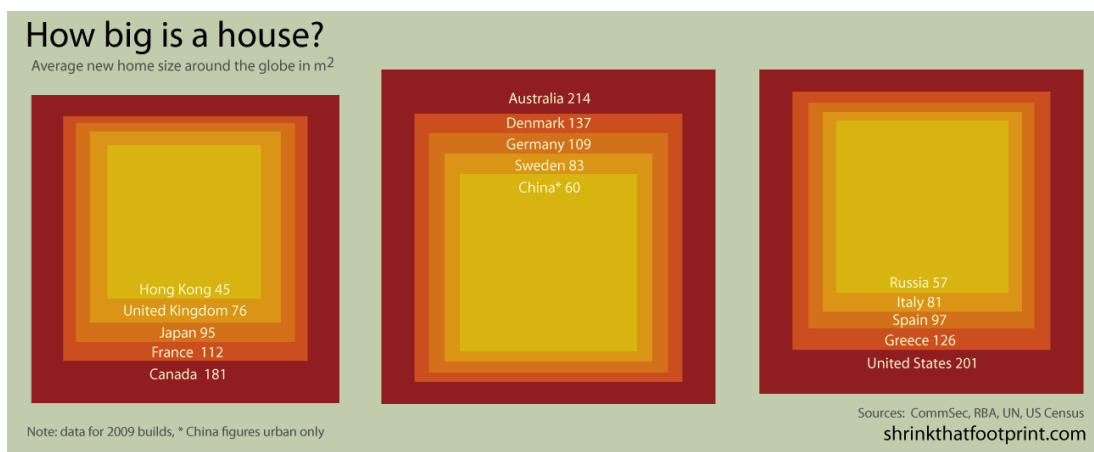


Figure 2. 1 Average House Size by Country (Wilson, 2014)

The average new home of different countries varied in size from 45 m² (484 ft²) in Hong Kong up to 214 m² (2,303 ft²) in Australia. US home size has fallen a little since the recession, to 201 m² (2,164 ft²) in 2009. UK house size is relatively small at 76 m² (818 ft²) while

Canadian houses are quite big at 181 m² (1,948 ft²). For China the data only reflects urban properties, which now average 60 m² (646 ft²) and have almost doubled in size in the last 15 years.

There are all sorts of reasons for these differences. Wealth levels, urbanization rates, land access and climate all play a part. Nonetheless the scale of the differences is pretty fascinating.

2.2.2.2 Average Floor Space per Person by Country

The Figure 2.2 from Lindsay Wilson (2014) illustrates how much floor space this equates to per person.

Using data on average household size, floor space per inhabitant for new homes can be estimated. This analysis is a bit rough, as it assumes new homes are being built for the average household. Nonetheless it is somewhat useful because it helps to control for the considerable differences in household size between countries.

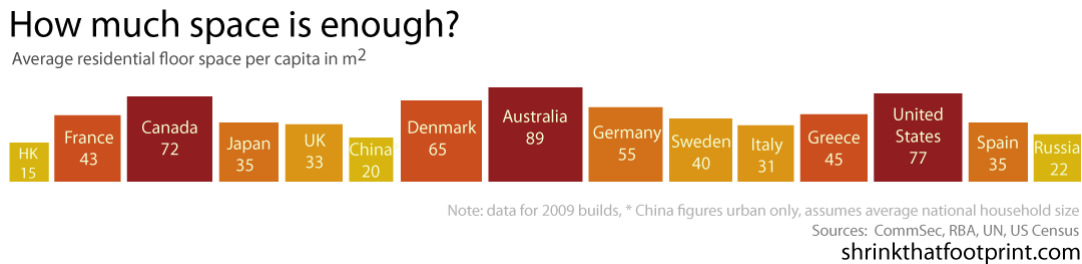


Figure 2. 2 Average Floor Space per Person by Country (Wilson, 2014)

At just 15 m² (161 ft²) a person in Hong Kong has just a quarter of the floor space of the average Australian or American. The averages for Italy, the UK, Japan, Spain, Sweden, France and Greece are in the range from 30-45 m² (323-484 ft²).

2.2.2.3 Average Floor Space per Person by Cities

The Figure 2.3 illustrates how much floor space this equates to per person of six cities. The data here comes from Seoul Institute's (2018) *Seoul and the world metropolis: a comparison of urban changes after the millennium*. Although the data of each city are obtained by different calculation methods, this result is still of high reference value for this thesis.

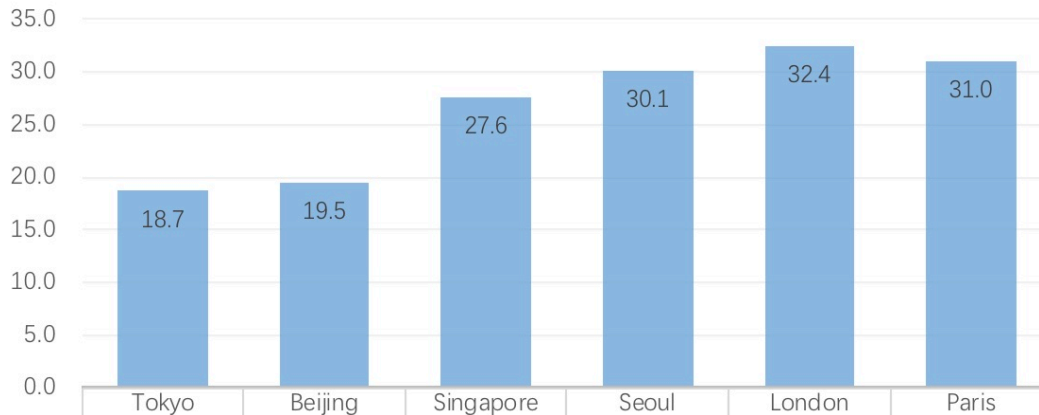


Figure 2. 3 Average Floor Space per Person by Cities

As an indication to compare physical residential density, "living space per capita" can show residential quality. The range of average floor space for urban habitats varies from 18.7~32.4 m² (201.2~348.6 ft²). By comparing the living area (usable area) per capita, it can be found that London ranks first with 32.4 m²(348.6 ft²), followed by Paris with 31.0 m²(333.5 ft²), Seoul with 30.1 m²(323.8 ft²), Singapore with 27.6 m²(296.9 ft²), Beijing with 19.5 m² (209.8 ft²) and Tokyo with 18.7 m²(201.2 ft²). It can be found that people in Beijing live only a little more spacious than people in Tokyo.

2.2.2.4 Regulated Space Size for Each Room

The Table 2.2 here is the seven main residential areas size regulations from *Guidelines for the Planning and Design of Urban Residential Areas of Science and Technology Industry*

Engineering for Modern Urban and Rural Residences (1996) conducted by the Ministry of Construction of China for housing of one bedroom and one bathroom.

	Living Room	Bedroom	Kitchen	Bathroom	Storage	Hallway	Balcony	Usable Area
1B1B(m ²)	12-18	9-12	4-6	3-4	1-2	1.5-2	2	32.5-46

Table 2. 2 Regulated Space Size for Each Room in China

Based on existing types of housing available on the market, among these seven functional areas, the bedroom, kitchen and bathroom are the three essential areas that every living space needs to cover. By adding up its minimum standard, (9 for bedroom, 4 for kitchen, and 3 for bathroom) the minimum size that fits to this regulation is 16 m² (172ft²). The maximum is 46 m² (495 ft²). As the Figure 2.4 shows, it is an example of 20 m² residence that contains the basic three areas.

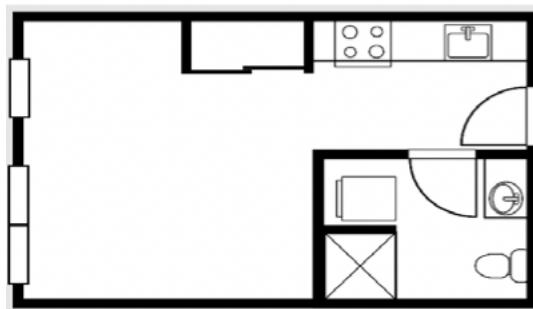


Figure 2. 4 20 m² Apartment Consist of One Bedroom, Kitchen and Bathroom

2.2.2.5 Le Corbusier's Cabanon

Before determining the final scope, a well-known case of small dwellings may also provide a great reference.

Le Corbusier, who is one of the 20th century's most admired architects and a key member of the Modernist movement, designed the cabin as a seaside escape away from Parisian city life. For 18 years Le Corbusier spent every August at the cabin, built in 1951 in Roquebrune-Cap-Martin – a small enclave between Monaco and Manton on the south coast. Although the

Cabanon resembles a traditional Canadian log cabin from the outside, it was carefully designed along modular principles developed by Le Corbusier. Made from prefabricated parts, the design is based on the Modulor – an anthropometric scale of proportion developed by the architect in response to the movement of the human body. The cabin contains a single 3.66*3.66*2.26-metre wood-lined space, which is about 14 m² (144 ft²) of floor size, with no kitchen. Instead, it was attached via an internal partition to the cafe next door (Ashton, 2016).

Le Corbusier's Cabin serves as an example of the extreme and possibilities of the minimum residence. Considering this case, the minimum area that this thesis discusses will further diminished.

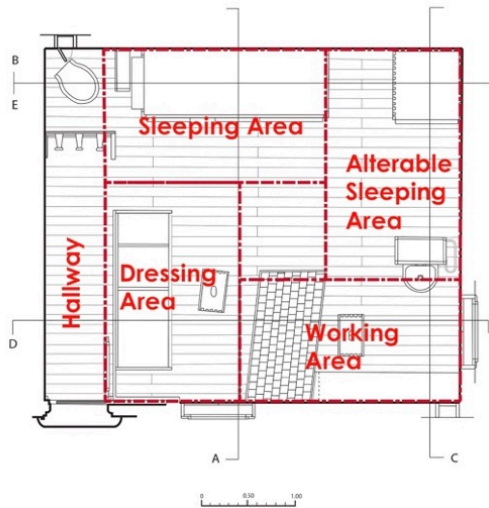
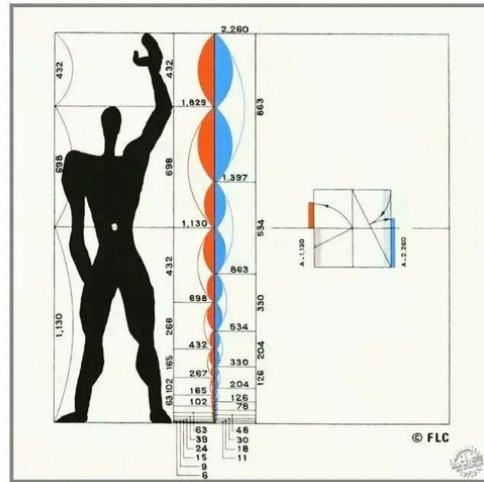
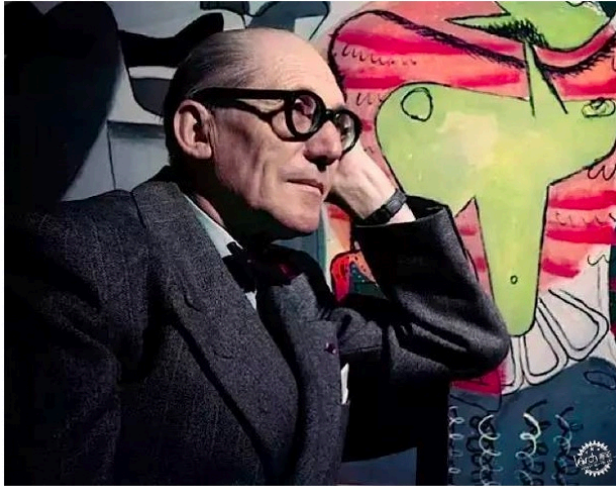


Figure 2. 5 Le Corbusier's Cabanon

2.2.2.6 The Range

According to the above data and cases, the final range of the thesis is set as interior using space of 14 ~ 46 m² (150~495ft) for one or two residents (singles or young couples).

2.2.3 Problems of Small Homes

Despite the regular space problems such as lack of storage space, lack of socializing space, lack of working place and easy physical collision, some further problems possibly ignored by designers are troubling the residents of small space.

2.2.3.1 Negative Psychological Feelings

Small apartments tend to be crowded and cluttered. This could have an effect of giving the people living there a stressed, trapped, crowded and claustrophobic feeling. The cause of those kinds of psychological feelings is not having enough space available. According to Statistics Norway (2017), one out of ten people in Norway are living in a crowded space. A survey done in 2012, in Britain, supports this stating that half the people surveyed claimed they don't have enough space for the furniture they own and not enough storage space (cited in Thøgersen, 2017).

2.2.3.2 Functional Chaos

Because the space is too small to contain all the basic furniture at the same time, the need for smart and space saving furniture solutions is significant. The main result from the lack of furniture space, is the residents having to make the space multipurposed by having multifunctional, modular or transformable furniture. However, unreasonable design and placement may lead to an opposite result. They have to refurnish and/or transform their apartments throughout the day. In practice, this means that they have to, e.g., transform a couch to serve as a bed, fold down a table from the wall or/and store away some chairs in designated smart storage areas (Thøgersen, 2017).

This might seem easy in the beginning, but it could quickly become a real struggle. Just going to sleep or making breakfast could be a hassle. Most people do not like adding extra steps to everyday tasks. In this case, the residents might eventually stop folding up or transforming their furniture.

2.2.3.3 Unhealthy Residential Environment

Small space is also easy to cause some congestion of intangible components, such as air, moisture, natural light and noise. Failure to manage these components in the design will not affect the functions but result in unhealthy and uncomfortable spaces.

Living in an apartment presents a unique set of challenges to having healthy air. Smaller floor plans, a lack of control over certain irritants, and more concentrated levels of pollutants in each room can all contribute to poor air quality. It's common for small residence to have windowless bathrooms and/or bathrooms and laundry rooms that are connected. When these "wet rooms" are in close proximity to each other, it can be even more challenging to keep them dry and free of mold and mildew. Maintaining good humidity levels is key to keeping the air healthy, which is not easy in small spaces because of poor ventilation and the closeness of bathrooms and the laundry room to the rest of living areas. Humidity levels should fall between 30 and 50 percent, for a healthy range (Vanvuren, 2017).

Some small spaces have problems of natural light insufficiency due to lack of windows, unreasonable window orientations, or surrounding buildings. Natural light helps regulate the internal bioclock. Ultraviolet rays in natural light kill bacteria. The insufficient natural light in the living environment leads to the necessity of using a large number of artificial light sources for illumination. Lots of artificial lights can damage people's eyes to some extent, and potentially bacterial issues. Meanwhile, many small spaces, especially for apartments, because of structural reasons, are struggling with noise problems, which severely influence their daily life.

2.2.3.4 Lack of Privacy

Fuyuhito Moriya, a 39-year-old unmarried man, lived with his mother in a home built on a 30-m² lot in Tokyo. After living in the home for six months, he cited privacy as his biggest

challenge with the space. He said, privacy has proven a challenge since he and his mother cannot exactly escape each other in their super small house (cited in Ford & Gomez-Lanier, 2017). Lack of privacy becomes a concern not only for those who do not live alone, but also for young singles. Small residences, especially small apartments, are more likely in cities of high population density. Units are getting even closer. Thus, the privacy issue can be regarded as two parts, inside and outside privacy.

2.3 How to Design?

Interior designers have created many novel design methods, such as cognitive mapping, moving line analysis and behavior observation, but it seems that, for small living space, a logical, systematic and targeted approach needs to be developed. Since the space is limited, it should jump out from traditional “space-started” and “room-guided” method to break the old framework and give the possibility of being more “user-centered”. Thus, some interdisciplinary methodology and thinking will be introduced.

2.3.1 Needs Satisfaction Approach

2.3.1.1 What is Need Satisfaction Approach

Need satisfaction approach is a particular sales technique where the sales person probes into the needs of the consumer, both stated or expressed needs and unstated or tacit needs and then prepares the sales pitch or presentation in accordance to these needs in order to satisfy the consumer. The salesperson gives the sales proposal in the form of a presentation showing the features of a product and how it satisfies those needs. This is also called need satisfaction selling.

Before the presentation, the salesperson makes the consumer realize his/her need and then tries to relate that realization with the product benefits. Then the additional benefits are

shown. The approach is quite skilled and not all sales people find it easy to implement because it requires a lot of analyzing and questioning capability.

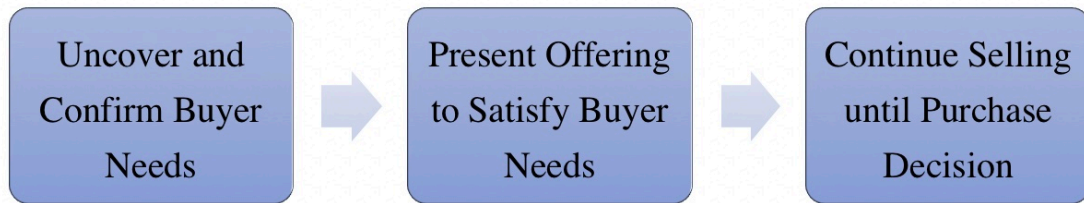


Figure 2. 6 Need Satisfaction Selling Basic Flow Diagram

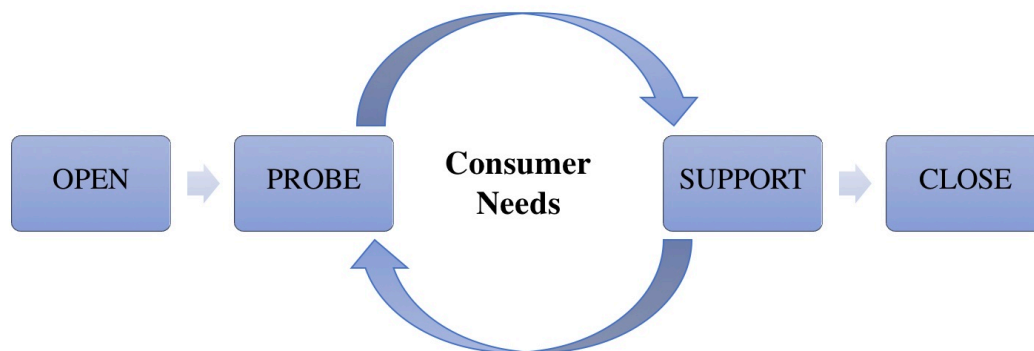


Figure 2. 7 The Diagram of Step by Step Process of Need Satisfaction Selling

1. Open: This is where the salesperson opens his or her presentation to the consumer to start the selling process.
2. Probe: Here, the sales person asks various questions to the consumer and listens carefully in order to understand the needs fully. Generally, in this stage, the expressed or stated needs are found.
3. Support: Here, the sales person shows that the consumer's needs are genuine by supporting in argument and approach. In this way, the sales person can extract more information about the consumer's needs, generally the tacit or the unstated needs.
4. Close: The sales person makes a value proposition to the consumer which satisfies needs and closes the transaction (MBASkool.com, 2011).

For example, a salesperson visits a major insurance company. In conversation, it emerges that the company has not changed its market segments for some time, mostly because they do not know any better. In the presentation, the salesperson shows data on a competing firm which has used micro segmentation to eat away at this company's consumer base. When the consumer starts getting worried, the salesperson talks about the need for fine details and rapid analysis. When they then start asking about how this can be achieved, the salesperson introduces the CRM system being sold.

2.3.1.2 Benefits

This approach is useful when the sales people use effective approaches to convince the consumers into buying their products. If successful, it helps build consumer trust and loyalty. In fact, the same benefits are shared when it applied as a design approach, especially for small space design.

1. The need satisfaction approach is a process of high client-participation. Consequently, the communication between consumers and designers is of higher efficiency, and the relationship is closer, which makes it easier for clients to understand designers' decisions. It can also make it possible to design individualized space.
2. The result of need satisfaction approach is need-oriented. The design behaviors are directed, accurate to the tasks and highly responsive to clients' needs. The satisfaction of clients can be improved more easily and efficiently.
3. In the case of this thesis, the space is limited while the need may be wide. When starting from the needs, it presents more opportunities for designers to make something new, to break the routines, to get new inspiration and create innovation.

2.3.2 Theories of Needs

As the demonstration above, the two main tasks of this thesis are building the “PROBE” and guiding the “SUPPORT”, which leads to the needs and satisfaction. Thus, some theories related to needs will be introduced.

2.3.2.1 Maslow's Hierarchy of Needs

Maslow's hierarchy of needs is a motivational theory in psychology comprising a five-tier model of human needs, often depicted as hierarchical levels within a pyramid.

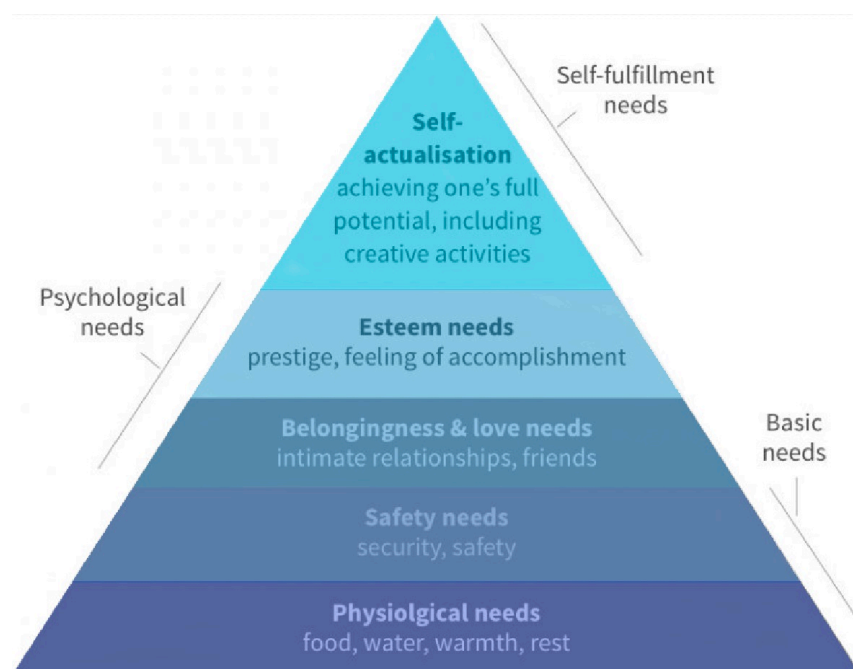


Figure 2. 8 Maslow's Hierarchy of Needs Five-Stage Pyramid

Maslow stated that people are motivated to achieve certain needs and that some needs take precedence over others. Our most basic need is for physical survival, and this will be the first thing that motivates our behavior. Once that level is fulfilled the next level up is what motivates us, and so on.

1. Physiological needs - these are biological requirements for human survival, e.g. air, food, drink, shelter, clothing, warmth, sex, sleep.

If these needs are not satisfied the human body cannot function optimally. Maslow considered physiological needs the most important as all the other needs become secondary until these needs are met.

2. Safety needs - protection from elements, security, order, law, stability, freedom from fear.

3. Love and belongingness needs - after physiological and safety needs have been fulfilled, the third level of human needs is social and involves feelings of belongingness. The need for interpersonal relationships motivates behavior.

Examples include friendship, intimacy, trust, and acceptance, receiving and giving affection and love. Affiliating, being part of a group (family, friends, work).

4. Esteem needs - which Maslow classified into two categories: (i) esteem for oneself (dignity, achievement, mastery, independence) and (ii) the desire for reputation or respect from others (e.g., status, prestige). Maslow indicated that the need for respect or reputation is most important for children and adolescents and precedes real self-esteem or dignity.

5. Self-actualization needs - realizing personal potential, self-fulfillment, seeking personal growth and peak experiences. A desire “to become everything one is capable of becoming” (Maslow, 1987, p. 64).

It is important to note that Maslow's five-stage model has been expanded to include cognitive and aesthetic needs and later transcendence needs. Changes to the original five-stage model are bolded in next introduction and include an eight-stage model shown in Figure 2.9.

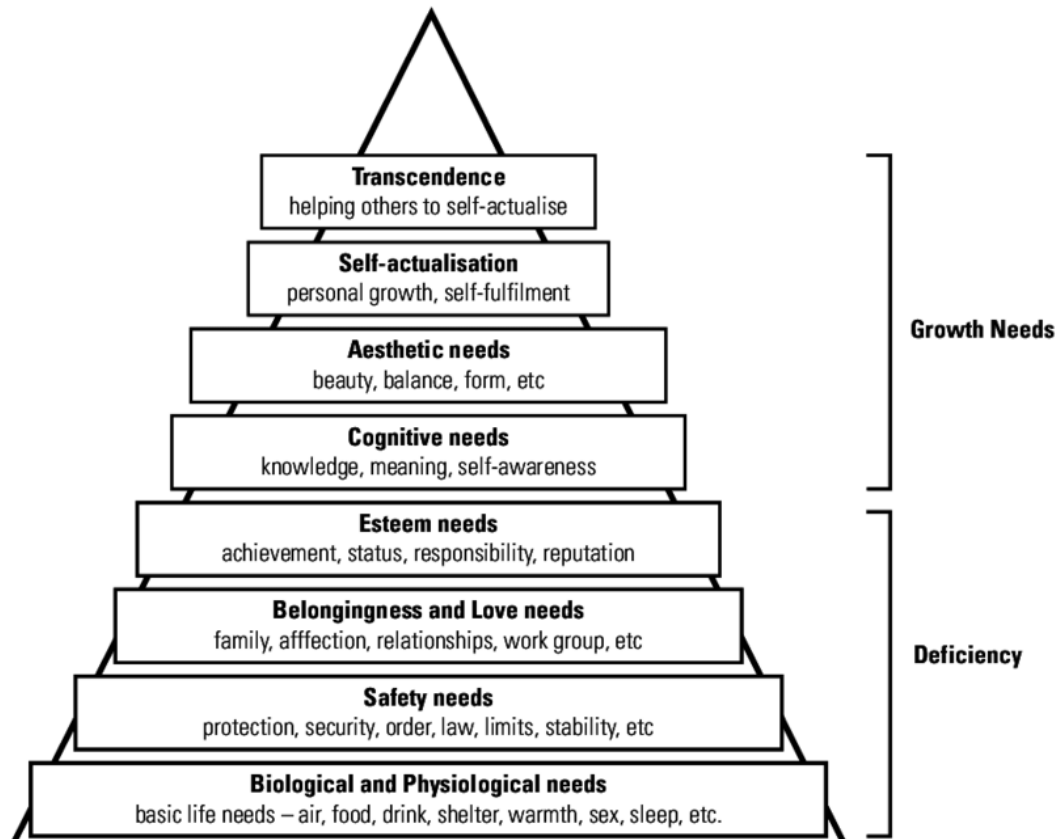


Figure 2. 9 Maslow's Hierarchy of Needs Eight-Stage Pyramid

1. Biological and physiological needs - air, food, drink, shelter, warmth, sex, sleep, etc.
2. Safety needs - protection from elements, security, order, law, stability, etc.
3. Love and belongingness needs - friendship, intimacy, trust, and acceptance, receiving and giving affection and love. Affiliating, being part of a group (family, friends, work).
4. Esteem needs - which Maslow classified into two categories: (i) esteem for oneself (dignity, achievement, mastery, independence) and (ii) the desire for reputation or respect from others (e.g., status, prestige).
5. **Cognitive needs** - knowledge and understanding, curiosity, exploration, need for meaning and predictability.
6. **Aesthetic needs** - appreciation and search for beauty, balance, form, etc.

7. Self-actualization needs - realizing personal potential, self-fulfillment, seeking personal growth and peak experiences.

8. **Transcendence needs** - A person is motivated by values which transcend beyond the personal self (e.g., mystical experiences and certain experiences with nature, aesthetic experiences, sexual experiences, service to others, the pursuit of science, religious faith, etc.). (cited in McLeod, 2018)

2.3.2.2 Jordan's Hierarchy of Consumer Needs

Based on Maslow's theory about needs, aiming at product design and human factor phase, Patrick W. Jordan (2000) proposes his three-level hierarchy of consumer needs.

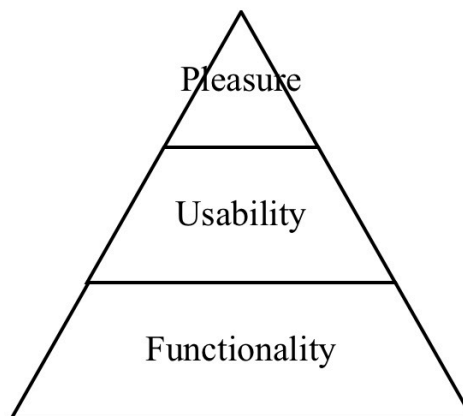


Figure 2. 10 Jordan's (2000) Hierarchy of Consumer Needs

- Functionality

A product will be useless if it does not contain appropriate functionality: a product cannot have any value if it does not contain functions necessary to perform the tasks for which it is intended. If a product does not have the right functionality this will cause dissatisfaction in order to be able to fulfill people's needs on this level, so designers must have an understanding of what the product will be used for and the context and the environment in which it will be used.

- Usability

Once people had become used to having appropriate functionality, they then wanted products that were easy to use. This more or less represents the situation at the moment in many product areas: people are used to products that function well, but now they also expect a prerequisite of usability, but it does not guarantee usability. Thus, there need to be some design principles to guide the design.

- Pleasure

Having become used to usable products, it seems inevitable that people will soon want something more: products that offer something extra, products that are not merely tools but kind of living objects that people can relate to; products that bring not only functional benefits but also emotional ones. This is the new challenge for product designers (Jordan, 2000).

By understanding how this hierarchy applies in product design area, it possibly works even better regarding a living space of ‘a product of daily life’.

Functionality – a place for rest, food, sanitation and warmth.

Usability – a place for storage of personal items and other activities.

Pleasure – a place to enjoy time and have the feeling of home and well-being.

This theory gives a logical and applicable support for designing small living spaces. However, there is something important in residential space that is easy to be ignored in this theory, for example, safety. Meanwhile, as the approach is expected to be individualized and client-oriented, the hierarchy seems to be built for the “average” person. Thus, some supplement will be made, especially to expand the ‘Pleasure’ and ‘Functionality’.

2.3.2.3 Lidwell et al. 's Hierarchy of Needs

Lidwell, Holden, Butler and Elam (2010) also present a similar but different hierarchy of needs, which is divided into five levels as shown in the following Figure 2.11. They also state

that a design must serve the low-level needs before the higher-level needs can begin to be addressed. “Good designs follow the hierarchy of needs principle, whereas poor designs may attempt to meet needs from the various levels without building on the lower levels of hierarchy first” (p.124).

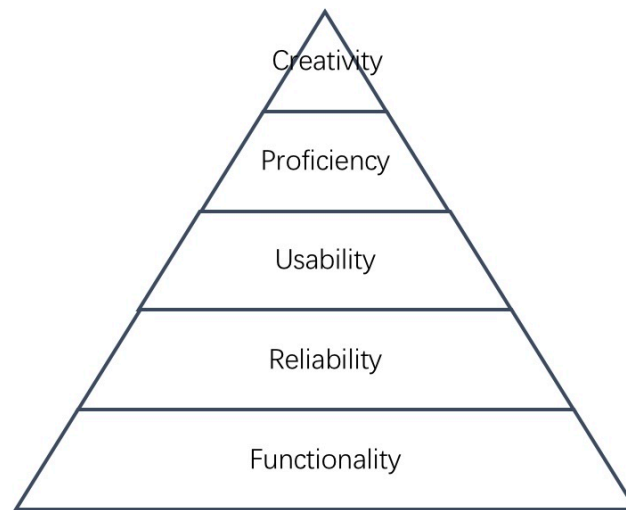


Figure 2. 11 Lidwell et al. 's Hierarchy of Needs

Comparing to Jordan’s hierarchy, this one has two shared levels but more closely corresponds to Maslow’s five-level hierarchy.

- Functionality

Functionality is quite the same to Jordan’s theory. It is something that has to do with meeting the most basic design requirements. Designs at this level are perceived to be of little or no value, but skipping this level it will be totally useless.

- Reliability

Reliability needs have to do with establishing stable and consistent performance. Design must avoid frequent errors, failures, and negative effects in use; otherwise users will lose their trust and the reliability needs will not be satisfied. Designs at this level are perceived to be of low value.

- Usability

Usability is again identical to Jordan's theory. It is about how easy and forgiving a design is to use. If it is too difficult to use, or the consequences of simple errors are too severe, it will come to a failure of usability. Designs at this level are perceived to be of moderate value.

- Proficiency

Proficiency needs have to do with empowering people to do things better than they could previously. Designs at this level are perceived to be of high value. As for space design, however, only few parts can be designed with proficiency.

- Creativity

Creativity is the highest level where the other four levels have been met. People begin to interact with the design in innovative way and participate in the process of design as well as use. Thus, it can be also understood as individualization. At this level designs are perceived to be of highest value and begin to build loyalty among users.

2.3.2.4 An Expanded Hierarchy

Based on the above referenced theories, a new needs hierarchy framework that applies to the small space design better in this thesis is developed. It has five levels: Functionality, Reliability, Usability, Pleasure and Individualization, with the order of most basic to the most optimal. The further details of this hierarchy will be introduced in Chapter 3.

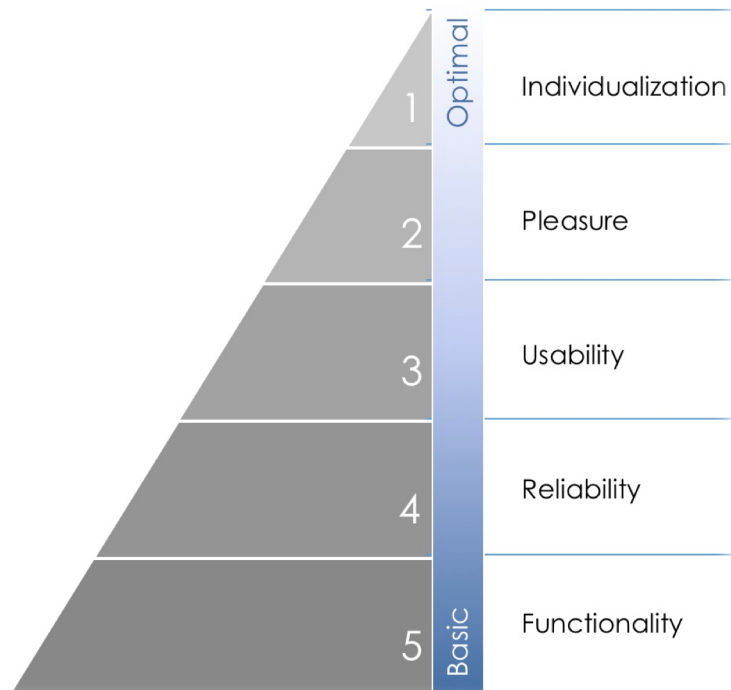


Figure 2. 12 Needs Hierarchy for Small Living Space

2.3.2.5 Environmental Psychology Research

Upon the home environment, Stuart Miller and Judith K. Schlitt (1985) and their team conducted interviews of over a hundred people, concerning their perceptions and recollections of significant home interior environments from the past, present and future. The questions included:

Describe, and give the location of, your important activities within the home. What significant experiences do you remember having there? Describe the feelings you have in each room. If this room would talk, what would it say to you, and how would it describe itself? What would your ideal home look like?

After they analyze the result, they verbalized it into a paragraph.

Because it is my home, I should have the ability to make changes in it when appropriate so that I can feel like an effective human being (control). I would prefer not to be disturbed, seen, or heard when I'm doing something in private (privacy). I would like to feel free to express my uniqueness as a person (identity). Certainly, I want to have

a feeling of being safe and protected there (security). Things should be arranged in an orderly and organized fashion (order) My home should be interesting and stimulating; but, at the same time, it should also help me to relax (variety). I want my home to express my own definition of what is beautiful (aesthetics). when I'm there I also want to experience the feeling of freedom of choice (choice). I would like my home to be a place where I can have satisfying relationship with guests, friends and family members (sociability). (Miller and Schlitt, 1985, p.3)

The word in parenthesis is actually what they drew from the research, nine psychological needs in a home place:

Control, Privacy, Identity, Security, Order, Variety, Aesthetics, Choice & Sociability.

These nine needs here can provide the content for the 'Pleasure' in the Hierarchy. It should be noted that two of these needs, Identity and Sociability (Relationship), are mentioned above in the psychological characteristics of young adults, which are of even higher importance among the nine.

2.3.2.6 Walter Schaer's Design Theory

Despite the needs theories discussed above, which could be generally included into intra-personal needs, the inter-personal discrepancy, or to say, the characteristics that are caused by outer conditions, other needs in small living spaces need to be addressed. Given the fact that every individual is complex and multifaceted, professor Walter Schaer's theory (1970) may help understanding from three aspects.

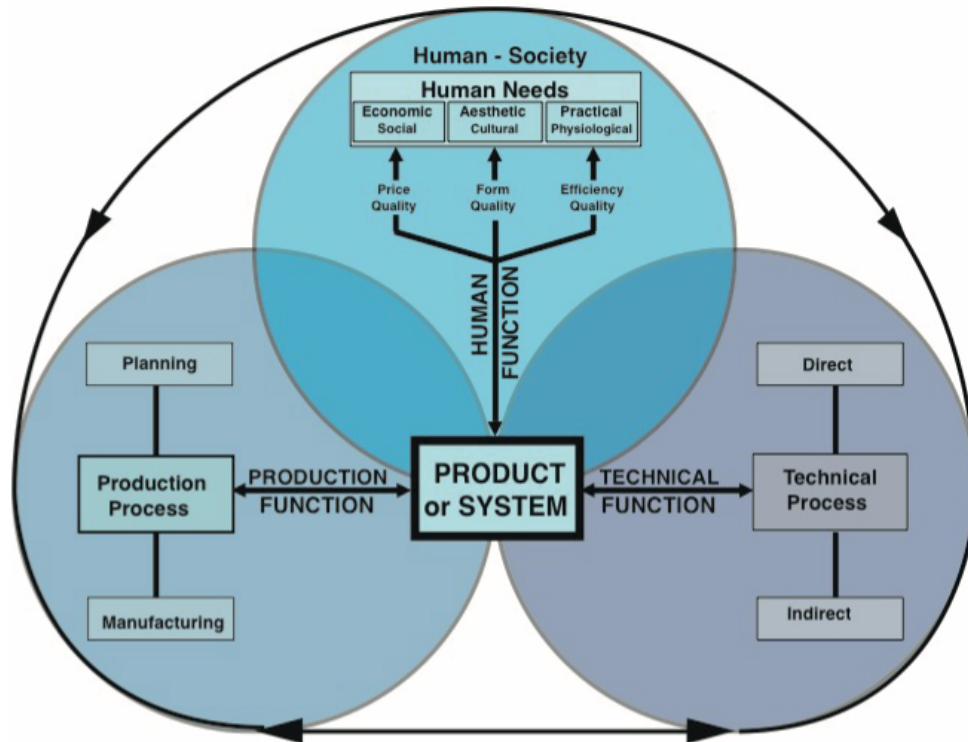


Figure 2. 13 The Functions of an Artifact in Three Dimensions

He proposed that a product or system contains three functions that influence each other and the whole, which is Human Function, Production Function and Technical Function.

Human Function: The human function involves the human needs that should be fulfilled by a product.

Technical Function: The technical function involves a technical process that becomes either direct or indirect.

Production Function: The production function involves a production process that splits into planning and manufacturing (p.9).

What we designers should concern about most is the **Human Function**.

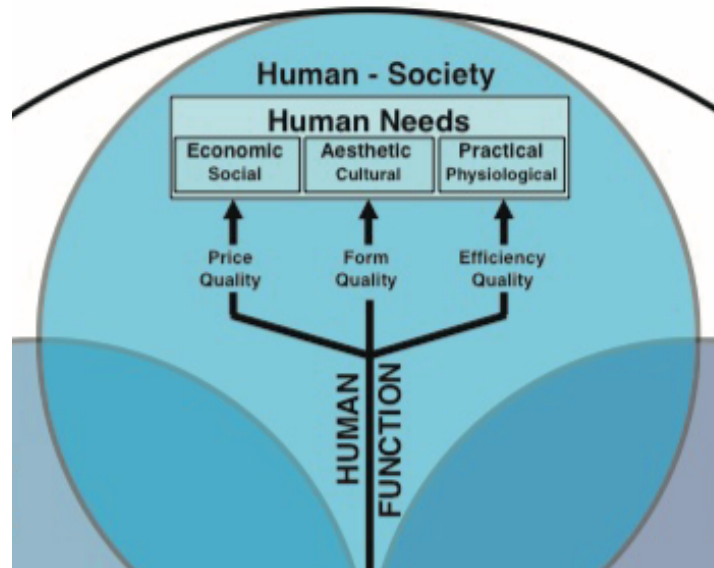


Figure 2. 14 Human Function

Among the Human Function, there are three aspects, which is of high relevance to the thesis. Each of the aspects is reflected in a quality of the product or system, in this case, the living space design.

Social-Economic——Price Quality;

Cultural-Aesthetic——Form Quality;

Physiological-Practical——Efficiency Quality (Schaer, 1970, p.10).

These three aspects, with each consist of two levels, give designers a good way to get to know their users. Again, what should be emphasized here is that the aspect that mentioned before is the socio-economic status of young adults. In a real design situation, Price Quality may be more important than thought to young people who are not well off financially, which greatly effects the decisions on material and furniture. Budget is a big deal.

2.3.2.7 Kano Model

Noriaki Kano (1984), a Japanese researcher and consultant, published a paper with a set of ideas and techniques that help us determine our users' (and prospects') satisfaction with product features. Since the application of this model in Chapter 3 tends to be more like research

rather than design, here it is introduced in the part ‘theories of needs’. It will help to generate the probe better.

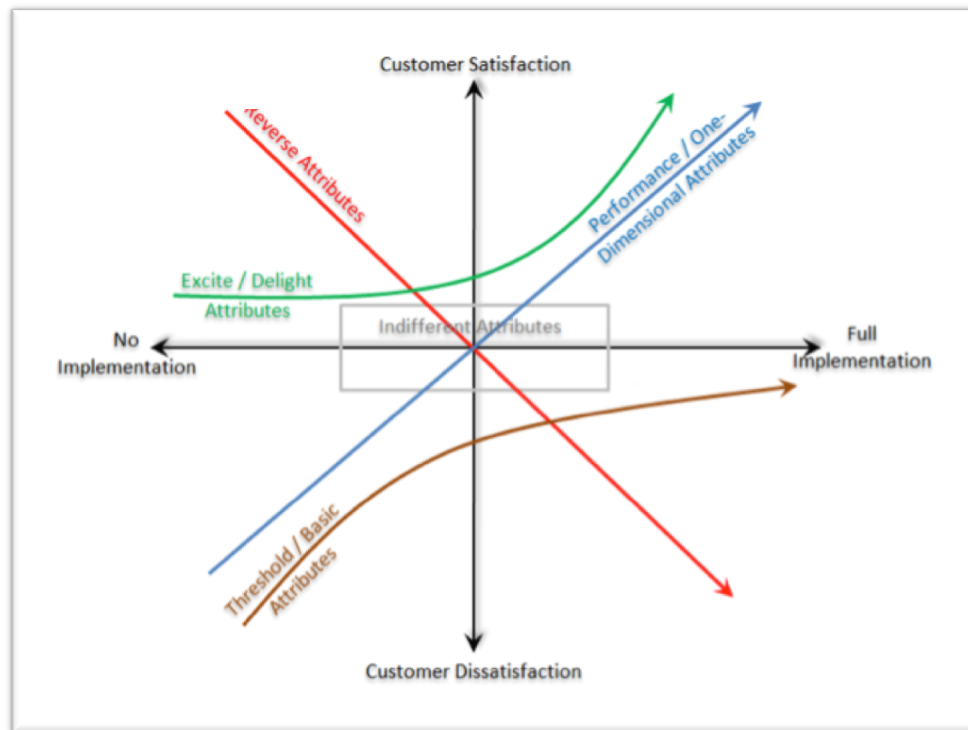


Figure 2. 15 Kano Model Diagram (Munagavalasa, 2014)

The Kano model says user satisfaction is not simply proportional to one-dimensional features, but rather the product should include additional attributes such as “must-have” and “exciter” features. The Kano model classifies user requirements into five categories: Basic/threshold attributes, Performance/linear/one-dimensional attributes, Excite/delight attributes, Indifferent attributes and Reverse attributes (cited in Munagavalasa, 2014, para.5). According to Munagavalasa’s explanation of Kano Model, the following are descriptions of each of these five attributes.

- Basic/Threshold Attributes

These are the bare-minimum features a product must have to meet user demands, and they are essential for the product’s survival. These features alone will not increase users’

satisfaction, but not implementing these features will lead to dissatisfaction. These features are taken for granted.

- Performance/Linear/One-Dimensional Attributes

The more performance attributes, the more user satisfaction results. These are the features users are more interested in, and the price users are willing to pay depends on these attributes. These features result in user satisfaction when fulfilled and user dissatisfaction when not fulfilled.

- Excite/Delight Attributes

These features result in increased user satisfaction when implemented but do not cause dissatisfaction when not implemented. These attributes can often stratify their latent needs. This is where the product is truly differentiated from competitors.

- Indifferent Attributes

Users are indifferent to these features; either they don't pay attention to them or they are not aware of these features. These attributes are of little or no consequence to the user. The satisfaction level neither decreases nor increases because of these features.

- Reverse Attributes

Reverse attributes may not be very common. This refers to added functionality resulting in dissatisfaction. Reverse attributes cause user dissatisfaction, and not having these attributes increases user satisfaction.

2.3.3 Methodologies of Satisfaction

Here some existing solutions for small space will be presented. Most of them are trying to solve problems separately.

2.3.3.1 Conventional Solution

The conventional solution for general interior design is to start with separate functional areas and to solve problems for each, as shown in Table 2.3. Small space design usually inherits this solution and consequently sets the limited space into a rigid frame. However, through this, some information about what functions a residential space should have can be determined.

Necessity	Category	Main Activity
Basic	Bedroom	Sleeping
	Bathroom	Washing, Toilet
	Kitchen	Cooking
Ordinary	Storage	Storing
	Living Room	Leisure
	Hallway	Transportation
	Balcony	Drying (clothes)
Optimal	Study Room	Learning and Working
	Dining Room	Dining
	Dressing Room	Dressing
	Fitness Room	Exercising
	Etc.	Other

Table 2. 3 Function Areas Category

It should be noted that the necessity of functional areas does not fully reflect the importance of its main activities, since when the specialized area is not contained, some activities could be merged and share the same space. In addition, the activities mentioned here is based on personal life. Family activities need additional consideration, which this thesis does not cover.

2.3.3.2 Furniture Solution

Furniture is an essential part of interior space. It takes up about 40-50 % of the floor space. The following figure represents which furniture is most common in people's homes and

especially one-bedroom apartments. The data in Figure 2.16 comes from a survey for people living in small apartments (Thøgersen, 2017) and the Figure 2.17 illustrates how much floor space the furniture takes up.

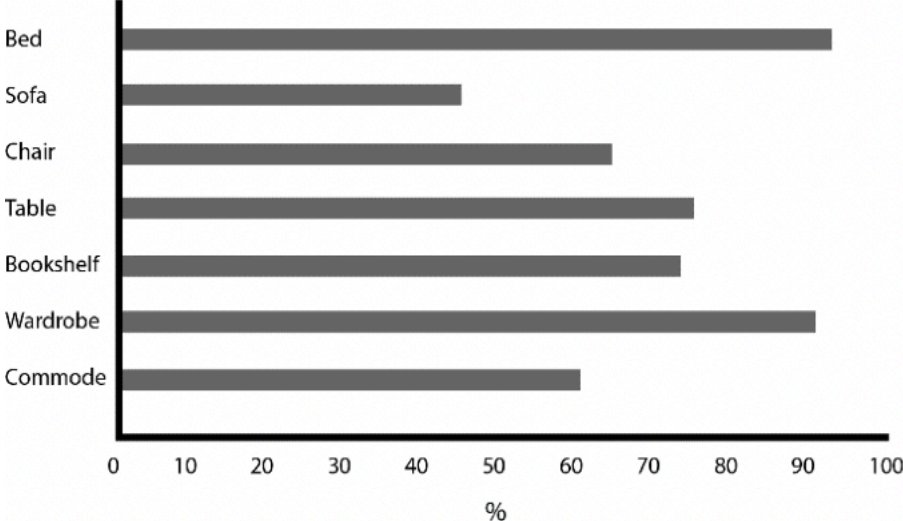


Figure 2. 16 Main Furniture in a Small Apartment (Thøgersen, 2017)

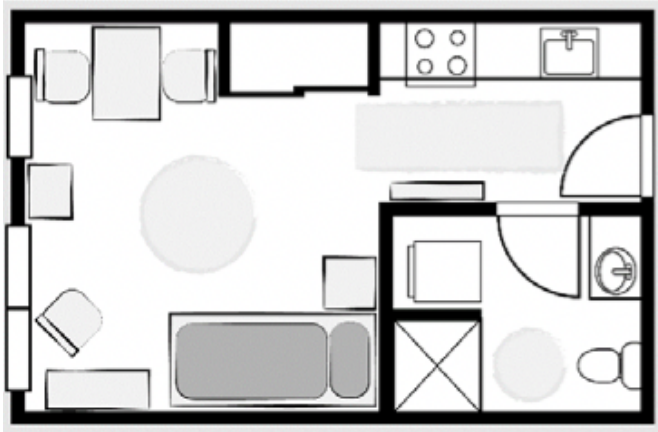


Figure 2. 17 Example of How Much Floor Space Furniture Occupy

Even so, the apartments are getting smaller and the furniture bigger. It is due to the human evolution: the physical measurements of the human body are changing. Over the past 50 years, the average human height has increased by nearly 10 centimeters (Игумнова, 2016). The space is getting smaller and crowded by furniture, while the furniture is getting larger due to the human body evolution. The conflict here become severe than ever. To solve this conflict, many

designers are working on more rational and clever furniture and a lot of furniture that is designed for smaller space and bigger human body appears. These kinds of furniture will be roughly divided into two categories to be introduced here: multifunctional and modular furniture.

2.3.3.2.1 Multifunctional Furniture

Multifunctional furniture goes by several names: multipurposed furniture, space saving furniture and transformable furniture. The basic idea of multifunctional furniture is that they, as the name suggests, perform more than one function.

There are a lot of different versions at the market. An example of the furniture is illustrated in the Figure 2.18 below. This furniture, named Sunflower Chair, designed by He Mu and Zhang Qian, performs the function as a bookshelf, as storage as well as a chair (Noe, 2012).



Figure 2. 18 Example of Multifunctional Furniture

Transformable furniture is very special under the category of multifunctional furniture. It is now very popular among furniture industry.

A very famous and old design is Murphy Bed (Rockler.com, n.d.), which is the bed that could be folded back when people is not using it. Murphy Bed has been popular for decades.

Here is another example of transformable book shelf into a table (homeli.co, n.d.).



Figure 2. 19 Murphy Bed



Figure 2. 20 Example of Transformable Furniture

2.3.3.2.2 Modular Furniture

Modular furniture is furniture divided into several pre-made parts, that a costumer can put together to fit preferences.

An example of this is the modular couch, which is a good thing with limited space and need of a couch that fits limited measurements. The following Figure 8 shows different parts that can be put together to create the needed couch.

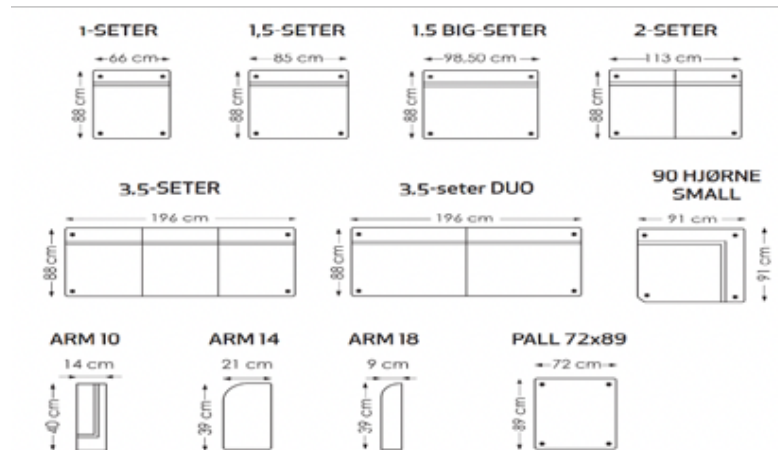


Figure 2. 21 Example of a Modular Couch (Thøgersen, 2017)

2.3.3.3 Circulation Solution

In architecture, circulation refers to the way people move through and interact with a building. In public buildings, circulation is of high importance; structures such as elevators, escalators, and staircases are often referred to as circulation elements, as they are positioned and designed to optimize the flow of people through a building, sometimes through the use of a core (Collins, Scruton, Gowans, & Ackerman, 2018). To simplify this concept, it is ‘how people move through space’.

The factors of what designers should consider about when designing circulation will include:

Direction of movement: horizontal or vertical;

Type of use: public or private, front of house or back of house;

Frequency of use: common or emergency;

Time of use: morning, day, evening, continuous.

There are couples of types of circulation, as the Figure 2.22 shows:

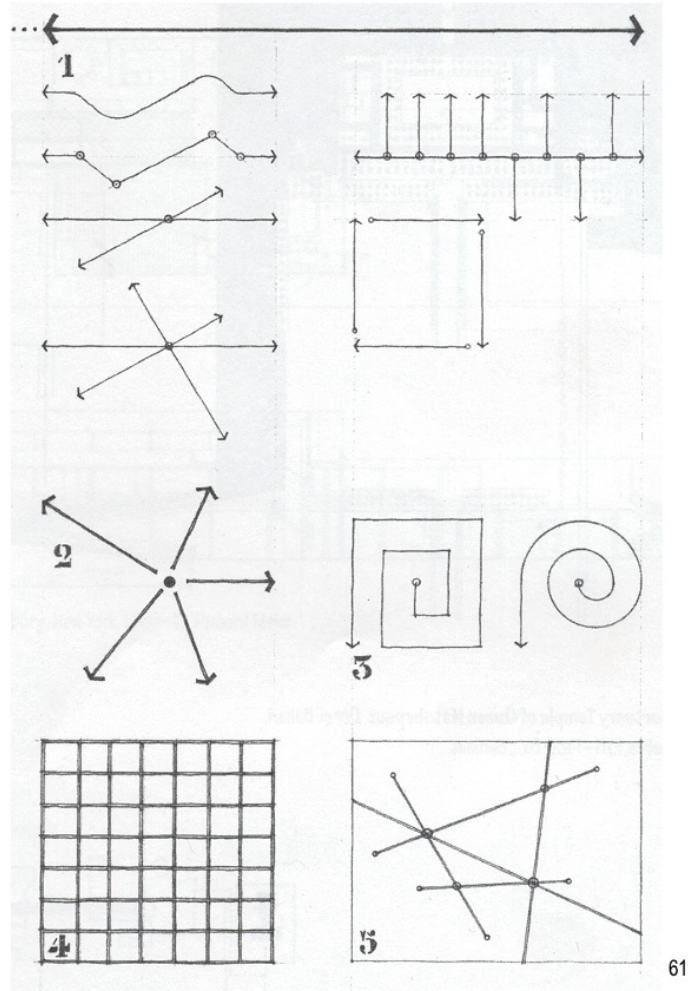


Figure 2. 22 Types of Circulation

Circulation method is widely applied especially in public space design. It is humanized, considerable and concerned from the movement of human. However, when it comes to the topic of personal residential space, some of the types would not have the chance to be applied, and when it comes to 'small' residential space, the option will be even limited.

Chapter 3 Design Approach

3.1 Overview

This approach is built on the original prototype of Need – Satisfaction selling approach. It is expected to achieve the goal of individualized design and improve the efficiency of space by working a highly user-participation and goal-oriented process. The result should be directly responsive to users' need and expectations. In this way, the comprehensive and complicated problems can be turned into respective solutions.

The approach can be divided into four steps:

Open – Prepare for starting the design process, measure the space and collect the spatial data as carefully as possible;

Probe – User-centered research, consisting of three phases: human, need and expectation;

Support – Solution and design based on the previous step, including “Functions Design”, “Feature Design” and “Space Refine”;

Close – Design finishes and construction phase starts.

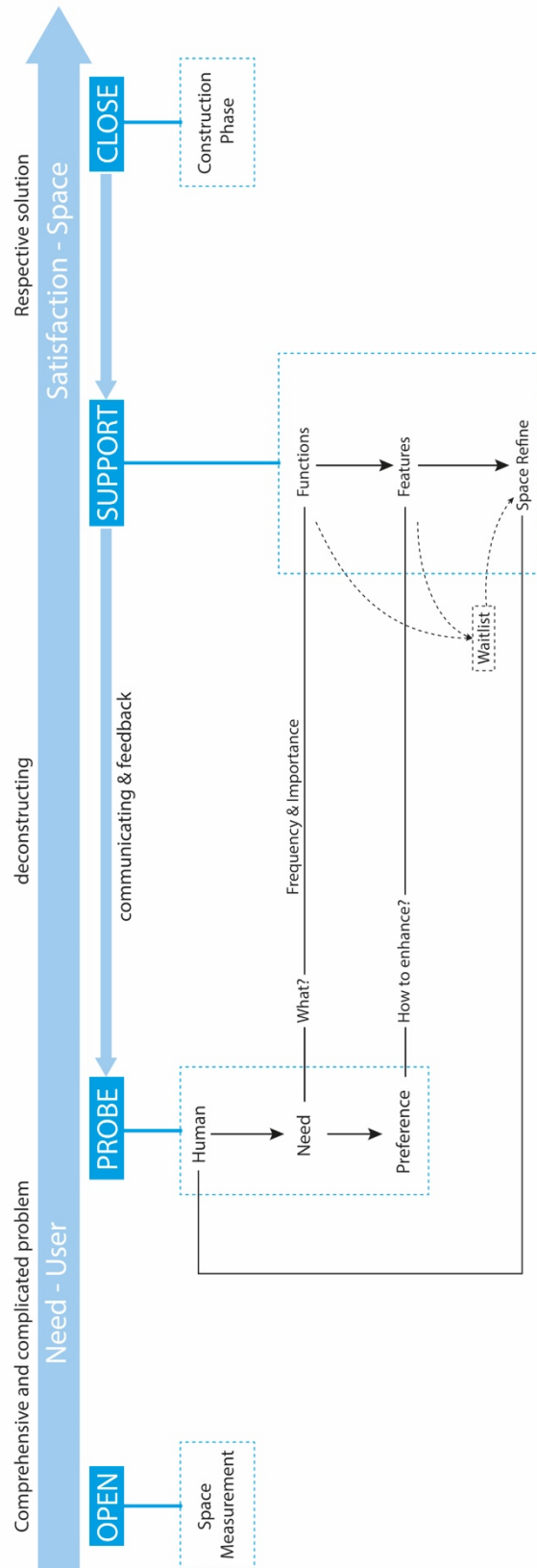


Figure 3. 1 Need – Satisfaction Design Approach

3.2 Open

Open is the very first step of the approach. At this step, the task is to have initial preparation work, the space measurement. Space measurement is not limited to size; it is more important to understand the existing limits of space.

1. **Basic size:** Basic size includes floor area and wall height. It generally determines the total volume of the space.
2. **Doors and Windows:** Doors and windows provide the path of traffic flow for not only human but also the air and light. In some cases, the doors and windows can be changed according to designers' decisions, while for others they are fixed to a size and position due to structural reasons, especially apartments.
3. **Hidden Components:** Hidden Components refer to the circuit, pipe, flue and sewer that are installed in the walls and beneath the floor. They guarantee the circulation of people's daily essential electricity, water and air. In some cases, they are unchangeable, so designers need to understand them in advance.

3.3 Probe

Probe is also considered as research. During the Probe phase what designers should do is to communicate with users to understand what the users like and dislike. This phase requires great skills and logic on the side of the designer, or otherwise the communication will be useless and inefficient. To help designers figure out what they should do and know from this step, a framework will be given, which consist of three main parts, human, need and preference.

3.3.1 Human Research

The very first part of the research is to answer the question "Whom to design for?", to let designers know their habitants better. The information obtained in this step will help guide the

last ‘Space Refining’ in the next ‘Support’ step, and also plays an important role in overall control.

Human Research will follow the theory of Professor Walter Schear, the three categories under human function: Social-Economic, Cultural-Aesthetic and Physiological-Practical.

Social-Economic	Career	
	Budget	
	Working Hour	
	Visitors/Other Habitants	
Cultural-Aesthetic	Education	
	Nationality	
	Hobby	
	Aesthetic/Favorite Style	
	Collection	
	Religion	
Physiological-Practical	Gender	
	Vision	
	Height	
	Body Width	
	Illness/Disability	
	Living Frequency	

Table 3. 1 Human Research Form

Note:

1. Blue type indicates the attributes that relate uniquely to the young adults’ characteristics. As young adults, the users may tend to be different in these aspects but share the similar importance and attention. ‘Visitor and other habitants’ shows

the potential relationships that are relevant to this space. ‘Hobby and aesthetic’ presents some of the personality.

2. When applying users’ activities to functions, ergonomic data is essential. As for small living space, to save every inch as possible, it is significant to design not only on regulated size, but on individualized data. In order to serve users better and simplify the research process, only two important data, namely body width and height data, are measured. Other design-related data can usually be calculated based on these two, such as sitting height.

3. Some special careers are of high mobility, such as flight attendants. Or some people work in a place but need a temporary residence in another. In these cases, the space is only a relatively long-term pied-à-terre for the user, for which the question of ‘living frequency’ is asked.

3.3.2 Need Research

Need research is to answer the question “What should be designed?”, to know what the users do and need in the space and to fill up the basic attributes according to Kano Model. The outcomes from this part will guide the function design section.

3.3.2.1 Hierarchy

To logically organize the diverse needs in research, some efforts are made to explore need-related theories. They seem to be professional but are not really suitable for a residential space.

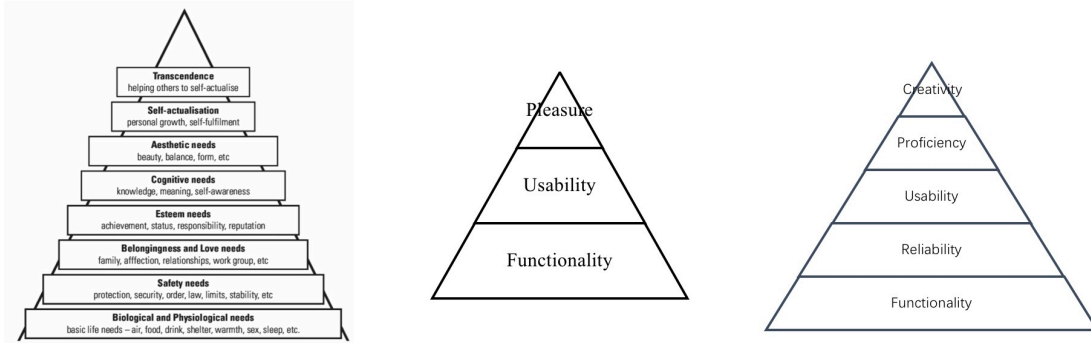


Figure 3. 2 Maslow's (1970) 8-stage Model, Jordan's (2000) Consumer Needs Hierarchy and William Lidwell's (2003) theory

According to Abraham Maslow's (1970) 8-stage Motivation Model, Patrick W. Jordan's (2000) Consumer Needs Hierarchy and William Lidwell's (2003) theory, a new model is established that best fits the situation of a residential space. To facilitate the next working steps, the concrete types of needs are also given here in Figure 3.3.

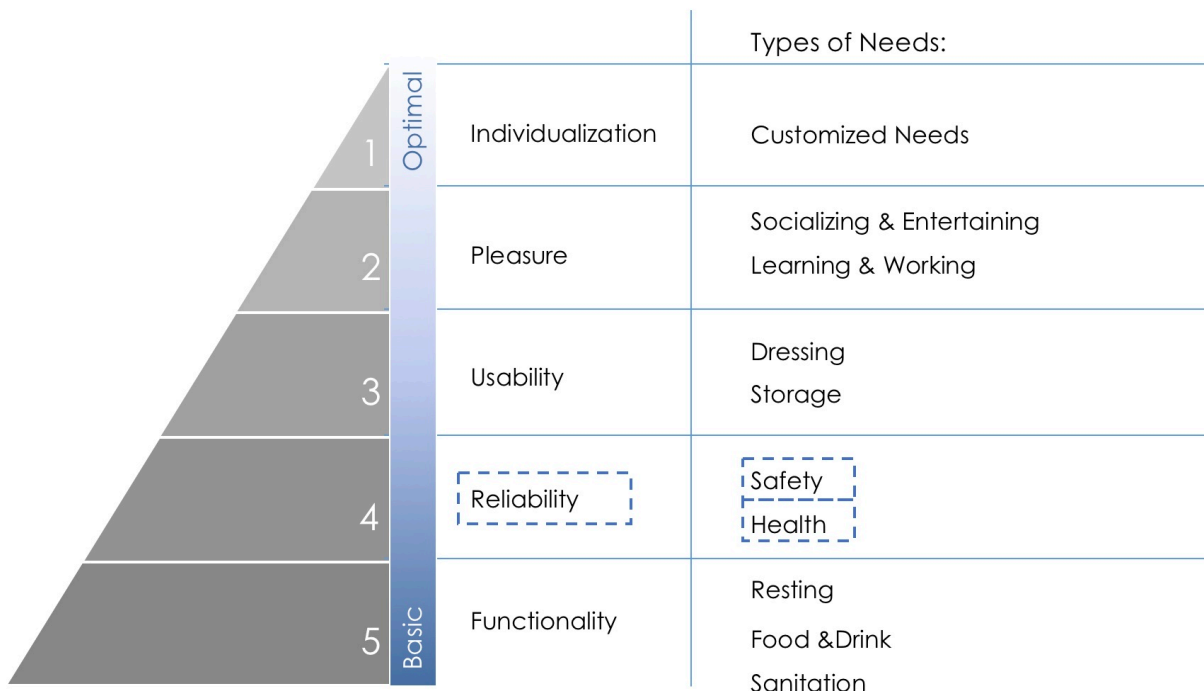


Figure 3. 3 Five-Level Needs and the Types

As Figure 3.3 shows, they are divided into five levels. The numbers on the left do not represent order but importance. From bottom to top are the most basic needs to the optimal needs. They are:

Functionality – Resting, Food & Drink, Sanitation;

Reliability – Safety, Health;

Usability – Dressing, Storage;

Pleasure – Socializing & Entertaining, Learning & Working;

Individualization – Customized Needs

The dotted rectangles on Figure 3.3 indicate Non-user-activated needs, while others are for User-activated needs.

User-activated needs are triggered by users' initiative behaviors and reflected in people's daily activities. Example: Sleeping, Learning, Cooking, etc.

Non-user-activated needs are carried by surrounding physical attributes or components. Users passively experience with them. Those can be set to living frequency by default, which comes from the previous Human Research. Example: Safety, Ventilation, Auditory, Lighting, etc.

3.3.2.2 Needs Research Form

In order to make the research more specific and detailed and the communication more effective, each type of needs is further satisfied. The user-activated needs are translated into human behavior and activities according to behavior habits, and the non-user-activated needs are categorized according to the item involved.

Level (L)	Types of Needs	Needs	Frequency (F)	Self-Assessing Importance (S)	Importance(I) $I=(L+2S)/3$	Design Priority(P) $P=F*I$	
5 Functionality Basic	Resting	Sleeping					
		Having a Break					
	Food & Drink	Preservation					
		Washing					
		Preparing					
		Cutting					
		Heating					
	Sanitation	Eating/Drinking					
		Bodily	Toilet				
			Shower/Bath				
		Item	Face/Hand				
			Tooth				
			Kitchenware/Tableware				
		Environment	Clothes				
	Vacuum						
4 Reliability	Safety	Physical Safety					
		Electricity Safety					
	Health	Ventilation	/				
		Air Conditioning					
		Lighting					
3 Usability	Personal Appearance	Auditory					
		Dress Up					
	Storage	Make Up					
		Clothes					
		Bedding					
2 Pleasure	Relationship & Entertainment	Collection					
		Essentials					
		Online Socializing					
		Party					
	Learning & Working	Guesting					
		Gaming					
		TV/Movie					
1 Individualization Optimal	Customized Function	Computer-based					
		Book-based					
	Customized Function	Exercising					
		Pets					
		Music					
						

Table 3. 2 Needs Research Form

Note:

1. Designers have the flexibility to use this form. Users also have the right to personalize editing. Each need can be added or removed, based on cultural differences and individual user differences.
2. The area with a light blue background is to be filled in by the user. The grey part is non-user-activated needs, for which it is hard to count the frequency. Those are set as living frequency, coming from the Human Research, by default. The frequency of putting in and taking out the stored items determines the frequency of storage.
3. Frequency (F), evaluating from 0~5 (half-band):
5=Everyday, 4=Every 2~3 days, 3=Weekly, 2=Monthly, 1=Yearly, 0=Never.
Self-Assessing Importance(S), evaluating from 0~5 (half-band): 5=Essential, 0=Not Important.
4. Importance (I): $I=(L+2S)/3$.
Importance is expected to be evaluated both objectively and subjectively, in which subjective factors play a dominant role due to the goal of individualized design. L objectively stands for the level it belongs to in the 5-level model; S stands for users' subjective evaluation (self-assessing importance).
5. Design Priority (P): $P=F*I$
Design priority will determine the order in which designers addresses the needs of users in Support Phase. The further explanation will be at 3.4.1.1.1 Design Priority.

3.3.3 Preference Research

Preference research is to answer the question “How to design better?”, to know what the users like and dislike and to get the instruction of satisfaction improvement. The outcomes from this part will guide the feature design section.

According to the Kano Model, besides the basic attributes that are covered in the previous need research, the other four attributes, performance, Delight/Excite, Reverse and Indifferent, will be reflected in this preference research.

Types of Needs		Preference			
		Performance	Delight/Excite	Reverse	Indifferent
Resting		Sleeping			
		Having a Break			
Food & Drink	Preparing	Preservation			
		Washing			
		Cutting			
	Eating/Drinking	Heating			
		Dining			
Sanitation	Bodily	Toilet			
		Shower/Bath			
		Face/Hand			
		Tooth			
	Item	Kitchenware/Tableware			
		Clothes			
Environment	Wiping				
	Vacuum				
Safety		Physical Safety			
		Electricity Safety			
Health	Ventilation				
	Air Conditioning				
	Lighting				
	Auditory				
Personal Appearance		Dress Up			
		Make Up			
Storage	Clothes				
	Bedding				
	Collection				
	Essentials				
Relationship & Entertainment	Online Socializing				
	Party				
	Guesting				
	Gaming				
	TV/Movie				
Learning & Working		Computer-based			
		Book-based			
Customized Function		Exercising			
		Pets			
		Music			
		...			

Table 3. 3 Preference Research Form

The research will be conducted as an interview. The form above is for designers to record the results. Users can choose to skip some questions if they have difficulty to answer or they do not have any specific preference or dislike.

Here is explanation for each attribute and some suggested ways of questions. Designers can also develop new questions as needed.

- Performance:

The performance attribute refers to the user's wishes on some design choices. It can help designers make the right decisions to improve user satisfaction. For instance, a user likes the rest area style of cool color tone, which the designer would understand in this step, and would apply cool color in the next design (support) step.

Question samples:

Use one or two words to describe the feeling/style you want for this.

Choose from pictures or use pictures to illustrate what you want.

- Delight/Excite:

The delight/excite attribute refers to the design points that can surprise the users. It does not have to be there, but if so, it would win a bonus of the space. It is more optimal but less prior than previous basic and performance attribute. Sometimes it is similar to the description of the former, so designers need to judge according to the actual situation. For example, a user would accept the traditional rectangular bed, but mentions that the round bed is a great experience. If space allowing, the round bed will be a design highlight, but if a round bed leads to the insufficiency of desk space, then give it up.

Question samples:

What good experience you have ever had or seen from somewhere else?

How do you think of ...?

- Reverse:

The reverse attribute is the something that the users dislike. It reduces user satisfaction and should be avoid when designing. For example, for users who hate having carpet in bedroom, the carpet should be replaced by wood or marble floor.

Question samples:

What annoying experience you have ever had or seen from somewhere else?

- Indifferent:

Indifferent attribute is something that the user does not have an opinion on. It will not make any difference to their satisfaction. Users usually do not initiate mentioning the things they do not care about. It usually comes from later support phase and ongoing communication with the users, since the need-satisfaction approach is not a linear and one-way process.

Question samples:

Do you mind if your ... to be ...?

3.4 Support

The step Support is to design. What the designers should do is to work out the solution for users' needs and implement their preference to raise satisfaction in the limited space design. There, the needs of user will be turned into functions of space, and the preference will be turned into features. Based on the previous research, this step will be clearly oriented by the willing of users themselves. It will have three sections: function organizing, feature developing and feature refining.

3.4.1 Function Organizing

Function organizing is based on the needs research. It consists of two tasks, comparing the design priority of needs, and determining the strategies for each of them. As it is said before, there are two important indices, frequency and importance, which will help in the next work.

3.4.1.1 Frequency – Importance

3.4.1.1.1 Design Priority

When a large number of problems are waiting for the solution, they need to be sorted properly. Similarly, when a large number of needs need to be met, it is necessary to have an order, and that is why the design priority is needed. Design priority is the credential that determines a designer's work timeline. Designers will address needs in order of design priority from high to low.

Design priority is calculated by:

$$\text{Design Priority} = \text{Frequency} * \text{Importance}$$

There are reasons of combining these two criteria, frequency and importance, as a comprehensive consideration.

First, the two criteria represent different aspects. Frequency represents the level of user behavior habit, of how the user is used to it, namely the ‘process’. Importance represents the level of its consequences and its impact, which is the ‘result’. It evaluates its ‘process’ and ‘results’ to determine whether and how much it needs for the ‘premise’, which is the space and facilities to make it happen.

For the general interior design cases, because there is enough space, these two standards are not effective at the same time. For example, an infrequently used guesting area remains in space for a long time because it is important. Another example is a frequently used armchair

taking up 6 ft 2 in, which is not important because what you do when sitting on it, such as reading, can also be done as sitting on bed. This kind of extensive evaluation and solution are apparently not suitable for the small-sized space with every inch particularly precious. The two-criteria evaluation will be more refined and help to develop the solution more accurately and effectively.

3.4.1.1.2 Matrix

Another method for frequency and importance assessment is to build a matrix that helps choosing a strategy.

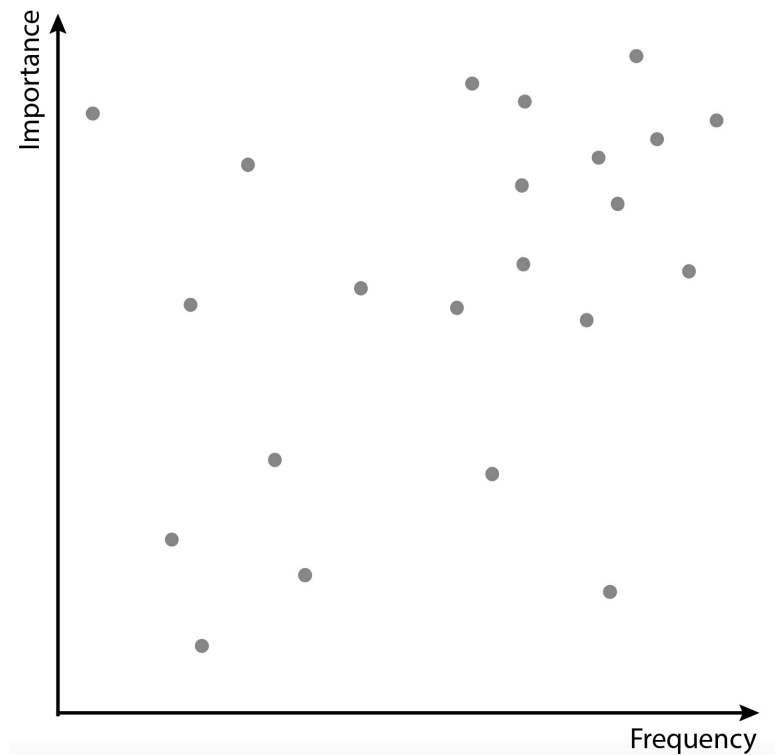


Figure 3. 4 Frequency-Importance Matrix

The vertical axis shows ‘Importance;’ the horizontal axis, ‘Frequency.’ Each need is positioned on the matrix as a point. The rough distribution could be presented but not clear enough at this point, and further improvement is still needed.

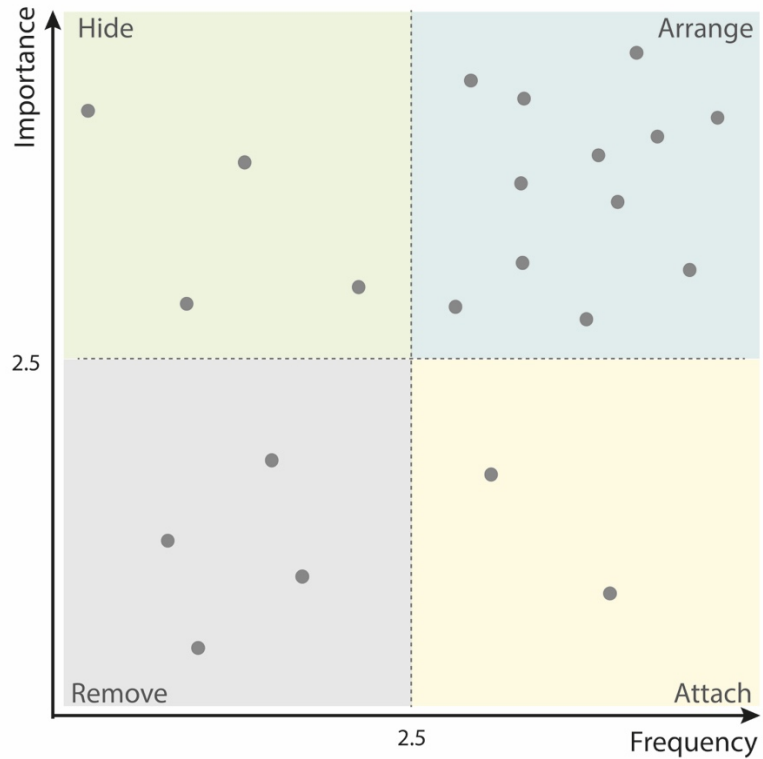


Figure 3. 5 Four-Quadrant Frequency-Importance Matrix

Based on the matrix, it is then divided into four quadrants and each of them are covering several needs. Both two dividing lines are at the 2.5. These needs are grouped into four categories according to frequency and importance. The needs that are close to the edge of quadrants (within the difference of 0.5) can be judged to either quadrant by designers themselves. Each category corresponds to a dominant strategy.

- High frequency and important needs – Arrange
- Low frequency but important needs – Hide
- High frequency but unimportant needs – Attach
- Low frequency and unimportant needs – Remove

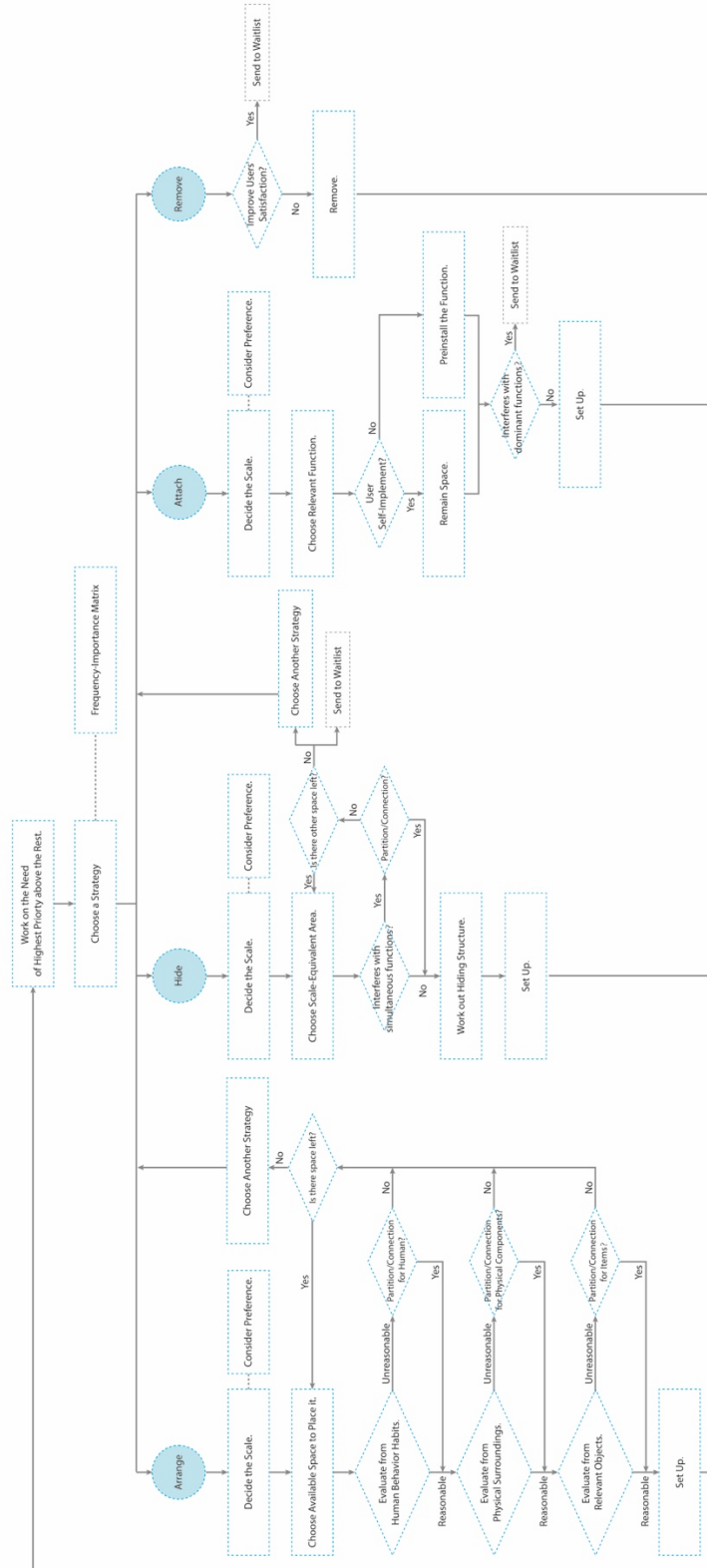


Figure 3. 6 The Four Strategies Flow Chart

Once the strategies of needs are determined, the designer will have four needs lists, the list of Arrange, the list of Hide, the list of Attach and the list of Remove, as Figure 3.7.

Strategy	Order	Description of need		
Arrange	1	Resting		Sleeping
	2	Food&Drink	Preparing	Re-heating
	3	Food&Drink	Eating & Drinking	Dining
	4	Food&Drink	Preservation	Preservation
	5	Sanitation	Bodily	Toilet
	6	Sanitation	Bodily	Face/Hand
.....				
Attach	21	Storage		Kitchenware/Tableware
	22	Storage		Bath&Body Essentials
.....				
Hide	32	Sanitation	Environment	Cleaning
	35	Relationship&Entertainment		Guesting (6~7)
.....				
Remove	39	Storage		Other
.....				

Table 3. 4 Needs List for Each Strategy (Sample)

3.4.1.2 Arrange

‘Arrange’ is to implement high frequency and important needs in space. Through this process, the space forms the basic framework, allowing the following parts to be supplemented. This not only addresses separate needs, but also solves the relationship and conflict between them. Figure 3.8 is the flow chart of Arrange.

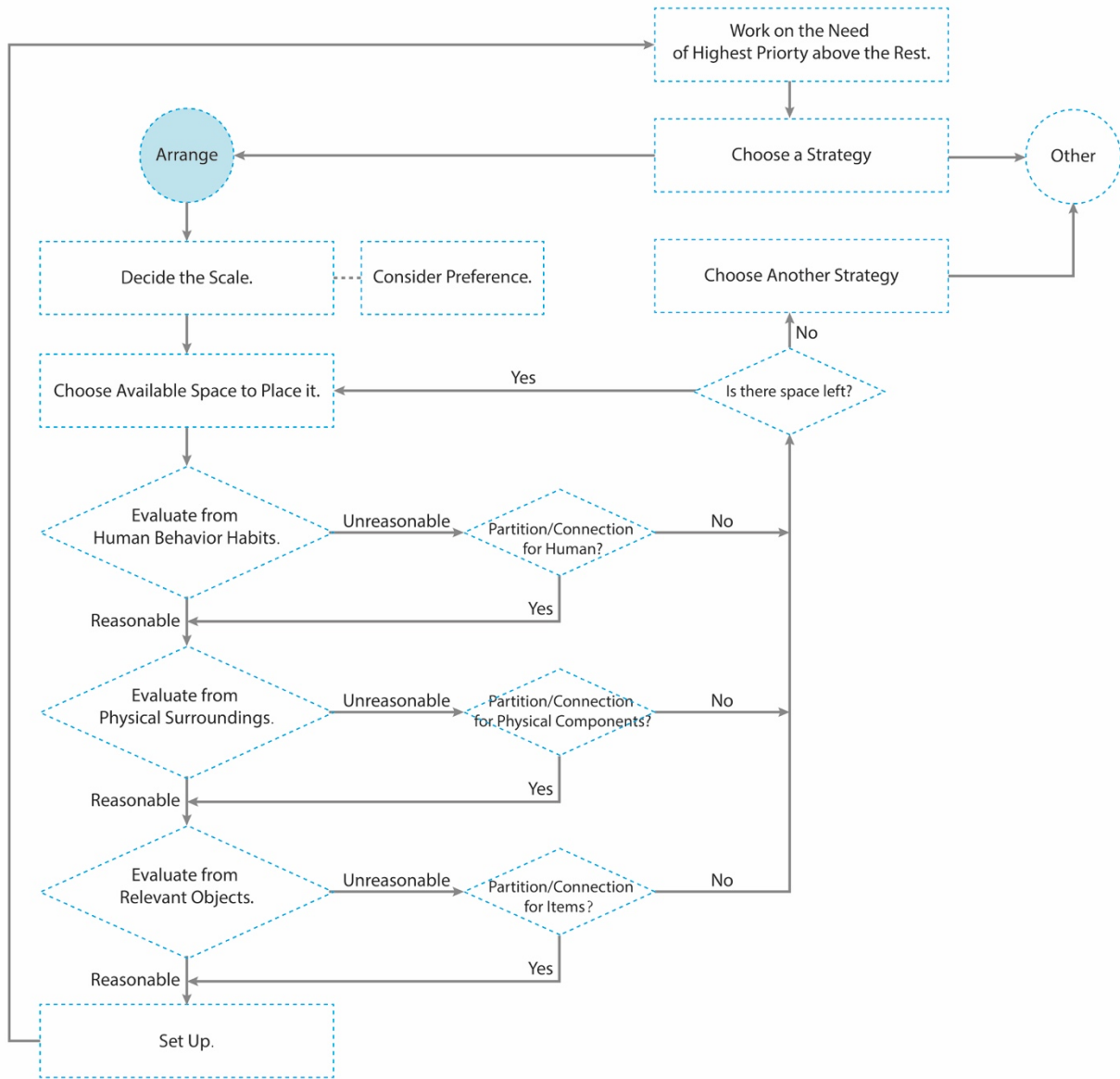


Figure 3. 7 'Arrange' Flow Chart

3.4.1.2.1 Scale

When abstract needs are set into concrete spaces, the inevitable problem is scale.

When calculating the scale for the specific needs of a specific user, there are usually two aspects to consider:

1. Posture: There are five kinds of common postures: walking, standing, sitting, squatting and lying down. Designers should consider dynamic or partial poses based on these five types.

2. Individual Data: In order to achieve the goal of Individualized space design, designers should not only refer to the standardized and industrialized human body size, but rather pay more attention to personal ergonomics measurement (body height and width) in previous human research, in order to save every inch of the limited space.

After the above two items are determined, the scale can be determined by searching for data or building a human model. The following figure shows the postures and corresponding scales of a user with a height of 174 cm. Due to the huge ergonomic theory system, this thesis does not elaborate.

In addition, for non-user-activated needs, for example, storage, in that the needed space scale is more flexible, the scale of storage objects need to be considered.

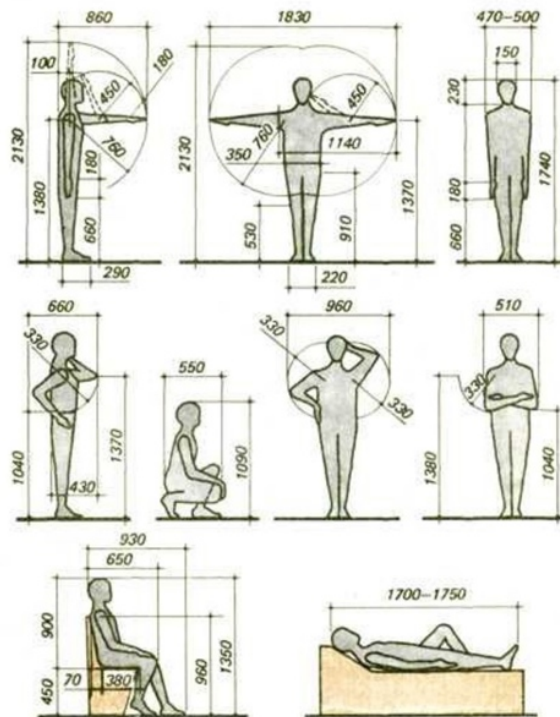


Figure 3. 8 User Ergonomic Dimension (Uzmandecoor.com, n.d.)

3.4.1.2.2 Placement

When scale of the need is determined, the way they are placed is what to do next. Simply put, find a place that is still unused at this point and larger than this scale so that it can accommodate this need. For the case of sufficient single-level space, this is not complicated. Designers often do this by drawing it on floor plans. However, for small space, it's not easy. If done this way, it will be realized that a lot of needs are left over. Two-dimensional design is not sufficient. As a result, limited space, combined with the use of it, will be seen more subtly as a four-dimensional system. It includes three dimensions in space and the time dimension generated by use. Thus, there are two ways of distribution: Spatial Distribution (Plane & Vertical) and Temporal Distribution.

- Spatial Distribution (Plane & Vertical)

Spatial distribution includes 2D plane distribution and 3D vertical distribution. Plane distribution is the conventional way to draw a plan for interior planning. Based on the particularity of small living space, with storey height allowing, how to make full use of the space on vertical direction is the key that designers pay attention to.



Figure 3. 9 Example of Vertical Distribution (hzcnd.com, n.d.)

- Temporal Distribution

Temporal distribution is more applicable for the strategy 'Hide'. It will be discussed later.

3.4.1.2.3 Evaluation

At this point, the need is stacked, but simply and roughly. Internal connections need to be sorted out and organized, which are between need and human, between need and space, and between this need and prior needs. Thus, this rough placement will be evaluated and judged. Once it fails to pass, which means it cannot be reckoned as reasonable, it will be returned to the previous section for another right placement, or sent to try other strategies of 'Hide' and 'Attach'. For now, for the needs in the first quadrant of high frequency and importance, it is not suggested to directly send to waitlist.

The evaluation includes three aspects: Human Behavior Habit, Physical Surroundings, and Relevant Items.

- Human Behavior Habit

People's behavior habit has continuity, discontinuity and repeatability. There are relations and conflicts between behaviors, which determines that functions should be combined or divided, or whether a partition or connection should be set.

For example, there is a relation between brushing teeth and washing face, because many people get foam on their mouth when they brush their teeth. Thus, the space that carries the functions of brushing teeth and washing face should be arranged close or combined together.

Another example of conflicts, people do not exercise right after dining because it is harmful to digestive system. So, the exercising space and dining space do not need to be close to each other.

A very common problem in residential space should also be included here, which is privacy. It is also one of the nine main psychological needs according to Miller and Schlitt's research (1985). For space inhabited by one person, privacy basically is considered as the appropriate partition with outside environment. And for space for two, such as young couples, despite their close relationship, for some specific high-privacy needs, there is still a need for privacy protection partition in the space.

- Physical Surroundings

Physical surroundings refer to all the physical properties of the space, including sound, light, temperature, humidity, etc. Different functions require different physical surroundings. People do not want a lot of light in the sleeping area but reading and learning area just the opposite, so reading and learning can be combined but they should be divided from sleeping by an opaque partition.

Because of the different forms of physical properties, there are many different ways to set up partitions and connections, where material and technology can play a very important part. Taking sound blocking as an example, it involves methods for ceiling, wall, window door and furniture. People use fiberglass insulation batts inside the walls and ceilings, use soundproof window with double or triple layers of glass, and use soft-surface or rough materials where it is close to the source of noise, such as cork. Through such technological innovation, the problem can be solved reasonably without causing extra waste of space.



Figure 3. 10 Soundproof Wall and Window (newenglandsoundproofing.com & eurotekwindows.com, n.d.)



Figure 3. 11 Sound-absorbing Cork Wall(icorkfloor.com, n.d.)

- Relevant Objects

Relevant objects refer to the items that are necessarily involved in functions, such as mobile phones, books, laptop, shampoo, make-ups and etc. If two functions that alternate in a short period of time share the same objects, then the space of these two functions are expected to be close or just combined, so that the distance for users to transport these objects from one to another can be shortened as much as possible. If they need different objects, then the space of the two functions should be avoided to be combined together, otherwise users may need to move things frequently. For example, cooking and dining sharing the tableware and food should get close, but dining and working are better separated because working requires totally different objects such as books and laptop and the two may happen very closely in time.



Figure 3. 12 Kitchen + Dining Space (hellomagazine.com, n.d.)



Figure 3. 13 Separate Desk and Dining Table Sharing the Bench (qq.com, 2019)

To solve these kinds of problem around objects in small space, a smart way is to provide a connection or a partition just for the objects, rather than human. It will take less space and effort to do so.

3.4.1.2.4 Set up

Once the function passed the evaluation and is regarded as reasonable, principally it is set up and will not be changed to accommodate the following functions that are less prior to it unless the change would not affect its use. After setting up, designers will go and work on the next function, which is of the highest priority among the rest of all.

3.4.1.3 Hide

After the ‘Arrange’ has finished, it is still important to work on ‘Hide’ important but low-frequency functions, such as a guest bed for friends or parents to visit, or a table to allow a group of friends to have small party. Hide is rather technical. The key of ‘Hide’ is to find a suitable ‘Cover function’, or to say, to deal with temporal distribution.

Temporal distribution is based on the sequence of use in a space. In the same space point, through some physical structural transformation, it can play different functions at different points in time. The well-known transformable furniture makes use of the temporal distribution. As the drawback of the temporal distribution is that it is easy to cause users’ operation fatigue and multifunction chaos, it is better to be avoided for the high-frequency functions or make it automatic, and is more suitable for low-frequency but important function in ‘Hide’ strategy.



Figure 3. 14 Foldable Bed, an Example of Temporal Distribution

As the figure above shows, in normal days this space can be used for other frequent function (sofa), and will only be displayed when needed (guest bed).

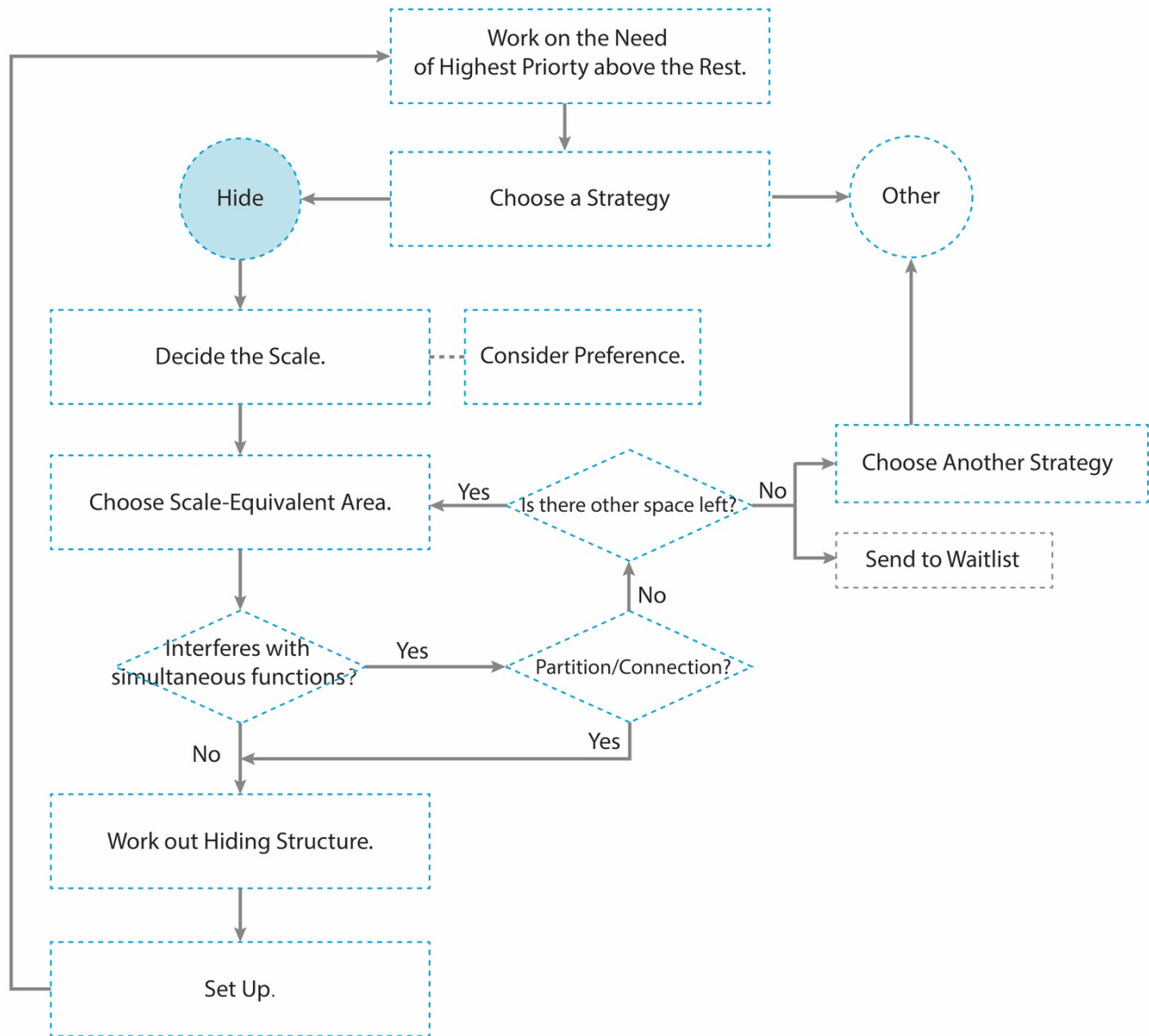


Figure 3. 15 'Hide' Flow Chart

Before explaining the steps of 'Hide', the two key aspects of the underlying relationship need to be figured out, which are the scale and the time. The area of 'cover functions' and 'hidden functions' are basically equivalent with scale. Meanwhile, the hidden function cannot interfere the simultaneous ones that have already set up. If so, whether a partition or connection eliminates this interference should be asked. If the answer is no, it should move to somewhere else, or send to the waitlist to see if it can be solved later. For example, to set an extendable table

for home socializing, it cannot extend to the kitchen area, because preparing food and guesting can happen at the same time. Thus, the steps of ‘Hide’ start with solving the scale and the time line, which are deciding the scale, choose scale-equivalent area and judge whether the hidden function interferes with simultaneous function.

Then designers should determine a suitable transformable structure to hide to make it work. There are several options of transforming that are widely applied in small space, or designers are encouraged to develop new structures.

1. Folding and Rotating;



Figure 3. 16 Example of Folding and Rotating (blessthisstuff.com, n.d.)

2. Sliding;



Figure 3. 17 Example of Sliding (esourcefurniture.com, n.d.)

3. Twisting (Soft Material);



Figure 3. 18 Example of Twisting (godownsize.com, n.d.)

4. Modularity.



Figure 3. 19 Example of Modularity (goodshomedesign.com, n.d.)

Once the structure makes it work, it can go on to next function.

3.4.1.4 Attach

In general, high frequency and unimportant functions tend to be small in scale, short in time, or can be parallel to other functions at the same time. Based on these characteristics, they are not difficult to implement. Meanwhile, as the users have the psychological need of ‘control’ their own space (Miller & Schlitt, 1985), these easy and attached functions can give them the feeling of control. Thus, there are two ways to realize them, by designers or by users. Designers can appropriately attach them to other functions, or just reserve the space and possibility for users to implement by themselves. For example, for a pen holder in the working area, the designer can make it together with the working desk, or just reserve the space for users to put their own favorite pen holder there.

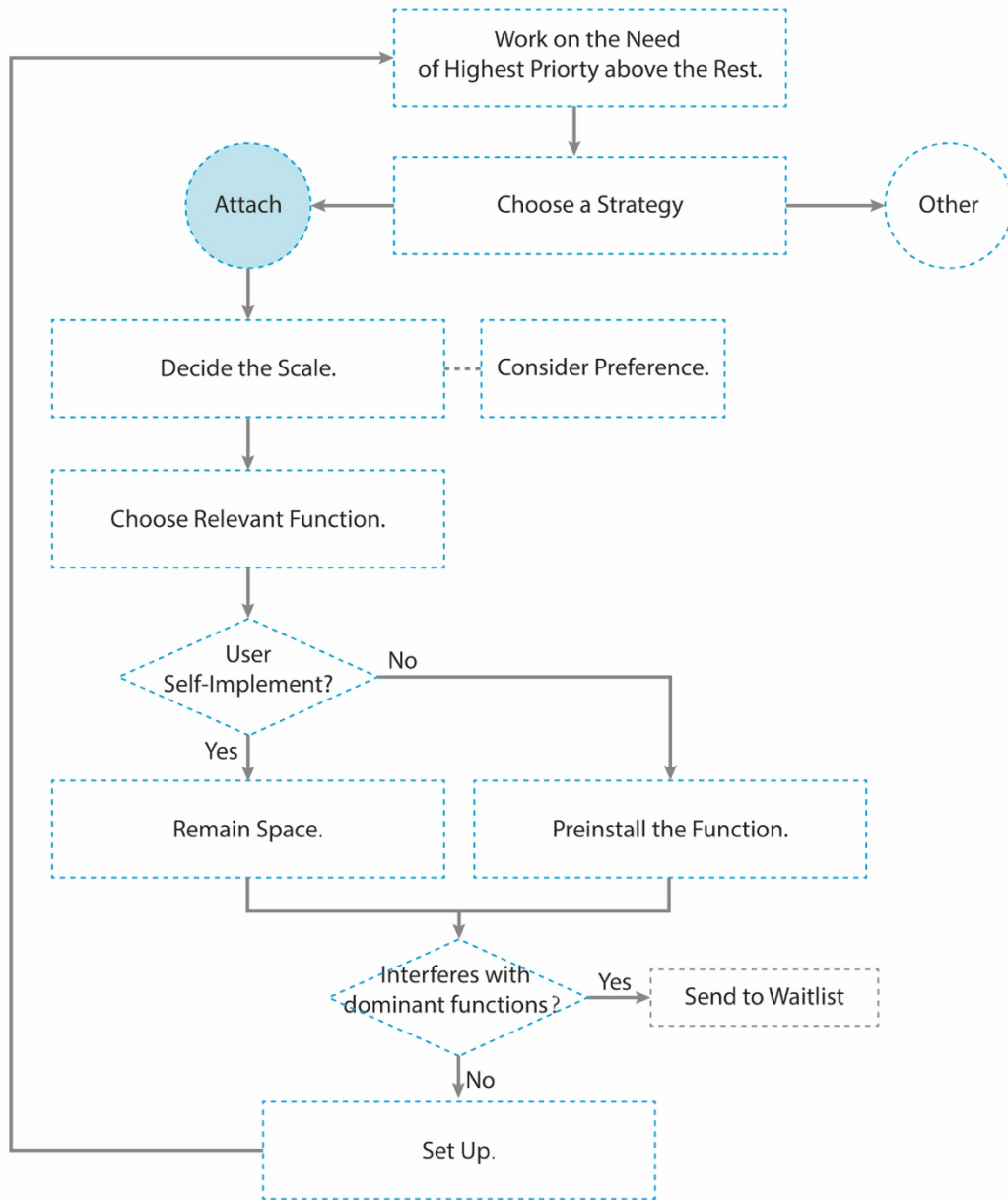


Figure 3. 20 ‘Attach’ Flow Chart

The principle of attach function is that it cannot interfere with the dominant function where it attaches to. If designers fail to eliminate the interference, it is better to send it to the waitlist.

3.4.1.5 Remove

In a sense, 'Remove' is very important for space. It requires a determination to break the routine. If the function can help to improve the satisfaction, it can temporarily remain in the waitlist. Otherwise it would be regarded as reverse attribute, in which cutting it out will improve users' satisfaction and also save the limited space so that the feeling of crowding can be reduced.

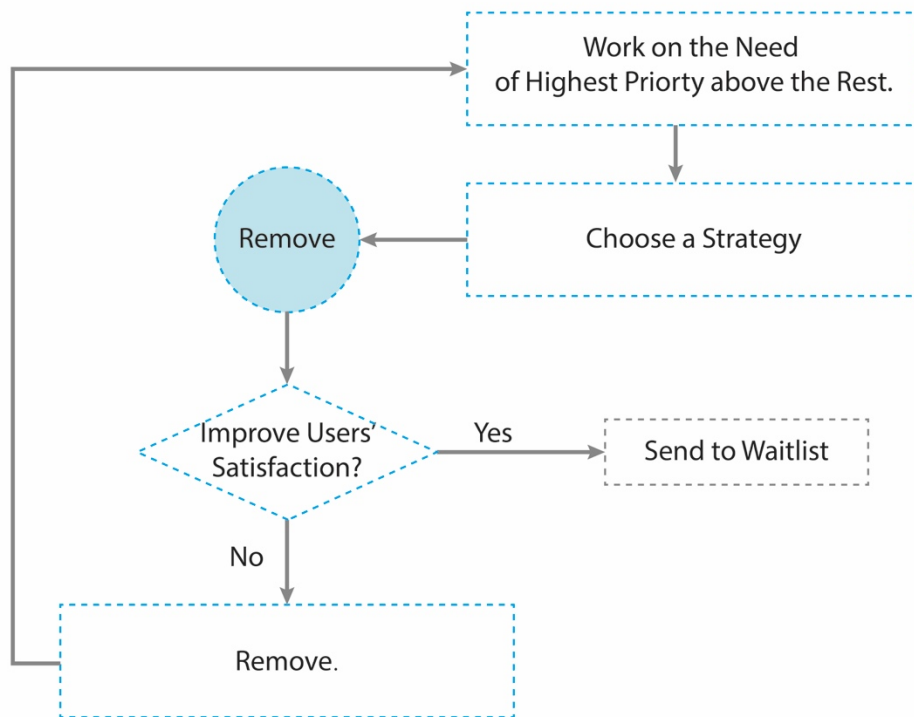


Figure 3. 21 'Remove' Flow Chart

3.4.2 Feature Developing

Feature developing is based on the preference research. It consists of four parts with each corresponding to one attribute of the research. Before getting to these four parts, the relationship of function and feature need to be clarified.

3.4.2.1 Relationship of Function and Feature

Functions and features can be represented on one object at the same time. In terms of the hierarchy theory above, the functions mainly serve for the first three levels, namely

Functionality, Reliability, and Usability, and the features for the last two, namely Pleasure and Individualization, despite a lot of intersection here. The relationship of function and feature is also working as the principle of feature developing.

- Function prioritizes over feature.
- Feature works for function.

Thus, all features must be developed under the premise of guaranteeing functions.

3.4.2.2 Four Kinds of Features

In the previous research, the preference of four attributes was obtained. Each attribute corresponds to some features. These features will be treated differently according to the attributes.

Performance Respect users' choices.
Delight/Excite Implement the delight features as far as possible.
Reverse Abolish.
Indifferent It depends.

Table 3. 5 Four Kinds of Features

Abolish the Reverse features.

Respect users' choices on Performance features.

Implement the Delight features as far as possible.

Decide the Indifferent according to the actual situation.

Since the feature development is directly guided by the results of preference research, the design is independent and respective with each other. They can be solved with detailed scattered solutions that can be easily found on the Internet. Designers are also encouraged to create new solutions according to their users' requirements.

3.4.3 Space Refining

So far, the functions of the space and user-specific features have been completed. The space has been framed completely. Space Refining is to finish up the design and lift the completion. There will be three tasks:

1. Visual Unifying: Based on the content of Human Research, users' aesthetics and personality should be expressed in space. This step is to change the appearance without hindering the functions and visually unify every part as a whole, such as material change, color change and stylized details.
2. Corner Space: Because the space of a small residence is all the more precious, it is very necessary to check and make use of every inch of the space, because the function frame may cause some corner space to be unused and wasted. Generally speaking, corner space can be used for storage, planting or decoration.
3. Waitlist: In the previous step, some unsolvable needs were sent into the waitlist. At this point, they can be reviewed once again and see if there still be possibility to address them. The principle is that the waitlist functions cannot interfere with the previous functions that have been previously determined.

3.5 Close

Going to 'Close' step means that the design is complete. It comes to the furnishing section. As there still will be many problems in the actual furnishing, the 'Close' here does not mean the 'end' in the real sense, but temporary. Again, this is not a one-way approach. Designers need to make appropriate adjustments to the design according to the actual situation.

Chapter 4 Design Application

In this chapter, a small space design that is following the approach in Chapter 3 will be demonstrated. The involved user's conditions and needs are virtually set by writer.

4.1 Open

To start with, a real existing space is adopted.

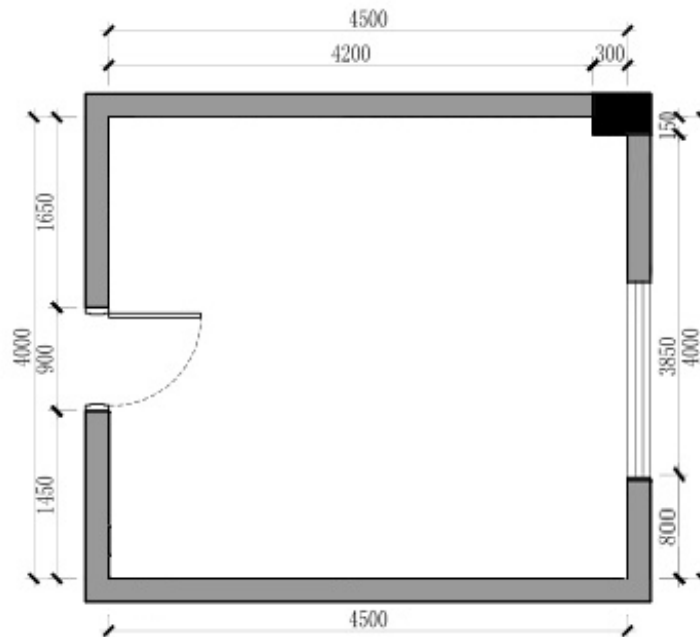


Figure 4. 1 Space Floor Plan (zhihu.com, 2019)

According to its description (zhihu.com, 2019), it is a space of 4 by 4.5m (13.1 by 14.8 ft.) space with a height of 3.8m (12.5 ft.). Its total area is 18 m² (193.65 ft²), which is in the range that is mentioned in Chapter 2 so that the approach can apply to it.

Since field measurements are not available, there is limited information available and other data will be estimated.

4.2 Probe

According to Chapter 3, there will be three sections in Probe part.

4.2.1 Human Research

The user is set to be a female company employee at the age of 25~30, single. As the instruction mentioned in Chapter 2, designers can learn about the user by the human research chart, as Table 4.1 shows.

Social-Economic	Career	company employee
	Budget	¥ 100,000 (\$15,000)
	Working Hour	8AM~18PM (M~F)
	Visitors/Other Habitants	Mother, Friends (Occasional)
Cultural-Aesthetic	Education	Master Degree
	Nationality	China
	Hobby	Drawing, Watching Videos
	Aesthetic/Favorite Style	Simplicity, Normcore, New Chinese Style
	Collection	Travel Postcards and Souvenirs
	Religion	None
Physiological-Practical	Gender	Female
	Vision	No Glasses
	Height	164mm(5.4 ft.)
	Body Width	36mm (1.2 ft.)
	Illness/Disability	Allergic rhinitis
	Living Frequency	Everyday

Table 4. 1 Human Research Form

4.2.2 Need Research

The next step is to know the user's needs. Here, a form of their needs should be generated as Table 4.2. The blue part is filled up by user and other data is calculated from the blue data:

Importance: $I=(L+2S)/3$; Design Priority: $P = F * I$.

Because the designer is able to edit the needs column according to actual situation, it is possible to have some differences compared to the sample form in Chapter 3.

Level (L)		Types of Needs	Needs	Frequency (F)	Self-Assessing Importance (S)	Importance (I)	Priority (P)	
Functionality	5	Resting	Sleeping	5	5	5.0	25.0	
	5		Relaxing	3	3	3.7	11.0	
	5	Food&Drink	Preparing	3.5	4	4.3	15.2	
	5		Re-heating	5	5	5.0	25.0	
	5	Eating & Drinking	Dining	5	5	5.0	25.0	
	5	Preservation	Preservation	5	5	5.0	25.0	
	5	Sanitation	Toilet	5	5	5.0	25.0	
	5		Bodily	Shower/Bath	4.5	5	5.0	22.5
	5			Face/Hand	5	5	5.0	25.0
	5			Tooth	5	5	5.0	25.0
	5		Items	Kitchenware/Tableware	4.5	4	4.3	19.5
	5			Clothes	3	4	4.3	13.0
	5	Environment	Cleaning	2	4	4.3	8.7	
Reliability	4	Safety	Physical Safety	5	4	4.0	20.0	
	4		Electricity Safety	5	5	4.7	23.3	
	4	Health	Ventilation	5	5	4.7	23.3	
	4		Air Conditioning	5	5	4.7	23.3	
	4		Lighting	5	5	4.7	23.3	
	4		Auditory	5	4	4.0	20.0	
Usability	3	Personal Appearance	Dress Up	4	5	4.3	17.3	
	3		Make Up	4.5	4.5	4.0	18.0	
	3	Storage	In-season Clothes	5	5	4.3	21.7	
	3		Out-of-season Clothes	1.5	4	3.7	5.5	
	3		Ornaments	3.5	4	3.7	12.8	
	3		Bags	3.5	4	3.7	12.8	
	3		Shoes	4	4	3.7	14.7	
	3		Bedding	2	3	3.0	6.0	
	3		Books	3	3	3.0	9.0	
	3		Medical	1.5	3	3.0	4.5	
	3		Kitchenware/Tableware	5	3	3.0	15.0	
	3		Bath&Body Essentials	5	3	3.0	15.0	
			Collections	1	4	2.7	2.7	
	3		Other	2	2	2.3	4.7	
Pleasure	2	Socializing &Entertainment	Online (SSN)	5	5	4.0	20.0	
	2		Visiting (1~2)	1.5	5	4.0	6.0	
2	Guesting (6~7)		2	4	3.3	6.7		
2	Gaming		3	1	1.3	4.0		
2	Watching Veideos		4	2	2.0	8.0		
2	Learning&Working		Computer-based	4	4	3.3	13.3	
	2	Paper-based	2.5	4	3.3	8.3		
Individualization	1	Customized Functions	Home Exercising	2	1	1.0	2.0	
	1		Digital Drawing	4	4	3.0	12.0	
1	Music		4.5	4	3.0	13.5		
1	Pet		0	1	1.0	0.0		

Table 4. 2 Needs Research Form

4.2.3 Preference Research

Preference research is open-ended. As is described in the last chapter, user can choose to skip some questions if she does not have any specific preference or dislike.

The result of preference research is shown in Table 4.3.

Level (L)	Types of Needs		Needs	Performance	Delight	Reverse	Indifferent	
Functionality	Resting		Sleeping	Queen Size	King Size	Too open, no privacy	Loft Bedroom	
			Relaxing	Soft Cushion	Open Area			
	Food&Drink	Preparing	Cooking		Oven		Open Kitchen	
			Re-heating	Microwave				
		Eating & Drinking	Dining	Warm Bright Light				
		Preservation	Preservation		Larger Refrigerator			
	Sanitation	Bodily	Toilet					
			Shower/Bath			Bath Tub		
			Face/Hand				Interfered by Make-ups	
		Items	Tooth	Warm Water				
			Kitchenware/Tableware	Dishwasher				
			Clothes	Washing Machine				
	Environment	Cleaning						
Reliability	Safety		Physical Safety	Handle		Vertical Ladder		
			Electricity Safety					
	Health		Ventilation					
			Air Conditioning			Outlet straight to bed		
			Lighting					
	Personal Appearance		Auditory					
Usability			Dress Up	full-length mirror				
		Make Up	Light Mirror					
	Storage	In-season Clothes	Separate					
		Out-of-season Clothes		Easy to Alternate				
		Ornaments						
		Bags						
		Shoes						
		Bedding						
		Books						
		Medical	Enclosed					
		Kitchenware/Tableware						
		Bath&Body Essentials						
		Collections	Presented for self and guest					
		Other						
Pleasure		Socializing &Entertainment		Online (SSN)				
	Visiting (1-2)			Guest Bed				
	Guesting (6-7)					Privacy Exposure		
	Gaming							
	Learning&Working		Watching Veideos	Before Sleeping				
			Computer-based					
		Paper-based						
Individualization	Customized Functions		Home Exercising					
			Digital Drawing	Wide desk for digital tablet		Direct Sunlight		
			Music					
		Pet						

Table 4. 3 Preference Research Form

4.3 Support

4.3.1 Function Organizing

Based on the previous Need Research, the functions of the space can be organized and arranged.

4.3.1.1 Frequency - Importance

4.3.1.1.1 Design Priority

Design Priority = Frequency * Importance. The designer can reorder the needs of the user by design priority ranking, as the following Table 4.4 shows.

Order	Types of Needs		Needs	Frequency (F)	Importance (I)	Design Priority (P)
1	Resting		Sleeping	5.0	5.0	25.0
2	Food&Drink	Preparing	Re- heating	5.0	5.0	25.0
3	Food&Drink	Eating & Drinking	Dining	5.0	5.0	25.0
4	Food&Drink	Eating & Drinking	Preservation	5.0	5.0	25.0
5	Sanitation	Bodily	Toilet	5.0	5.0	25.0
6	Sanitation	Bodily	Face/Hand	5.0	5.0	25.0
7	Sanitation	Bodily	Tooth	5.0	5.0	25.0
8	Safety		Electricity Safety	5.0	4.7	23.3
9	Health		Ventilation	5.0	4.7	23.3
10	Health		Air Conditioning	5.0	4.7	23.3
11	Health		Lighting	5.0	4.7	23.3
12	Sanitation	Bodily	Shower/Bath	4.5	5.0	22.5
13	Storage		In- season Clothes	5.0	4.3	21.7
14	Safety		Physical Safety	5.0	4.0	20.0
15	Health		Auditory	5.0	4.0	20.0
16	Relationship&Entertainment		Online (SSN)	5.0	4.0	20.0
17	Sanitation	Items	Kitchenware/Tableware	4.5	4.3	19.5
18	Personal Appearance		Make Up	4.5	4.0	18.0
19	Personal Appearance		Dress Up	4.0	4.3	17.3
20	Food&Drink	Preparing	Cooking	3.5	4.3	15.2
21	Storage		Kitchenware/Tableware	5.0	3.0	15.0
22	Storage		Bath&Body Essentials	5.0	3.0	15.0
23	Storage		Shoes	4.0	3.7	14.7
24	Customized Functions		Music	4.5	3.0	13.5
25	Learning&Working		Computer- based	4.0	3.3	13.3
26	Sanitation	Items	Clothes	3.0	4.3	13.0
27	Storage		Ornaments	3.5	3.7	12.8
28	Storage		Bags	3.5	3.7	12.8
29	Customized Functions		Digital Drawing	4.0	3.0	12.0
30	Resting		Relaxing	3.0	3.7	11.0
31	Storage		Books	3.0	3.0	9.0
32	Sanitation	Environment	Cleaning	2.0	4.3	8.7
33	Learning&Working		Paper- based	2.5	3.3	8.3
34	Relationship&Entertainment		Watching Veideos	4.0	2.0	8.0
35	Relationship&Entertainment		Guesting (6~7)	2.0	3.3	6.7
36	Storage		Bedding	2.0	3.0	6.0
37	Relationship&Entertainment		Visiting (1-2)	1.5	4.0	6.0
38	Storage		Out- of- season Clothes	1.5	3.7	5.5
39	Storage		Other	2.0	2.3	4.7
40	Storage		Medical	1.5	3.0	4.5
41	Relationship&Entertainment		Gaming	3.0	1.3	4.0
42	Storage		Collections	1.0	3.7	3.7
43	Customized Functions		Home Exercising	2.0	1.0	2.0
44	Customized Functions		Pet	0.0	1.0	0.0

Table 4. 4 Design Priority Form

4.3.1.1.2 Matrix

A Frequency-Importance Matrix can be set up. Each point represents a need. Some points may overlap. The numbers next to the points represents the order of needs.

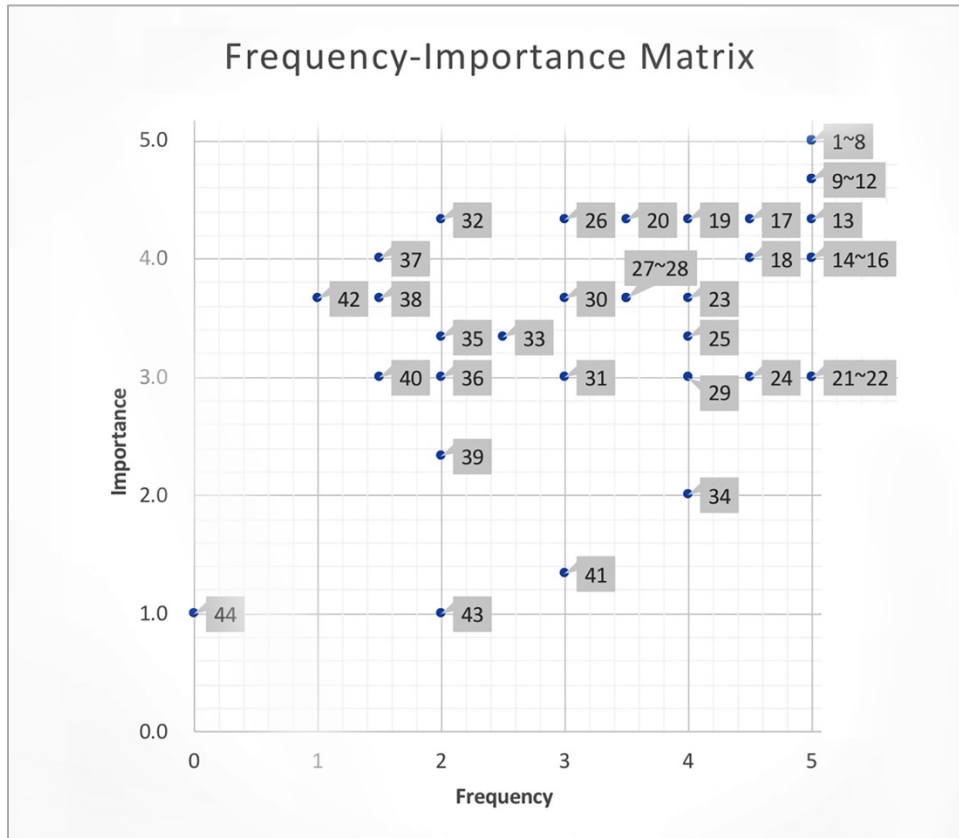


Figure 4. 2 Frequency-Importance Matrix

4.3.1.2 The Four Strategies

The designer divides all the points into four quadrants with some adjustments and judgments, as Figure 4.3 shows.

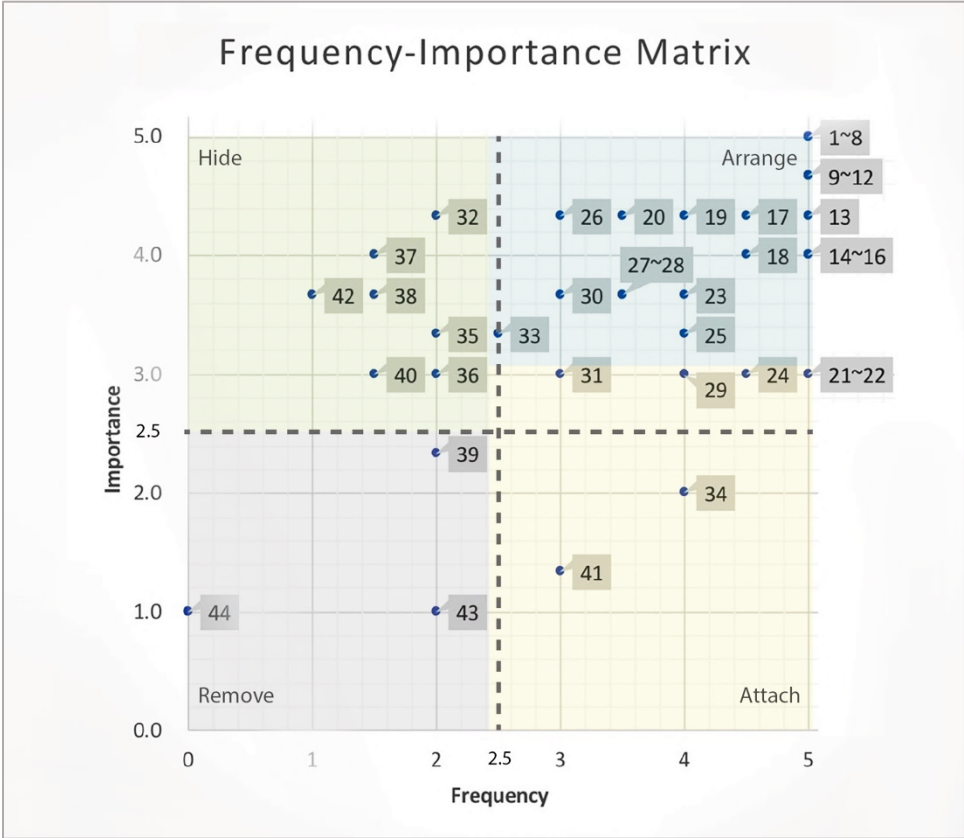


Figure 4. 3 Four-Quadrant Frequency-Importance Matrix

According to the analysis above, the needs are sorted into four strategies: Arrange, Hide, Attach and Remove as the Table 4.5 shows.

Strategy	Order	Types of Needs	Needs	Frequency (F)	Importance (I)	Design Priority (P)	
Arrange	1	Resting		Sleeping	5.0	5.0	25.0
Arrange	2	Food&Drink	Preparing	Re - heating	5.0	5.0	25.0
Arrange	3	Food&Drink	Eating & Drinking	Dining	5.0	5.0	25.0
Arrange	4	Food&Drink	Eating & Drinking	Preservation	5.0	5.0	25.0
Arrange	5	Sanitation	Bodily	Toilet	5.0	5.0	25.0
Arrange	6	Sanitation	Bodily	Face/Hand	5.0	5.0	25.0
Arrange	7	Sanitation	Bodily	Tooth	5.0	5.0	25.0
Arrange	8	Safety		Electricity Safety	5.0	4.7	23.3
Arrange	9	Health		Ventilation	5.0	4.7	23.3
Arrange	10	Health		Air Conditioning	5.0	4.7	23.3
Arrange	11	Health		Lighting	5.0	4.7	23.3
Arrange	12	Sanitation	Bodily	Shower/Bath	4.5	5.0	22.5
Arrange	13	Storage		In-season Clothes	5.0	4.3	21.7
Arrange	14	Safety		Physical Safety	5.0	4.0	20.0
Arrange	15	Health		Auditory	5.0	4.0	20.0
Arrange	16	Relationship&Entertainment		Online (SSN)	5.0	4.0	20.0
Arrange	17	Sanitation	Items	Kitchenware/Tableware	4.5	4.3	19.5
Arrange	18	Personal Appearance		Make Up	4.5	4.0	18.0
Arrange	19	Personal Appearance		Dress Up	4.0	4.3	17.3
Arrange	20	Food&Drink	Preparing	Cooking	3.5	4.3	15.2
Attach	21	Storage		Kitchenware/Tableware	5.0	3.0	15.0
Attach	22	Storage		Bath&Body Essentials	5.0	3.0	15.0
Arrange	23	Storage		Shoes	4.0	3.7	14.7
Attach	24	Customized Functions		Music	4.5	3.0	13.5
Arrange	25	Learning&Working		Computer - based	4.0	3.3	13.3
Arrange	26	Sanitation	Items	Clothes	3.0	4.3	13.0
Arrange	27	Storage		Ornaments	3.5	3.7	12.8
Arrange	28	Storage		Bags	3.5	3.7	12.8
Attach	29	Customized Functions		Digital Drawing	4.0	3.0	12.0
Arrange	30	Resting		Relaxing	3.0	3.7	11.0
Attach	31	Storage		Books	3.0	3.0	9.0
Hide	32	Sanitation	Environment	Cleaning	2.0	4.3	8.7
Arrange	33	Learning&Working		Paper - based	2.5	3.3	8.3
Attach	34	Relationship&Entertainment		Watching Veideos	4.0	2.0	8.0
Hide	35	Relationship&Entertainment		Guesting (6~7)	2.0	3.3	6.7
Hide	36	Storage		Bedding	2.0	3.0	6.0
Hide	37	Relationship&Entertainment		Visiting (1~2)	1.5	4.0	6.0
Hide	38	Storage		Out-of- season Clothes	1.5	3.7	5.5
Remove	39	Storage		Other	2.0	2.3	4.7
Hide	40	Storage		Medical	1.5	3.0	4.5
Attach	41	Relationship&Entertainment		Gaming	3.0	1.3	4.0
Hide	42	Storage		Collections	1.0	3.7	3.7
Remove	43	Customized Functions		Home Exercising	2.0	1.0	2.0
Remove	44	Customized Functions		Pet	0.0	1.0	0.0

Table 4. 5 Strategy Form

4.3.1.2.1 Arrange

Arrange	1	Resting		Sleeping
	2	Food&Drink	Preparing	Re-heating
	3	Food&Drink	Eating & Drinking	Dining
	4	Food&Drink	Preservation	Preservation
	5	Sanitation	Bodily	Toilet
	6	Sanitation	Bodily	Face/Hand
	7	Sanitation	Bodily	Tooth
	8	Safety		Electricity Safety
	9	Health		Ventilation
	10	Health		Air Conditioning
	11	Health		Lighting
	12	Sanitation	Bodily	Shower/Bath
	13	Storage		In-season Clothes
	14	Safety		Physical Safety
	15	Health		Auditory
	16	Relationship&Entertainment		Online (SSN)
	17	Sanitation	Items	Kitchenware/Tableware
	18	Personal Appearance		Make Up
	19	Personal Appearance		Dress Up
	20	Food&Drink	Preparing	Cooking
	23	Storage		Shoes
	25	Learning&Working		Computer-based
	26	Sanitation	Items	Clothes
	27	Storage		Ornaments
	28	Storage		Bags
	30	Resting		Relaxing
	33	Learning&Working		Paper-based

Table 4. 6 "Arrange" List

As Table 4.5 shows, all tasks for “Arrange” strategy are listed. Designer can arrange them in the space one by one in order.

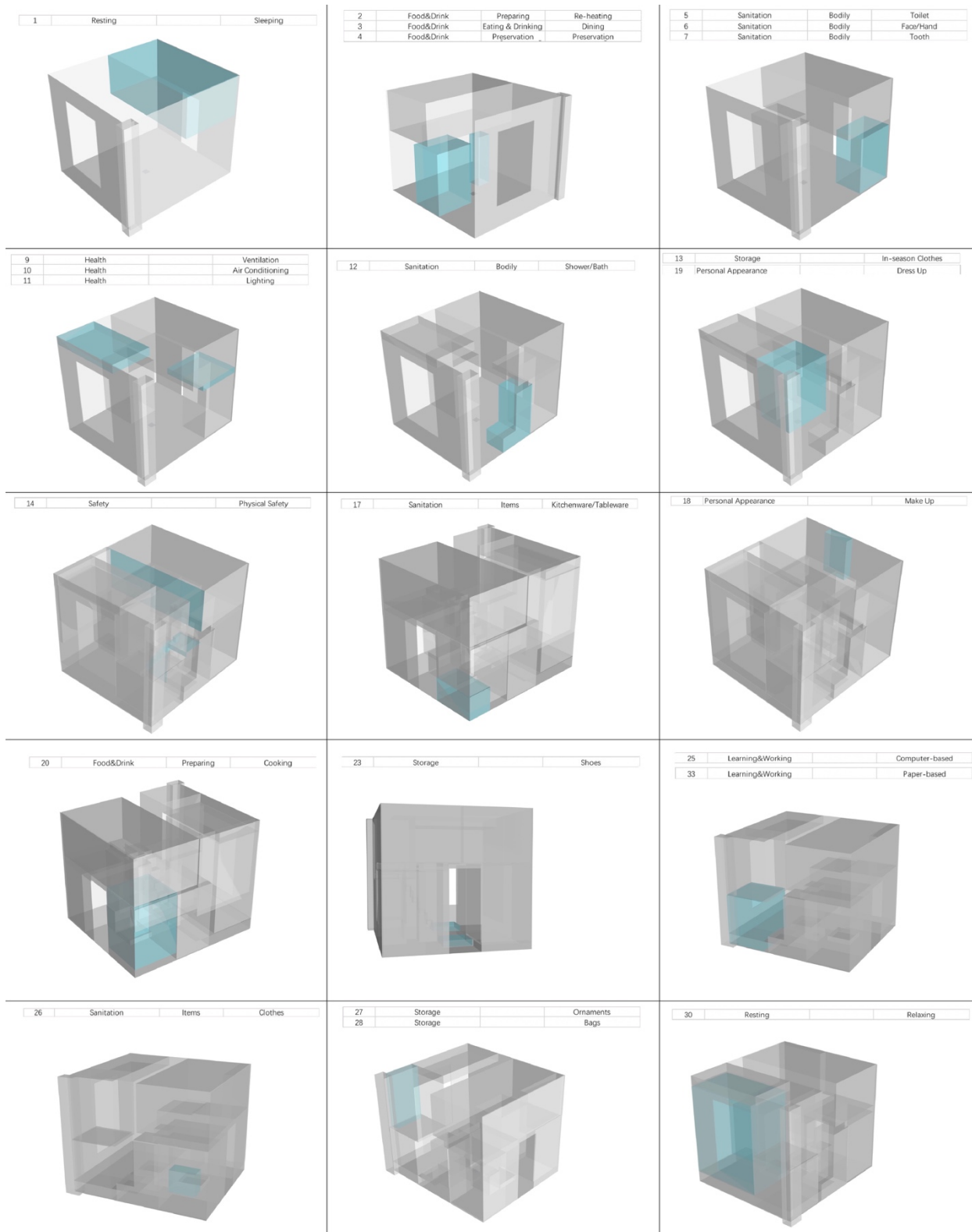


Figure 4. 4 Process of Arrange

Note:

1. Some functions seem to overlap together. This situation is allowed if designer makes sure that the low-priority function does not interfere the high-priority one.
2. Due to the limitations of objective conditions, some of these functions are omitted in the process, such as electricity safety and auditory health.
3. As Chapter 3 suggested, it is possible that some of them are not suitable for this strategy since the four-quadrant matrix just works as an advice. For example, the order 16 in the list is online socialization, which cannot be solved here. Designer can choose another strategy or keep it in the Waitlist temporarily.

4.3.1.2.2 Hide

Hide	32	Sanitation	Environment	Cleaning
	35	Relationship&Entertainment		Guesting (6~7)
	36	Storage		Bedding
	37	Relationship&Entertainment		Visiting (1~2)
	38	Storage		Out-of-season Clothes
	40	Storage		Medical
	42	Storage		Collections

Table 4. 7 "Hide" List

The functions listed in Table 4.6 are for “Hide”.

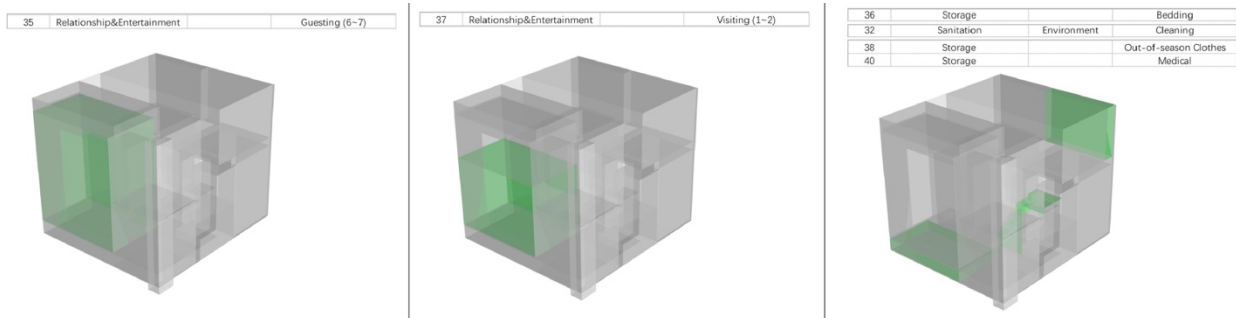


Figure 4. 5 Process of Hide

Note: As user required that the collections should presented to guests and herself, it is not suitable to hide it but, instead, to attach.

4.3.1.2.3 Attach

Attach	21	Storage		Kitchenware/Tableware
	22	Storage		Bath&Body Essentials
	24	Customized Functions		Music
	29	Customized Functions		Digital Drawing
	31	Storage		Books
	34	Relationship&Entertainment		Watching Veideos
	41	Relationship&Entertainment		Gaming

Table 4. 8 "Attach" List

The functions listed in Table 4.7 are for “Attach”.

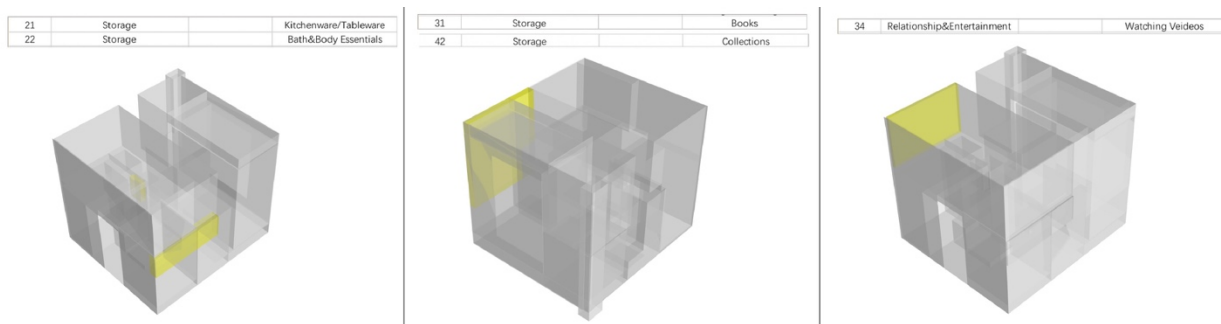


Figure 4. 6 Process of Attach

4.3.1.2.1 Remove

Remove	39	Storage		Other
	43	Customized Functions		Home Exercising
	44	Customized Functions		Pet

Table 4. 9 "Remove" List

The three functions listed in Table 4.9 are located in the fourth quadrant, “Remove” zone. However, before the removing, as the approach indicates, it should be judged if keeping the function could improve user’s satisfaction. In this case, the order 39, other storage meet this criterion so that it can be kept and combined with previous storage functions.

By checking the functions list, there is a waitlist at this point as Table 4.10 shows. In addition, partitions and connections will be illustrated in detail in the following design concepts.

Waitlist	16	Relationship&Entertainment		Online (SSN)
	24	Customized Functions		Music
	29	Customized Functions		Digital Drawing
	41	Relationship&Entertainment		Gaming

Table 4. 10 Function Waitlist

4.3.2 Feature Developing

Since there are many features involved in the whole space, this section only takes four examples to represent four kinds of features respectively.

4.3.2.1 Reverse Feature

The user mentions that she does not like the outlet of air conditioner straight to bed area. Thus, air outlet of the air conditioner ought to not only meet the temperature control of the bedroom area with a higher position, but also not to directly face the bed.

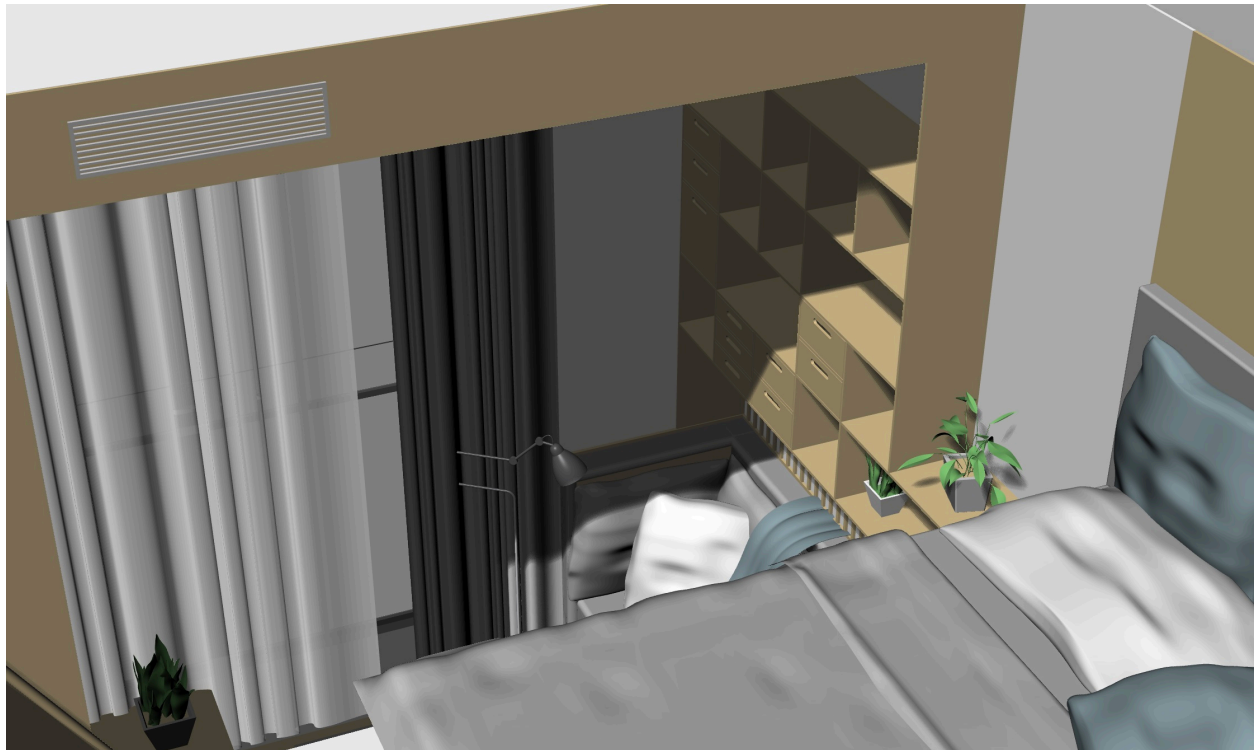


Figure 4. 7 Reverse Feature Example

4.3.2.2 Performance Feature

The user requires as performance attribute that she wants a full-length mirror in dressing area.

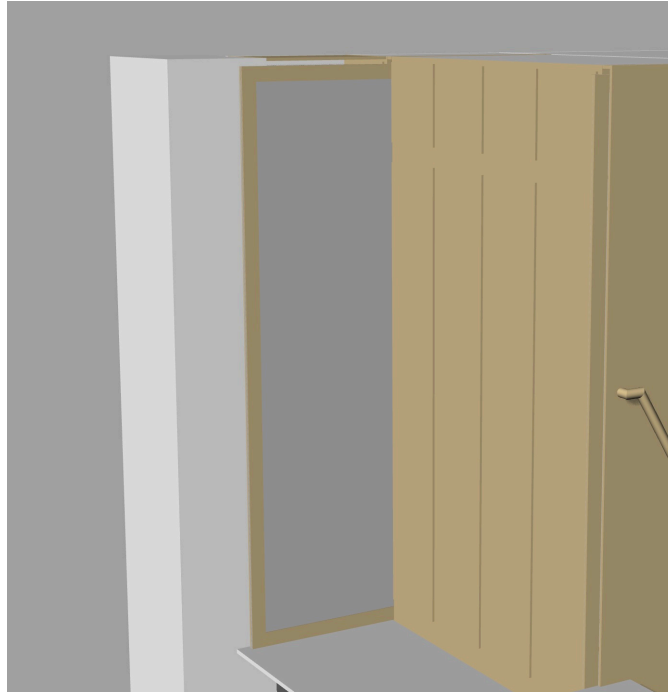


Figure 4. 8 Performance Feature Example

4.3.2.3 Delight Feature

The user wants queen size bed and would feel even satisfied if she has a king size bed. To improve the satisfaction, the size of bed is 1800 mm, which is a large wide bedding area for this size of space.



Figure 4. 9 Delight Feature Example

4.3.2.4 Indifferent Feature

For the entire layout, the designer asks if a loft bedding area is acceptable. This is an indifferent feature for the user.



Figure 4. 10 Indifferent Feature Example

4.3.3 Space Refining

In Space Refining step, there are three main tasks:

1. Visual Unifying: The user mentioned in Human Research section that she likes Simplicity and New Chinese Style. The designer gets inspiration from traditional oriental grilles (Figure 4.11) and decides to use a simplified version on doors and partitions in order to meet the aesthetic needs of user.



Figure 4. 11 Oriental Grilles (home.ifeng.com, 2016)

2. Corner Space: For corner like space under the stairs, designer build drawers there so that the storage functions have been even improved.
3. Waitlist

Waitlist	16	Relationship&Entertainment		Online (SSN)
	24	Customized Functions		Music
	29	Customized Functions		Digital Drawing
	41	Relationship&Entertainment		Gaming

Table 4. 11 Function Waitlist

As the four functions in Waitlist are able to be implemented by the user herself, the designer decides to leave freedom and possibility for self-participating space design.

4.4 Close

As this is a virtual design case, there is no construction phase. Instead, I will move to prototype phase and make a 1/12 scaled model.

4.5 Design Concept

4.5.1 Digital Model and Renderings



Figure 4. 12 Top View

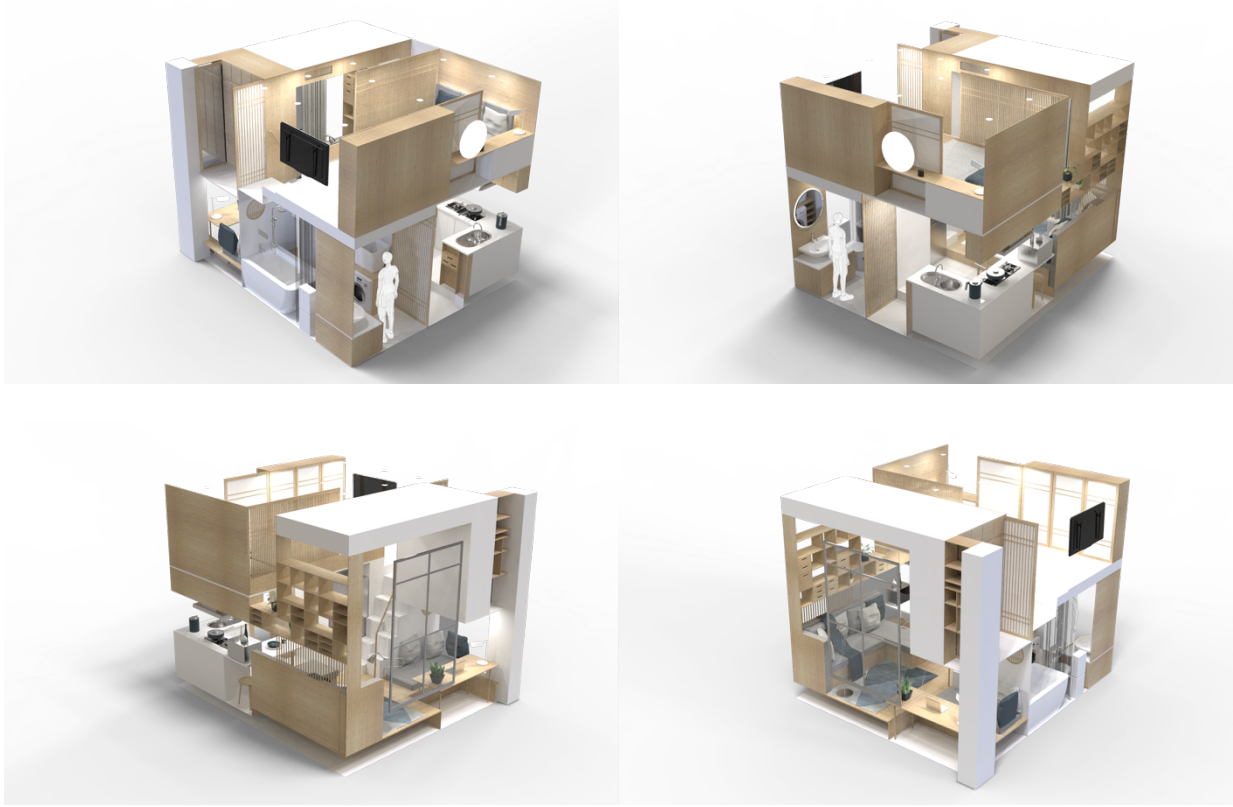


Figure 4. 13 Overviews

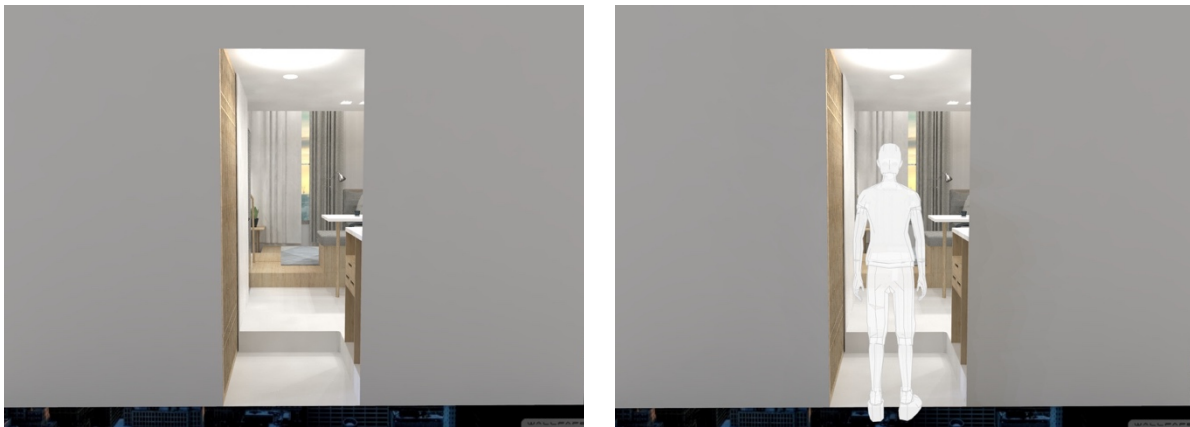


Figure 4. 14 Entry



Figure 4. 15 Kitchen and Dining Area



Figure 4. 16 Bathroom



Figure 4. 17 Bathroom (with Human Scale)



Figure 4. 18 Relaxing Area



Figure 4. 19 Stairs and Working Area



Figure 4. 20 Dressing Area



Figure 4. 21 Bedding Area



Figure 4. 22 Making-up Area and Bedside Table



Figure 4. 23 Television (Lying-on-bed View)



Figure 4. 24 Partition



Figure 4. 25 Connection (for Laundry)

4.5.2 Prototype Photos



Figure 4. 26 Prototyping Process

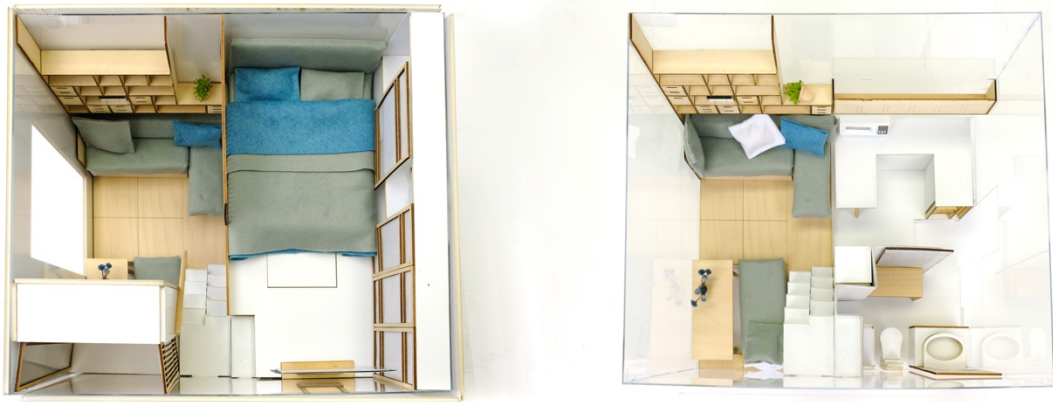


Figure 4. 27 Model Top View

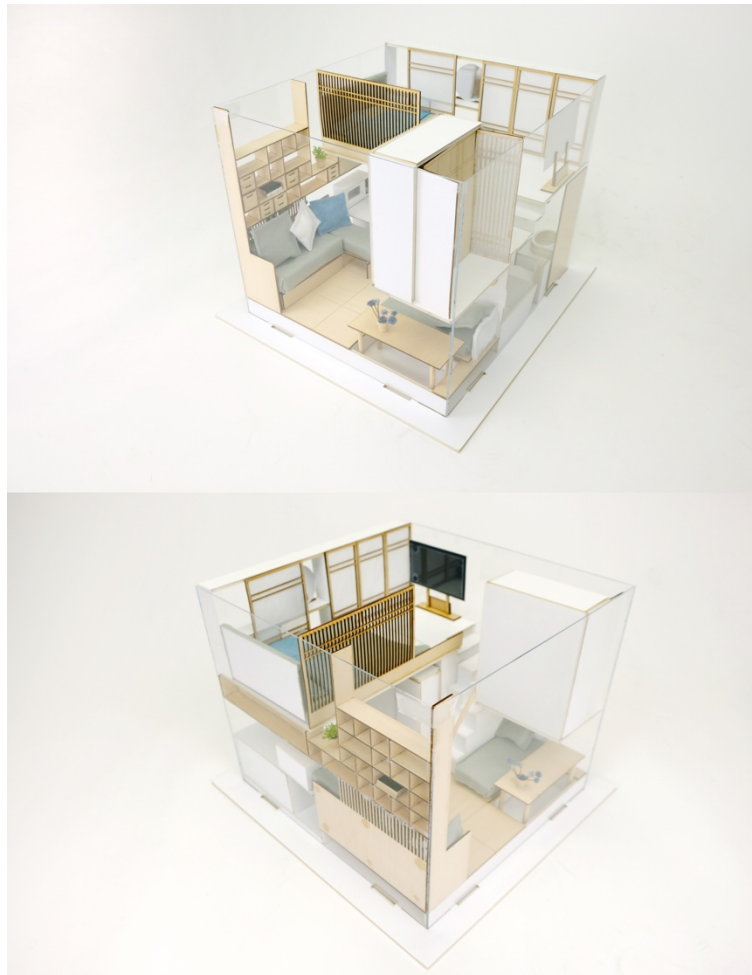


Figure 4. 28 Model Over View



Figure 4. 29 Guest Bed Function (Hide)



Figure 4. 30 Guesting Function (Hide)



Figure 4. 31 Other Details

Chapter 5 Conclusion

5.1 Conclusion

The intention of this thesis was to help young people live better lives in their small living space. Designers can implement users' multiple needs and improve their satisfaction with this approach. The value of this approach is mainly in two aspects:

1. Designers fully understand and analyze the user's needs at the early stage, and start to design with the needs management and organization. In this way the relationship of space and needs is getting even closer and clearer so that the space can serve the user better. The design behavior is goal-oriented and directly responsive to needs.
2. The approach uses the frequency-importance model as a bridge between requirements and functions, and introduce the concept of 4D space design and temporal distribution to inspire designers to explore more possibilities.

5.2 Further Development

Besides small living space, this approach probably can be applied to other kinds of space that are larger or for more residents to live in, which could be the direction in future development. During the process of Application, it is found that the needs should be defined more reasonably. Meanwhile, another problem, how to combine psychological emotional needs with physical needs organically, is also the possible development direction for this approach in the future.

References

- Arnett, J. J. (1997). *Young People's Conceptions of the Transition to Adulthood*. *Youth & Society*, 29(1), 3–23. [doi:10.1177/0044118X97029001001](https://doi.org/10.1177/0044118X97029001001)
- Ashton, Izzy. (2016). *Le Corbusier's Cabanon seaside cabin is his smallest building on the World Heritage List*. Retrieved from: <https://www.dezeen.com/2016/07/20/le-corbusier-french-holiday-home-cabanon-17-buildings-unesco-world-heritage-list/>
- Beatty, Lee A. (2002). *Developmental Counseling: The Young Adult Period. Critical Issues in Young Adult Development*. Distributed by ERIC Clearinghouse.
- Brown, D. J., Badanes, S., & Southeastern Center for Contemporary Art. (2004). *The HOME House Project: The future of affordable housing*. Winston Salem: Southeastern Center for Contemporary Art.
- Collins, P., Scruton, R., Gowans, A., & Ackerman, J. S., (2018). *Architecture.*, Published by Encyclopædia Britannica, Retrieved from: <https://www.britannica.com/topic/architecture/Planning-for-use#ref405527>
- Crain, William. (2011). *Theories of Development: Concepts and Applications (6th ed.)*. Upper Saddle River, NJ: Pearson Education, Inc. ISBN 978-0-205-81046-8.
- DESIGNSORI CO. (2019). *Zen and Spa Center*. Retrieved from: <http://asiadesignprize.com/exhibition/49941>
- Druta, O., Limpens, A., Pinkster, F.M. & Ronald, R. (2018). *Early adulthood housing transitions in Amsterdam: Understanding dependence and independence between generations*. *Popul Space Place*. doi:10.1002/psp.2196

- Environmental Protection Agency (EPA). (2009). Buildings and their impact on the environment: A statistical summary. Retrieved from:
<http://www.epa.gov/greenbuilding/pubs/gbstats.pdf>
- Ford, J. & Gomez-Lanier, L. (2017). *Are Tiny Homes Here to Stay? A Review of Literature on the Tiny House Movement*. *Fam Consum Sci Res J*, 45: 394-405. doi:10.1111/fcsr.12205
- Grosemans, I., Hannes, K., Neyens, J., & Kyndt, E. (2018). *Emerging Adults Embarking on Their Careers: Job and Identity Explorations in the Transition to Work*. *Youth & Society*. doi: 10.1177/0044118X18772695
- Hildner, C. (2011). *Small houses: contemporary Japanese dwellings*. Basel: Birkhäuser.
- Holland, J.L. (1992). *Making Vocational Choices: A Theory of vocational Personalities and Work Environments (2nd Ed.)*. Odesa, FL: Psychological Assessment Resources.
- Homeli.co. (n.d.). *Convertible Shelf / Table from Dot & Bo*. Retrieved from:
<http://homeli.co.uk/convertible-shelf-table-from-dot-bo/>
- Jordan, P. W. (2000). *Designing pleasurable products: An introduction to the new human factors*. London: Taylor & Francis.
- Kano, Noriaki. et al. (1984). *Attractive quality and must-be quality*. *Journal of the Japanese Society for Quality Control* (in Japanese).
- Kaufmann, Carol. (2015). *Tiny Houses Are Becoming a Big Deal*. Retrieved from:
<https://www.aarp.org/livable-communities/housing/info-2015/tiny-houses-are-becoming-a-big-deal.html>

- Kulp, Kayleigh. (2017). *Tiny houses grow in popularity, yet drawbacks abound*. Retrieved from:
<https://www.cnn.com/2017/02/02/tiny-houses-grow-in-popularity-yet-drawbacks-abound.html>
- Lee, E., Allen, A., & Kim, B. (2013). *Interior design practitioner motivations for specifying sustainable materials: Applying the theory of planned behavior to residential design*. *Journal of Interior Design*, 38(4), 1– 16.
- Lidwell, W., Holden, K., Butler, J., & Elam, K. (2010). *Universal principles of design: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design*. Published by Rockport Publishers.
- Lind, Carl. (2017). Assessment and design of industrial manual handling to reduce physical ergonomics hazards – use and development of assessment tools.
10.13140/RG.2.2.20231.91044.
- Mack, L. (1988). *Conran's living in small spaces*. Boston: Little, Brown.
- Mackie, K. P. (2016). *Young people and housing: identifying the key issues*, *International Journal of Housing Policy*, 16:2, 137-143, DOI: 10.1080/14616718.2016.1159273
- Maslow, A. H. (1987). *Motivation and personality* (3rd ed.). Delhi, India: Pearson Education.
- MBASKool.com. (n.d.). *Need Satisfaction Selling*. <https://www.mbaskool.com/business-concepts/marketing-and-strategy-terms/12218-need-satisfaction-selling.html>
- McCarthy, M. W., & Moore, K. H., (2013). *Posture: a study of the evolution of furniture design and its influence on architectural spaces*. Auburn, Alabama: Auburn University.
- McLeod, S. A. (2017). *"Erik Erikson"*. Simply Psychology. Retrieved from
<https://www.simplypsychology.org/Erik-Erikson.html>

- McLeod, S. A. (2018). *Maslow's hierarchy of needs*. Retrieved from <https://www.simplypsychology.org/maslow.html>
- Miller, S., & Schlitt, J. K. (1985). *Interior space: Design concepts for personal needs*. New York: Praeger.
- Mitchell, R. (2014). *Tiny house living: ideas for building and living well in less than 400 square feet*. Cincinnati, Ohio: Betterway Home.
- Moreman, J. B., & Lau, T., (2015). *Guidelines to change the cultural paradigms of designers toward third world people groups through missiology to influence furniture design*. Retrieved from <http://hdl.handle.net/10415/629>
- Munagavalasa, Chandra. (2014). *Excite and Delight Your Customers by Using the Kano Model*. Retrieved from: <https://www.agileconnection.com/article/excite-and-delight-your-customers-using-kano-model>
- N.D. (2019). *18 Square Meters Minimal LOFT Apartment, How to Decorate Practical, Comfortable and Warm?* Retrieved from: <https://www.zhihu.com/question/327967085>
- N.D. (n.d.). *Vertical Mount Deluxe Murphy Bed Hardware*. Retrieved from: <https://www.rockler.com/deluxe-murphy-bed-kits-vertical-mount>
- Naciri, J. (2017). *Not Your Father's Retirement: Three Ideas That Are Reinvigorating the Next Stage*. Realty Times. Retrieved from: <http://www.luxuryonthehudson.com/real-estate-news/not-your-fathers-retirement-t-.htm>
- Noe, R. (2012). He Mu and Zhang Qian's Sunflower Chair. Retrieved from: <https://www.core77.com/posts/23382/he-mu-and-zhang-qians-sunflower-chair-23382>

- Nyström, S. (2009). The dynamics of professional identity formation: Graduates' transitions from higher education to working life. *Vocations and Learning*, 2, 1-18.
doi:10.1007/s12186-008-9014-1
- Prowler, D. (1985). *Modest mansions: design ideas for luxurious living in less space*. Emmaus, Pa.: Rodale Press.
- Richardson, P. (2011). *Nano house: innovations for small dwellings*. London: Thames & Hudson, Inc.
- Schaer, Walter. (1970). *De-sign*. Published by Auburn Design.
- Seoul Institute. (2018). *Seoul and the world metropolis: a comparison of urban changes after the millennium*. Retrieved from: https://www.thepaper.cn/newsDetail_forward_1997716
- Shafer, P., & Weiner, J., (1984). *Small space design: remodeling apartments for multiple uses*. New York, N.Y.: Van Nostrand Reinhold.
- Smith, N. (1995). *Small space living: design*. Washington, D.C.: Distributed to the book trade and art trade in the U.S. by the American Institute of Architects Press.
- Statistics Norway. (2017). *One in ten live in a crowded dwelling*. Retrieved from: <https://www.ssb.no/en/bygg-bolig-og-eiendom/artikler-og-publikasjoner/one-in-ten-live-in-a-crowded-dwelling>
- Super, D. E. (1980). *A Life-span, Life-space Approach to Career Development*. *Journal of Vocational Behavior* 16:282-298.
- Thøgersen, Kristoffer. (2017), *Small spaces need smart solutions Designing furniture for small spaces, in connection with human wellbeing*. Retrieved from: https://www.ntnu.edu/documents/139799/1279149990/31+Article+Final_krithog_fors%C3%B8k_2017-12-07-22-08-50_TPD4505+-+Designteori+-

+Small+spaces+need+smart+solutions+-+Kristoffer+Th%C3%B8gersen.pdf/11a2f430-986b-4da8-9b44-14b204436e01

Vanvuren, Christina. (2017), *Apartment Living & Healthy Air: Problems You May Not Know About*. Retrieved from: <https://molekule.com/blog/apartment-living-healthy-air-problems-may-not-know/>

Vege sack, A. von., Eisenbrand, J., & Deutscher Z., (2006). *Open house: architecture and technology for intelligent living*. Weil am Rhein: Vitra Design Stiftung.

Widick, C., Parker, C. A. and Knefelkamp, L. (1978), *Erik Erikson and psychosocial development*. New Directions for Student Services, 1978: 1-17.

Wilson, L. (2014). *How big is a house? Average house size by country*. Retrieved from: <http://shrinkthatfootprint.com/how-big-is-a-house>

Zhang, J. (2016). *Survey report on housing status and purchase attitude of urban youth*. Retrieved from: <http://news.qq.com/cross/20161202/tw0K1q74.html>

Игумнова, Е. (2016). *Is our furniture getting bigger? Yes. Here's why*. Houzz. https://www.houzz.com.au/ideabooks/696514_06/list/is-our-furniture-getting-bigger-yes-heres-why