

Residential Space Planning Reflecting User Preferences Utilizing Big Data -focused on Newlywed Households

Jae Hee Chung^{*1}, Seung Yeob Baek², Changse Kim³, In Hyo Yeo⁴

^{*1}Associate Professor, Dept. of Architecture, Hongik University, 2639, Sejong-ro, Jochiwon-eup, Sejong City, 30016, Korea

²Dept. of Architecture, Hongik University, 2639, Sejong-ro, Jochiwon-eup, Sejong City, 30016, Korea

³Dept. of Architecture, Hongik University, 2639, Sejong-ro, Jochiwon-eup, Sejong City, 30016, Korea

⁴CEO, 4Goodcompany, 401-2, Guksecheong-ro 4, Sejong City, 30128, Korea

archijenny@gmail.com^{*1}, psy10042@naver.com², kimchangse@naver.com³, yeoinhyo@gmail.com⁴

Article Info

Volume 83

Page Number: 3970 - 3981

Publication Issue:

March - April 2020

Abstract

Background/Objectives: This study intends to propose a residential space planning approach that reflects user preferences focused on newlywed households, utilizing big data

Methods/Statistical Analysis: This study develops a methodology to derive user-customized residential planning by collecting and analyzing big data. Through precedent research and theoretical consideration, this paper analyzes the characteristics of newlywed households and residential space planning factors according to their preferences. Then, by collecting big data, users' life styles and preferred space types are analyzed and user preference categories are derived. In the conclusion, user-customized housing models are proposed.

Findings: Based on the analysis of the characteristics of newlywed households and user preferences according to life style and life cycle, a system is configured comprising parameters that can be combined according to the user preferences of newlywed households. The prototypes are developed for three stages: a newlywed couple, a couple with an infant, and a couple with a toddler. The user-customized housing prototypes are suggested according to the life style and life cycle of residents. Much research has been published on the topic of housing for newlywed households, but there have been few integrated studies that propose flexible housing plans that adapt to their life types. This study is distinct from previous studies as it presents residential space models reflecting user preferences according to the life style and life cycle of newlywed households.

Improvements/Applications: It is expected that the results of this study can be expanded, and prototypes customized for other users such as young people will be suggested in the future.

Keywords: user preferences, residential space, planning, big data, newlywed

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 26 March 2020

1. Introduction

According to the rapid flow of data in the information age, approaches considering actual users are becoming necessary. Moreover, in the era of declining populations, housing that corresponds to users' life styles and changes in

family composition has become an issue. Understanding user needs and the characteristics of housing types preferred by them is important to provide user-customized housing. Therefore, this study collects big data on user preferences to derive user-customized housing plans and utilize

them as basic data applicable to actual plan in the future.

2. Methods

The scope of the research sets the target users as newlywed households in Korea for whom residential planning according to their life style and life cycle does not sufficiently reflect their needs.

The research process is as follows. First, through

a literature review and theoretical research, the characteristics of newlywed households and residential space planning factors according to user preferences are analyzed; second, by collecting big data, users' lifestyles and preferred space types are analyzed and user preference categories derived; third, based on the previous process, a residential space system is configured, and user-customized residential space models are proposed, as shown in Figure 1.

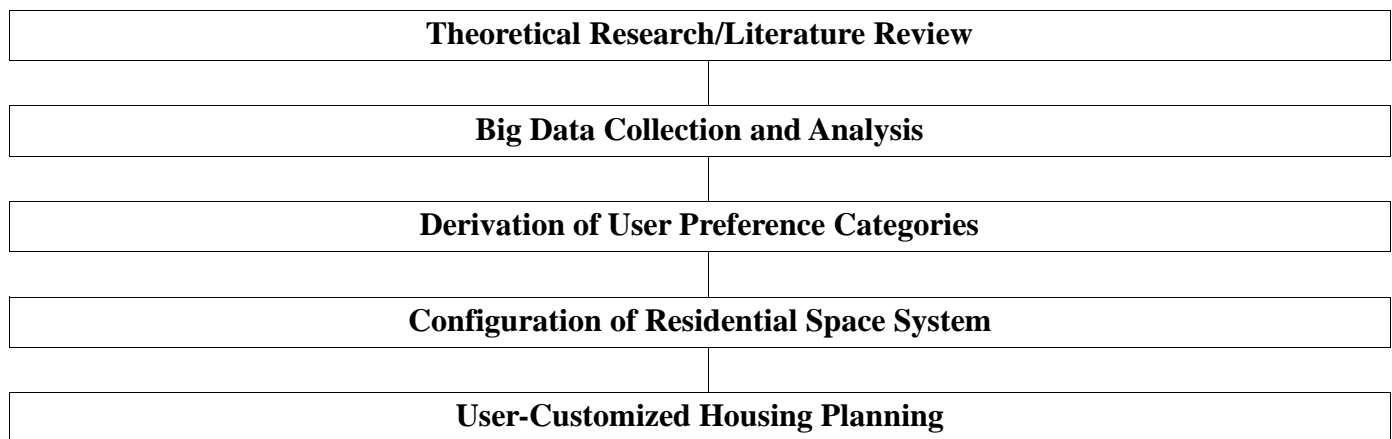


Figure 1. Research Methods and Process.

3. Results

3.1. Theoretical Research and Literature Review

• Big Data Concept and Application

Gartner defined big data as high-volume, high-velocity, and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision-making. In short, the characteristic of big data can be defined as volume, velocity, and variety [1]. In 2012, IBM added “veracity” to the list of characteristics to highlight the importance of uncertainty, error, or other issues

in the data [2]. By 2016, “value” was also being included by IBM. The attributes of big data are indicated below in figure 2.

Given this flow, the value of big data may go beyond big data in and of itself. What can be done using big data and the value that can be created is important. The value of big data is not just a collection of information, but also the development of a customized service model and further connection with the realization of a happy society [3]. Therefore, the present study also aims to create value in user-customized housing planning by collating big data on user preferences.

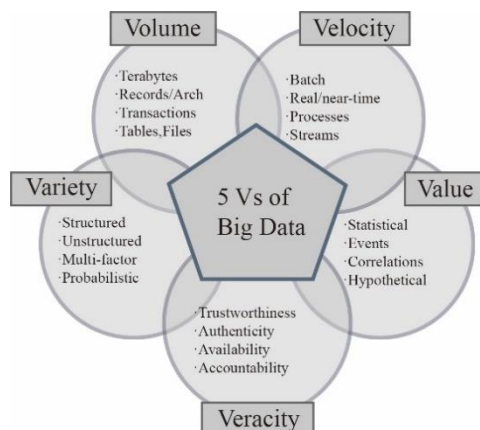


Figure 2. 5 Vs of Big Data.

• Characteristics of Newlywed Households

Newlyweds whose length of marriage is less than seven years are mostly in their 20s and 30s. As a cultural leader, this group has clear individual and collective value systems, which makes them respond to lifestyle changes sensitively. In recent years, this generation's lifestyle trend has shifted toward valuing work-life balance and the pursuit of healing, leisure time, self-improvement, and modest but certain happiness. Newlywed households generally place an emphasis on family and work life, leisure activities, the necessities of life, shopping, and media activities. In this regard, a study classified their lifestyles in the categories of self-improvement-oriented, convenience/leisure-oriented, family-oriented, and benefit-oriented [4]. Another study divided their lifestyles into the pursuit of self-expressing trends, the pursuit of convenience and ostentation,

the pursuit of psychological trends, the pursuit of practicality and thrift, and the pursuit of well-being [5]. With increases in dual-income couples, the “You live only once (YOLO)” Tribe, and the “double income, no kids (DINK)” Tribe who have no plans to have children, the lifestyles of newlyweds who are mostly young people show increasingly various trends. Therefore, floor plans that can meet newlyweds' various needs should be considered. In relation to this, alpha rooms are emerging as a new trend in the recent apartment market. In their initial stage, alpha rooms were merely a spare space in the corner of a living room or kitchen to be used as an extra storage area. However, with increases in those who want “my own space,” alpha rooms are increasingly being used as spaces for hobbies, rest, and childcare, to accommodate newlyweds' diverse lifestyles as shown in figure 3.



Figure 3. Alpha Room at Suwon Gwon Apartment.

The life cycles of newlywed households can be adjusted to fit the scope of their children's childhood. According to Korea's Nursing Unabridged Dictionary, those in childhood comprise infants and toddlers. Infants are babies from birth to 12 (or 18) months of age who require breastfeeding. Toddlers are children from post-infancy to preschool age (five or six years old).

In the planning of residential space in newlywed households, a study showed that communal spaces were most important, and in terms of the demand for spare rooms, rooms for prospective newborn babies and studies exhibited high demand [6]. During the infant-parenting period, spaces are required for parents and children to continue childcare activities together. In addition, residential planning for this period should enable play activities during the hours when infants are active as well as physiological activities, such as eating and napping. In the toddler-parenting period, children's learning activities begin. Thus, spaces for learning activities and independent play should also be taken into account in planning [7]. A common residential plan for the infant- and toddler-parenting periods is to arrange couples' bedrooms and their children's space to be in close proximity or open to each other for greater accessibility in consideration of parents' childcare and contact with children as well as children's sleep [8]

• Residential Space Planning Factors According to User Preferences

To meet varied life styles according to the times, from the residential space planning stage, it is necessary to plan spaces that can respond to newlywed households' needs for a cultural life and their diverse lifestyles. Such needs should be

arranged through the planning of spaces such as an alpha room, spaces that can help storage, hobbies, and childcare in reflection of newlywed households' needs. Newlywed households, which account for at least 80% of the country's childbirths, represent a group who experience a clear change in numbers of family members. In this sense, residential floor plans developed according to the group's life cycle should be diversified by reflecting childbirth and childcare. Specifically, user-customized residential floor planning is necessary according to the life cycle of family formation, infant-parenting, and toddler-parenting.

With regard to newlywed households' preferred residential areas, 20 to 30 pyeong accounted for 24% and 30 to 40 pyeong took up 40%. In addition, approximately 60% of women after childbirth focused on raising their children, discontinuing economic activity. This signifies the need for space planning that can support childcare and newlywed households that raise children. As to the importance of space after childbirth, bedrooms (34%) and children's rooms (34%) were equally important. Of the floor plans for newlywed households, the plans for bedrooms and children's rooms were important, and newlyweds spent a considerable amount of time in their bedrooms and children's rooms within their residential spaces. Storage (31%) was the most important feature of space planning. In terms of preferences for the use of alpha rooms, dress rooms were the most preferred at 63% [9]. This is probably because in the family formation stage, many storage spaces are required. Based on this, the elements of residential space planning according to the life styles and life cycles of newly-married families are presented in table 1.

Table 1. Residential Planning Factors Considering the Life Style and Life Cycle of Newlywed Households.

	Residential Planning Factors		
Life Style	Parenting, Education	Hobby	Storage
	<ul style="list-style-type: none"> · Infant's room · Toddler's room · Toy room · Study room 	<ul style="list-style-type: none"> · Fitness room · Music room · Game room · Movie room 	<ul style="list-style-type: none"> · Dress room · Collection room · Pantry
Life Cycle	Family Formation	Parenting Period of Infant	Parenting Period of Toddler
	<ul style="list-style-type: none"> - Couple's marriage life without children - Hobby/work/storage room according to user preferences 	<ul style="list-style-type: none"> - Infant needs 24-hour care - Connect infant room and couple's room without a door 	<ul style="list-style-type: none"> - Separate couple's room and toddler's room - Provide a toddler with independent learning, play, sleeping space.

3.2. User-Customized Housing Planning

Customization refers to "providing information based on user preferences and situational customization based on active user participation while taking into account the characteristics of the user". This study proposed a methodology for user-customized residential plan by in-depth analysis of users in consideration of users' behaviors and situation utilizing big data. [10].

• Big Data Collection and Analysis

Based on the analysis of the preliminary study conducted earlier, keywords drawn from collating the first set of big data were combined to collate the second set of big data as seen in table 2. The results of the Word2Vec and Word Cloud analyses in table 3 were analyzed to apply them to residential space modeling. The data collection period was from January 1, 2013 to December 31, 2018, and data was collected by crawling using the Twitter API.

According to the Word2Vec analysis, keywords such as Happiness Housing, New Stay, life style, DIY furniture, prefabricated furniture, self-interior, baby, toddler, alpha room, health room, dress room, and three rooms were derived. From the Word Cloud analysis, keywords such as Happiness Housing, self-interior, self-development, childcare, Infant, education, life






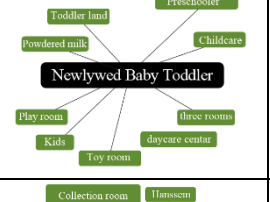

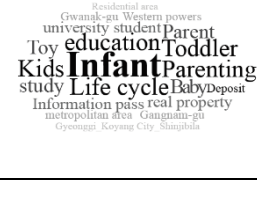




cycle, well-being, hobby room, storage, built-in, DIY, and three rooms were derived.

The fact that keywords such as Happiness Housing and New Stay had high frequencies in relation to newlywed households suggests that economic feasibility is important for housing selection. While keywords such as DIY, prefabricated furniture, and self-interior are associated with economic feasibility, they may also be linked with self-development for newlyweds as a unique generation. Keywords such as self-development, workplace, telecommuting show individual and collective value systems of newlyweds as mentioned. Keywords such as toddler, Infant, childcare, parenting and education also indicate the characteristics of newlywed households whose lifestyle emphasizes childbirth, childcare, and education. Moreover, keywords such as well-being, hobby room, health room, and alpha room represent the new generation's life style, which values hobbies and leisure time. Keywords such as storage, dressing room, and built-in point to the need for ample space during the family formation and childcare stages. An interesting point is that keyword of "three rooms" was drawn from both analyses. This may indicate the preference for an alpha room that can function as "my own room" alongside the consideration of childbirth and childcare.

Table 2. Keywords for Big Data Collection.

Big Data Collection and Analysis			
Keywords for Big Data Collection			
<ul style="list-style-type: none"> · Newlywed – Life Cycle · Newlywed– Infant · Newlywed– Toddler · Newlywed– Self-development · Newlywed – Three Rooms 	<ul style="list-style-type: none"> · Newlywed– Life Style · Newlywed – Education · Newlywed – Storage · Newlywed – DIY– Furniture · Newlywed – Prefabricated Furniture 	<ul style="list-style-type: none"> · Newlywed – Happiness Housing · Newlywed – New Stay · Newlywed – Hopetown · Newlywed – Well-being · Newlywed – Self-Interior 	<ul style="list-style-type: none"> · Newlywed – Parenting · Newlywed – Built-in · Newlywed – Hobby · Newlywed – Alpha Room · Newlywed – Dress Room

Table 3. Big Data Analysis.

Word2Vec Analysis of Big Data a technique to select the keywords in documents and quantify them		Word Cloud Analysis of Big Data a technique to highlight keywords to intuitively identify the keywords and concepts of documents					
1		2		1		2	
3		4		3		4	
5		6		5		6	

• Configuration of Residential Space System

Based on the earlier preliminary study and big data analysis, the categories of user preferences were produced. Broadly, user preferences were

categorized into housing type, residence type, area (number of rooms), life style, and life cycle. The selection and combination of parameters were then conducted according to these categories as shown in figure 4.

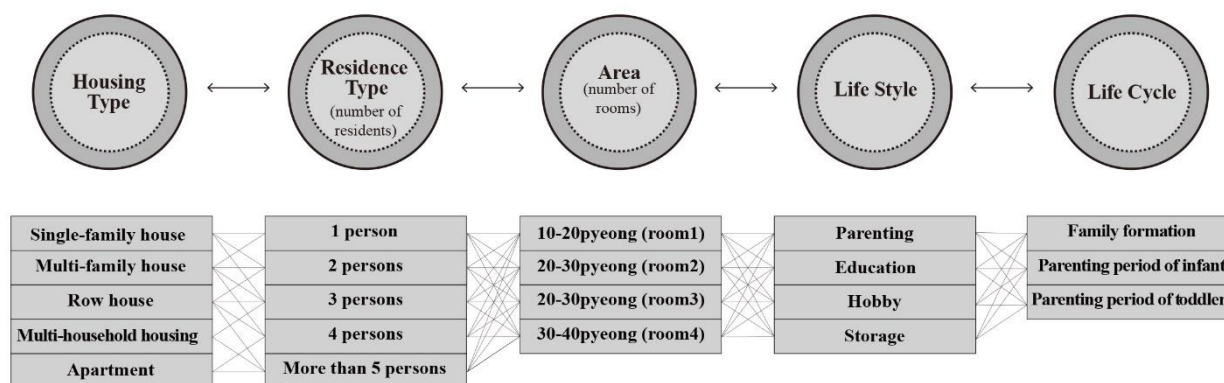


Figure 4. Combination of Parameters According to User Preference Categories.

Then, a residential space system was configured based on the big data analysis. To support the variability of residential spaces, the size of one module was set at 3m x 3m based on the transportable sizes of the low-bed trailer and 5t truck. Moreover, the system's configuration for each user was set at 6, 8, 9, and 12 modules in consideration of the newlyweds' preferred pyeong-based areas identified earlier. According

to newlywed households' lifestyles and their life cycles depending on the presence of children, the overall life cycle of newlywed households was divided into the family formation stage, the infant-parenting stage (couple + infant), and the toddler-parenting stage (couple + toddler), and then their residential space system was proposed as presented in table 4.

Table 4. Residential Space System.

Residential Modules		Stages	S1 (couple)	S2 (couple+infant)	S3 (couple+toddler)
		Unit Types	6M-1-a (self-development)	6M-1-b (infant care)	6M-1-c (toddler care, self-development,)
6-1 modules (54m²)	6-2 modules (54m²)		6M-2-a (self-development)	6M-2-b (infant care)	6M-2-c (toddler care, self-development,)
			8M-1-a (hobby-enhancement)	8M-1-b (infant care, alpha room- enhancement)	8M-1-c (2 alpha rooms, toddler care, alpha room- enhancement)
8 modules (72m²)	9 modules (81m²)		9M-1-a (2 alpha rooms, living room- enhancement)	9M-1-b (2 alpha rooms, infant care, self-development)	9M-1-c (toddler care, master bedroom/ living room -enhancement)
			12M-1-a (3 generations, 3 alpha rooms, self-development)	12M-1-b (3 generations, 3 alpha rooms, infant care, self-development)	12M-1-c (3 generations, 3 alpha rooms, toddler care, living room- enhancement)
12-1 modules (108m²)	12-2 modules (108m²)				


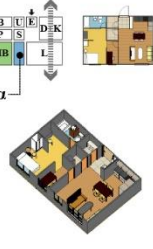





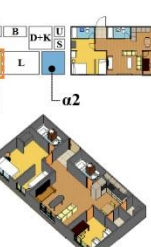




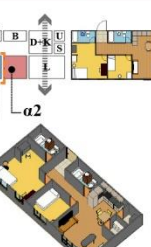


• Residential Space Model


Based on the combination of the categories of user preferences and the residential space system, a residential space data analysis model was developed. A matrix of residence types was formed according to the selected module sizes and types to suit each user's characteristics and their corresponding modules. This was also planned to enable residential spaces to respond flexibly to users' lifestyles and life cycles. The matrix of the residential space data analysis model is outlined in figure 5.


In the family formation stage(S1), according to the life style of newly-married households, the use of alpha room was planned as two types of storage-enhanced and hobby-enhanced. In the case of storage reinforcement, it is used as a space required for storage such as a dress room. In the case of hobby reinforcement types, it is used as a space suitable for the hobbies of newly-married households such as movie room, study room, fitness room, and music room. In the S2 stage when couple and infant live together, alpha room, which is used as an infant room, was planned by connecting the couple's bedroom and


the infant's room without a door in consideration of contact with children and safe parenting. In S3 stage when, child grows up to become toddler, the toddler's is separated from the couple's bedroom by the wall to give independence of each space. The toddler's is an independent child space, which has the functions of a learning space, a play space, and a sleeping space that the child needs.


In the case of 6M and 8M, alpha room is used as one for self-development in S1 stage, and the infant's room is connected to the couple's bedroom without a door in S2. In the S3 stage, the toddler's room and the couple's bedroom are separated to give each space independence. In the case of 9M, two alpha rooms are planned, and in the case of 12M, as three generations living together, three alpha rooms are planned. Alpha room 1 is placed between the master bedroom and the living room and used as a room for self-development (S1) or as an expanded living room or extended master bedroom (S3) depending on the life cycle. The other alpha room is used as hobby / work / storage (S1, S2) or toddler's room (S3).


TYPE		MODULE(AREA)				
Newly weds house holds	Lifestyle	6M-1-a	6M-2-a	8M-1-a	9M-1-a	12M-1-a
	Couple	 <ul style="list-style-type: none"> 1 generation household LDK Integrated Alpha Room : hobby/work /storage according to user preferences 	 <ul style="list-style-type: none"> 1 generation household L+D+K Ventilation-enhanced Alpha Room : hobby/work /storage 	 <ul style="list-style-type: none"> 1 generation household L+D+K Ventilation-enhanced Alpha Room : hobby/work /storage 	 <ul style="list-style-type: none"> 1 generation household L+D+K Ventilation-enhanced 2 Alpha Rooms > α 1 : living room-enhanced > α 2 : hobby/work/storage 	 <ul style="list-style-type: none"> 3 generation household (parents+couple+children) L+D+K Ventilation-enhanced 3 Alpha Rooms > α 1 : master bedroom-enhanced > α 2 : hobby/work/storage > α 3 : Toddler
	Couple + Infant	 <ul style="list-style-type: none"> 2 generation household LDK Integrated Alpha Room : infant connect infant room and couple's room without a door 	 <ul style="list-style-type: none"> 2 generation household L+D+K Ventilation-enhanced Alpha Room : infant 	 <ul style="list-style-type: none"> 2 generation household 2 Alpha Rooms > α 1 : infant > α 2 : hobby/work/storage 	 <ul style="list-style-type: none"> 2 generation household 2 Alpha Rooms > α 1 : infant/living room-enhanced > α 2 : hobby/work/storage 	 <ul style="list-style-type: none"> 3 generation household LDK Ventilation-enhanced 3 Alpha Rooms > α 1 : infant > α 2 : hobby/work/storage > α 3 : hooby/work/storage
	Couple + Toddler	 <ul style="list-style-type: none"> 2 generation household LDK Integrated Alpha Room : toddler provide a toddler with independent learning, play, and sleeping space 	 <ul style="list-style-type: none"> 2 generation household L+D+K Ventilation-enhanced Alpha Room : toddler 	 <ul style="list-style-type: none"> 2 generation household L+D+K Ventilation-enhanced 2 Alpha Rooms > α 1 : master bedroom-enhanced > α 2 : toddler 	 <ul style="list-style-type: none"> 2 generation household 2 Alpha Rooms > α 1 : master bedroom/living room-enhanced > α 2 : toddler 	 <ul style="list-style-type: none"> 3 generation household LDK Ventilation-enhanced 3 Alpha Rooms > α 1 : living room-enhanced > α 2 : hobby/work/storage > α 3 : toddler


 α room


 toddler room


 infant room

 master bedroom

 infant care

 living room-enhanced

 master bedroom-enhanced

 Ventilation-enhanced

L	Living Room - Size : 4500 x 3000	MB	Master Bedroom - Size : 4500 x 3000
D	Dining - Size : 1800 x 1500	R	Bedroom - Size : 3000 x 3000
K	Kitchen - Size : 2100 x 1500	P	Powder Room
E	Entrance - Size : 1200 x 900	B	Bathroom - Size : 2100 x 1800
K+D	Kitchen + Dining - Size : 2400 x 1800	S	Storage - Size : 1500 x 1500
U	Utility Room - Size : 1500 x 1500	α	Alpha Room - Size : 3000 x 1500 ~ 3000
I	Infant	T	Toddler

Figure 5. Matrix of Residential Space Model.

3.3. Summary

The overall research process of user-customized housing planning is summarized in figure 6.

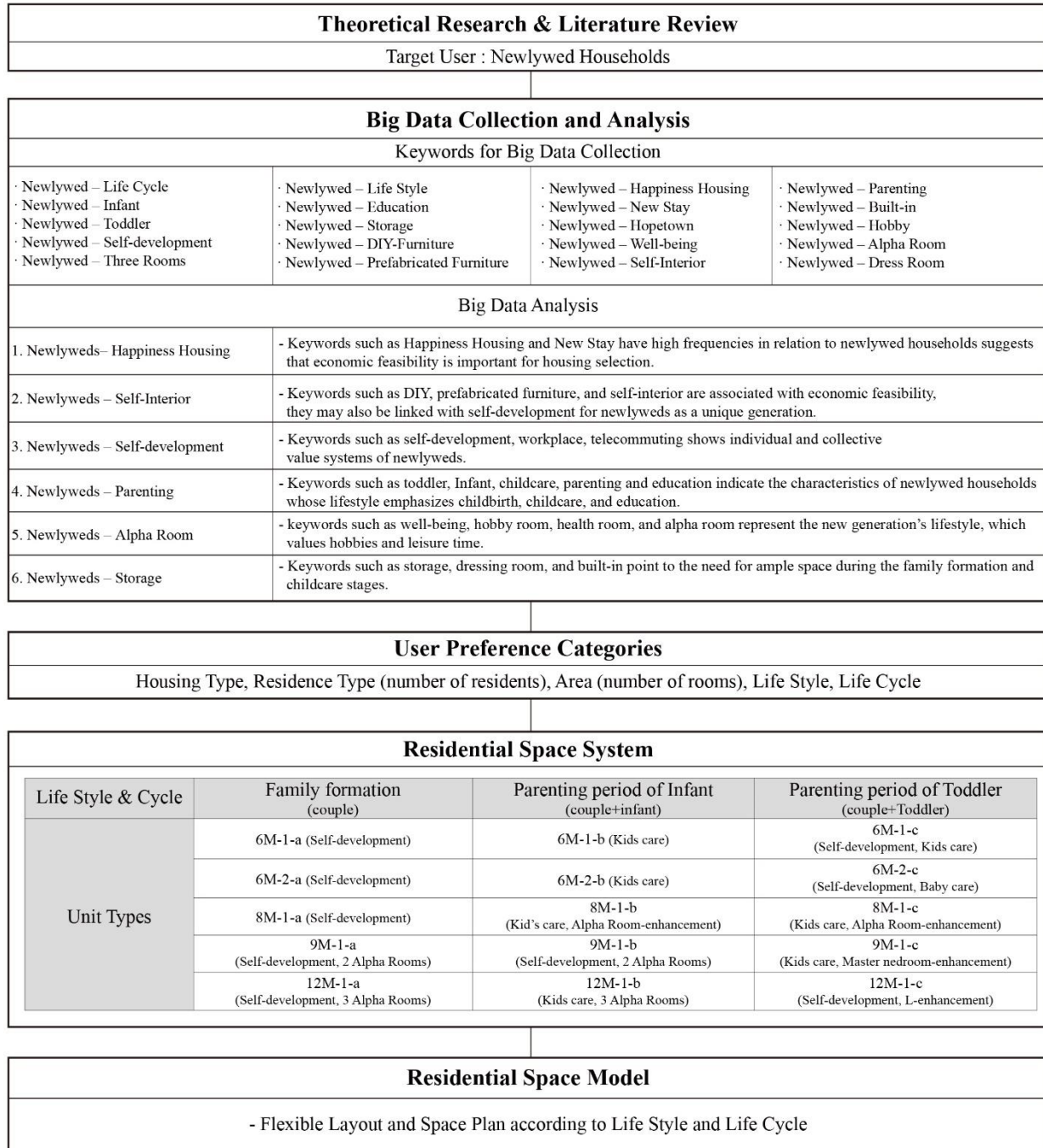


Figure 6. Research Process of User-customized Housing Planning.

4. Conclusion

This study proposed a methodology to derive user-customized residential space planning by collecting and analyzing big data. Through

precedent research and theoretical consideration, this paper analyzed the characteristics of newlywed households and residential space planning factors according to their preferences. Then, by collecting big data, users' life styles

and preferred space types were analyzed, and user preference categories were derived. Based on the analysis of the characteristics of newlywed households and user preferences according to life style and life cycle, a system was configured comprising parameters that can be combined according to the user preferences of newlywed households. The prototypes were developed for three life cycle stages: a newlywed couple, a couple with an infant, and a couple with a toddler. In the conclusion, user-customized residential space models were proposed according to the life style and life cycle of residents.

This study can be differentiated from previous studies as it analyzes user preferences and suggests user-customized housing based on big data. To improve the reliability of the data analysis, the period and range of collection of the big data should be expanded, and user feedback for the proposed residential spaces should be verified. It is expected that the results of this study can be expanded, and prototypes customized for other users, such as young people, and will be used as basic data applied to a real plan in the future.

5. Acknowledgment

This research was supported by the Ministry of Small and Medium-sized Enterprises(SMEs)and Startups and through the 2018 Industry-University-Research Cooperation Technology Development-Local Prospective Project(no. S2606592) and supported by 2020 Hongik University Research Fund.

References

- [1] Gartner. Gartner's 2012 hype cycle special report evaluates the maturity of 1,900 technologies. 2012. Available from: <http://www.gartner.com/technology/research/hype-cycles>
- [2] Zikopoulos P, Eaton C, Deroos D, Deutsch T, Lapis G. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data. IBM Corporation. 2012. 166p. Available from: <https://www.immagic.com/eLibrary/ARCHIVES/EBOOKS/I111025E.pdf>
- [3] Back MH, Oh DS, Jun HJ. Construction of database about Residential location based on household characteristics and selection of houses-type utilizing Big Data. Proceedings of the Society of CAD/CAM Conference; 2015 Feb 4-6; Pyeongchang, Korea: 202–207. Available from: http://www.dbpia.co.kr/journal/articleDetail?nodeId=NODE06284088&language=ko_KR
- [4] Cho ME, Yoon BJ. A Study on the Preference of Apartment Housing According to X-generations Life style Type. Journal of Architectural Institute of Korea. 2000 Feb;11(1):79-87 Available from: http://www.auric.or.kr/User/Rdoc/DocRdoc.aspx?returnVal=RD_R&dn=204429#.X1GBJ_57noo
- [5] Kim YS, Ko JS. Lifestyle and Housing Preference of Apartment Residents in Their 30~40s. The Korea Spatial Planning Review. The Korea Spatial Planning Review 2012 Sep; 74: 249-263. Available from: https://www.dbpia.co.kr/journal/articleDetail?nodeId=NODE01984870&language=ko_KR
- [6] Jung DW, Kang SJ. Double-income Newlywed Couple's Lifestyle and Needs of Urban-Compact Housing. Journal of the Korean Housing Association. 2010; 10(2): 178-183. Available from: http://www.auric.or.kr/user/Rdoc/DocRdoc.aspx?returnVal=RD_R&dn=243870#.X1GAR_57noo
- [7] Lee E J, Chong KS, Kang HY. An Analysis on the Change of Behavioral Affordance of the Living room in a Residence Depending on the Child's Developmental Stage -Focused on Double-Income Families with One Child Residing in Apartment Housing in Seoul. Journal of the Korean Housing Association. 2016; 27(6): 9-18. Available from: http://www.auric.or.kr/User/Rdoc/DocRdoc.aspx?returnVal=RD_R&dn=345711#.X1GAtf57noo
- [8] Hong Y, Lee SO, Lee SH. A study on the Flexible Unit Plan According to the Life-cycle in Apartment. Proceedings of Architectural Institute of Korea, 2010;30(1): 179-180. Available from: http://www.auric.or.kr/User/Rdoc/DocRdoc.aspx?returnVal=RD_R&dn=242937#.X1GABv57noo

- [9] Baek SY, Chung JH. A Study on the Flexible Residential Planning according to the User's Life Cycle-focused on Newlywed Households. Journal of Next-generation Convergence Technology Association. 2019; 3(3): 100–108.
Available from:
<http://www.earticle.net/Article/A363526>
- [10] Chung JH, Baek SY, Heo J. Design Platform for User-customized Residential as a Decision Support System. Journal of Next-generation Convergence Technology Association. 2019; 3(1): 15–20. Available from:
<http://www.earticle.net/Article/A351909>