Comparative Analysis of the Spatial Structure of Apartment Unit Plans in Asia
- Apartments in Korea, Vietnam, and Kazakhstan -

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Abstract

Though apartments are often criticized for their homogeneous nature, they are being actively adopted as an efficient method of providing houses for developing countries. In this paper, the authors argue whether such phenomenon can be seen simply as cultural identity giving in to internationalism. That is, apartments can indeed reflect locality within their spatial structure. To support this argument, apartment units from Korea, Vietnam, and Kazakhstan, three countries from dramatically different climate zones and cultural backgrounds, are analyzed. In doing so, Space Syntax, a quantitative analysis method widely used to interpret the cultural aspects embedded into a spatial structure is utilized. Each country's apartment units had different functions at the topological center, which should not be seen as a mere coincidence since they were consistent with the spatial characteristic found in their respective traditional houses. Therefore, it can be said that apartments, in their unit plans, do reflect locality, a direct contradiction to the general belief.

1. Introduction

Apartments are being adopted as an efficient method of providing houses for developing countries. Specifically, Asian Governments have politically and economically supported apartment projects. In these countries, apartments are the tangible outcome of rapid urbanization and economic prosperity. As an example, Korea first introduced apartment buildings in 1962 to solve housing shortage problems. Since then, they have become the mainstream housing type accommodating over 70% of the urban population.

However, apartments are often criticized for their homogeneous nature. Known as a housing type influenced by the perspective of modernism, apartments are believed to disregard locality. This study questions such belief, leaving the possibility that apartments can reflect the cultural context.

In doing so, apartment units from Korea, Vietnam, and Kazakhstan, three countries from dramatically different climate zones and cultural backgrounds, will be analyzed in relation not only to each other, but to their respective traditional houses. Such analysis should be able to distinguish the global characteristics of the

housing type from the region specific characteristics. Furthermore, consistency of the region specific characteristics with the respective traditional houses should be able to support the authors' hypothesis of apartments as an embodiment of locality.

2. Research Objective and Methodology
2.1 Culture Engrained in Spatial Configuration

Previous studies have focused on how spatial structures of houses reflect many physical and socio-cultural forces. In his study Rapoport (1969) described the forces that give human dwellings identifiable characteristics, which include climate, material, economy, religion etc. Culture is built into housing layouts, and houses convey culture through their configurations. Therefore, different house forms in separate regions can be explained by the comparison of different cultures.

This perspective has been applied to the comparison of spatial form and cultures in apartments located in Korea, Kazakhstan, and Vietnam. Cultural preferences were not only embodied and expressed by traditional houses, but also by apartment houses, a modernized type of housing. Empirical studies, Choi *et al.* (1996) for instance, have verified cultural patterns from the spatial forms of apartments. Through focusing on the differences of space configurations in apartment units and investigating cultural backgrounds, it is possible to obtain a profound understanding of the local characteristics embedded in apartment spaces.

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2.2 Methodology

Quantitative analysis was used for sociological comparison of spatial configurations. The theory of Space Syntax was applied as a method to analyze apartment unit plans. It is common that different functions are spatialised in different ways, and that this can often be expressed clearly through 'integration' analysis.[1] Space Syntax was developed by Bill Hillier and Julienne Hanson to quantitatively describe spatial layouts in terms of the pattern of connections between spaces. This analysis method is efficient for objectively understanding and comparing spatial structure. The integration value of a space expresses the relative depth of that space from the others in the graph, and integration is one of the fundamental ways in which houses convey culture through their configuration.[2]

Fig.1. Composition of Convex Maps

The spatial composition is presented as a type of graph which uses nodes and edges. In this research, convex maps were composed. Several criteria were made when composing the convex maps for this research. The most critical part is how to illustrate and define the open spaces in the convex map when mapping layouts of a housing plan. These open spaces can be found in public areas, like the entrance, corridor, kitchen, and living room. The openness of these spaces is mostly similar in all three countries. Standards for writing convex maps, which were established based on the expected movements of residents, were equally applied to the floor plans of all three countries.

2.3 Selection of Comparison Samples

Unit plans of apartments were analyzed to understand the unique space organization of apartment houses in each country. Samples were randomly selected among apartments which were built during the last 10 years.[3] The floor area of the apartment units statistically showed differences which are related to the population in each city. For instance, in cities with high population density, the floor areas of unit plans are generally small. However, despite the difference in floor area, the number of bedrooms in each unit showed similarity. This applies to all three countries. Mostly three or four bedrooms were planned in apartments that were built for mid-income groups. Therefore, 3 bedroom-apartment units were selected as samples for the comparative analysis. Based on these criteria, a total of 60 samples, 20 samples for each country were selected.

3. Results
3.1 Space Syntax Results of Korea, Kazakhstan, and Vietnam Apartment Unit Plans

Table 1. Space Categorization

Category	Subspaces
Public Area	Corridor (CO), Entrance (ENT), Living room (LV)
Kitchen Area[4]	Kitchen (K), Dining (D), Kitchen/Dining (D/K)
Private Area	Bedroom (BR), Dressing room (DR), Master bedroom (MB), (ENS)
Service Area	Toilet (WC), Utility Room (UT)
Terrace	Terrace (TE)

In this chapter, the theory of Space Syntax was applied for analyzing the spatial structure in apartment unit plans. Rooms in each unit plan have been classified as in the following table (Table 1.).

By determining the order of the integration value of each room (cell), spatial centrality has been examined. Spatial characteristics of the unit plans in each country have been defined through this process. Table 2. shows the results of the average integration derived from the selected samples.

Generally, the corridors are defined as the central space of apartment unit plans. This can lead to a conclusion that apartment unit plans are homogeneous regardless of their 'nationalities.' However, the fact that corridors show high integration is an inevitable result considering that corridors act as a mediator space through which residents pass to enter other rooms. Therefore, one should focus on spaces, other than corridors, for an accurate analysis of spatial characteristics. In this regard, the following rooms have been redefined as central spaces; living rooms in Korean, dining rooms in Vietnamese, and entrance spaces in Kazak apartments. Spatial structures and the connection of rooms are examined in the next chapter.

3.2 Comparative Analysis of Spatial Structure

In this chapter, the spatial structure of apartments in the three countries, Korea, Vietnam and Kazakhstan, have been comparatively analyzed. The average integrations of rooms are shown in descending order. Through ANOVA analysis, differences between the countries were statistically verified. Based on this research, similarity and differences were discovered in the spatial structure of the apartments in the three countries.

3.2.1 Public Area

The results of the ANOVA analysis showed that the corridor, living room and entrance have different characteristics according to the nationality. Through these results the differences of spatial structure can be interpreted by the spatial connection between the mentioned spaces. In other words, differences of spatial structures are determined by the placement of public areas.
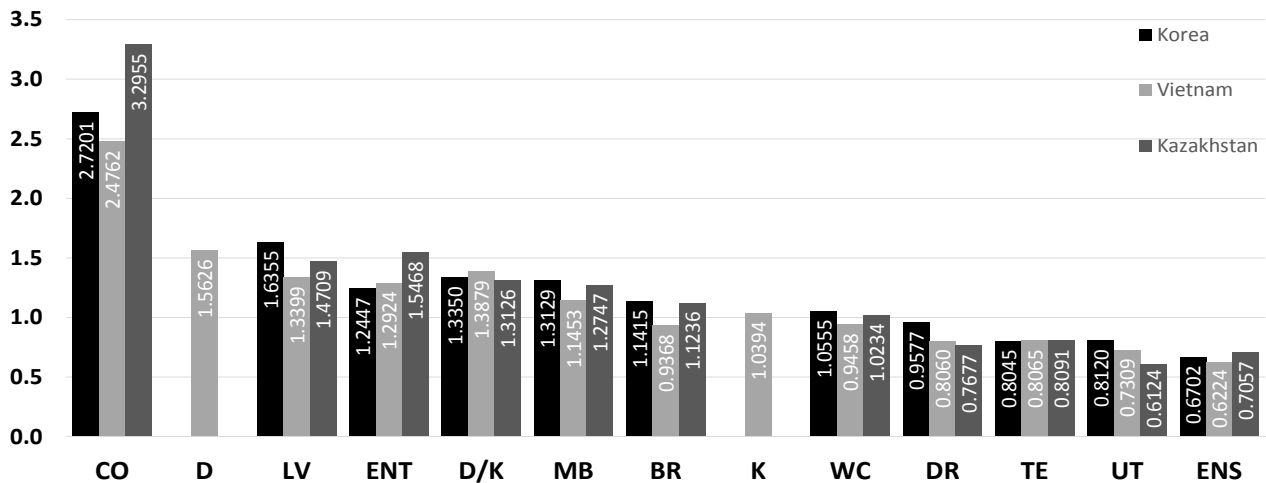
Fig.2. Average Integration Value of Each Room

Table 2. Rank of Average Integration Values

Korean Apartment Units			
Rank	Aveg. Integration	Room	Area Type
1	2.7201	Corridor	Public
2	1.6355	Living room	Public
3	1.3350	Dining/Kitchen	Kitchen
4	1.3129	Master Bedroom	Private
5	1.2447	Entrance	Public
6	1.1415	Bedroom	Private
7	1.0555	Toilet	Service
8	0.9577	Dressing room	Private
9	0.8120	Utility room	Service
10	0.8045	Terrace	Terrace
11	0.6702	Toilet (Master Bedroom)	Private
Vietnamese Apartment Units			
Rank	Aveg. Integration	Room	Area Type
1	2.4762	Corridor	Public
2	1.5626	Dining Room	Kitchen
3	1.3879	Dining/Kitchen	Kitchen
4	1.3399	Living Room	Public
5	1.2924	Entrance	Public
6	1.1453	Master Bedroom	Private
7	1.0394	Kitchen	Kitchen
8	0.9458	Toilet	Service
9	0.9368	Bedroom	Private
10	0.8065	Terrace	Terrace
11	0.8060	Dressing room	Private
12	0.7309	Utility room	Service
13	0.6224	Toilet (Master Bedroom)	Private
Kazak Apartment Units			
Rank	Aveg. Integration	Room	Area Type
1	3.2955	Corridor	Public
2	1.5468	Entrance	Public
3	1.4709	Living room	Public
4	1.3126	Dining/Kitchen	Kitchen
5	1.2747	Master Bedroom	Private
6	1.1236	Bedroom	Private
7	1.0234	Toilet	Service
8	0.8091	Terrace	Terrace
9	0.7677	Dressing room	Private
10	0.7057	Toilet (Master Bedroom)	Private
11	0.6124	Utility room	Service

Also, entrances of Korean, Vietnamese, and Kazak apartments showed differing characteristics. Taking off one's shoes before entering the house is a common cultural gesture of all three countries. However, whether this space is clearly divided or not, and whether this space distributes residents' movements, differs in each country. Entrance spaces in either Korean or Vietnamese culture are simply small spaces where one can take off one's shoes and pass through to enter the household. On the contrary however, entrance spaces in Kazak culture are not only where one takes off one's shoes but also where direct entries to other rooms such as kitchen/dining, bathroom, living room, etc. can easily be made.

Table 4. Comparison of Entrance Space

Korea	Vietnam	Kazakhstan
Sol Park (84m²)	Sunrise City (129.3m²)	На Водно-зеленом бульваре (164m²)

Table 5. Comparison of Living Room

Korea	Vietnam	Kazakhstan
Lotte Castle (101m²)	The Vista (135m²)	Долина Роз (172m²)

According to statistical analysis, there was a distinction between the average integration for the living rooms in Vietnamese and Korean samples. The living rooms in Korean apartments are mainly planned at the central location of the apartment while,

Table 3. Results of ANOVA Analysis[5]

Category	Country	N	Aveg.	SD	df.		F	Sig.
CO*	Vietnam	19	2.4762	1.2074	Between Group = 2		3.232	0.047
	Kazakhstan	20	3.2955	1.2072	Within Groups = 56			
	Korea	20	2.7201	0.5760	Total = 58			
	Total	59	2.8366	1.0763				
	Post Hoc Multiple Comparisons (Scheffe): Kor – Vie: 0.765, Kor – Kaz: 0.224, Vie – Kaz: 0.056-							
LV*	Vietnam	20	1.3399	0.3270	Between Group = 2		4.072	0.022
	Kazakhstan	20	1.4709	0.3278	Within Groups = 57			
	Korea	20	1.6355	0.3301	Total = 59			
	Total	60	1.4821	0.3449				
	Post Hoc Multiple Comparisons (Scheffe): Kor – Vie*: 0.023, Kor – Kaz: 0.292, Vie – Kaz: 0.456							
ENT**	Vietnam	20	1.2924	0.2911	Between Group = 2		6.787	0.002
	Kazakhstan	20	1.5468	0.3777	Within Groups = 60			
	Korea	23	1.2097	0.2509	Total = 62			
	Total	63	1.3430	0.3359				
	Post Hoc Multiple Comparisons: Kor – Vie: 0.683, Kor – Kaz**: 0.003, Kaz – Vie*: 0.040							
D/K	Vietnam	8	1.3879	0.2633	Between Group = 2		0.152	0.860
	Kazakhstan	20	1.3126	0.4087	Within Groups = 45			
	Korea	20	1.3350	0.2450	Total = 47			
	Total	48	1.3345	0.3206				
BR	Vietnam	40	0.9368	0.2261	Between Group = 2		14.014	0.000
	Kazakhstan	39	1.1236	0.1815	Within Groups = 116			
	Korea	40	1.1415	0.1600	Total = 118			
	Total	119	1.0668	0.2113				
MB	Vietnam	20	1.1453	0.2921	Between Group = 2		2.163	0.124
	Kazakhstan	19	1.2747	0.1978	Within Groups = 56			
	Korea	20	1.3129	0.2952	Total = 58			
	Total	59	1.2438	0.2719				
TE	Vietnam	24	0.8065	0.3874	Between Group = 2		0.004	0.996
	Kazakhstan	17	0.8091	0.0884	Within Groups = 102			
	Korea	64	0.8045	0.0954	Total = 104			
	Total	105	0.8057	0.1998				
WC	Vietnam	21	0.9458	0.1751	Between Group = 2		2.301	0.107
	Kazakhstan	38	1.0234	0.1906	Within Groups = 77			
	Korea	21	1.0555	0.1278	Total = 79			
	Total	80	1.0114	0.1751				

(*: $P<0.05$, **: $P<0.01$)

in Vietnamese and Kazak apartments, they are located at the corners of the apartment unit. Disregarding these different planning techniques, the reason why data results show a similarity between Korean and Kazak samples is because the living rooms are planned as open spaces, connecting to the kitchen/dining rooms.
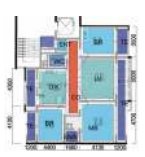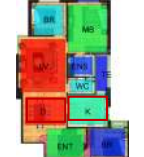
3.2.2 Kitchen Area

Contrary to the results found in the entrance space and living room, no statistical differences between the three countries have been discovered in the kitchen and dining area. However in the Vietnamese samples, the kitchen and dining area are mainly planned separately, which is unique compared to the apartments of other countries. This planning technique is not applied in the other two groups, meaning that a comparison of D/K spaces will be difficult. However, in chapter 3.1, integration of the dining room was shown to be the second highest and integration of the kitchen showed low numbers. This leads to the understanding that the dining room and kitchen each have contrasting centrality in Vietnamese apartments.

The dining areas of Vietnamese apartments can mainly be accessed directly from the entrance of the

house. This accessibility is maintained even when the dining and kitchen areas are combined to form a single space. Considering this characteristic, location of the dining area will be an important matter when planning apartment units in Vietnam. Also, the fact that the dining area showed the second highest integration can lead to the conclusion that the dining area is culturally an important area in apartments in Vietnam.

The characteristics of spatial structure differ according to whether the kitchen and dining areas are planned separately or not. Therefore, the placement and planning methods of these areas can be considered as a feature of the spatial structure in Vietnamese apartments.

Table 6. Comparison of Kitchen

Korea	Vietnam	Kazakhstan
Woorim Lumi (84m²)	Meridian Tower (119m²)	Mega Tower (126m²)

4. Comparative Analysis of Spatial Structure

From the previous analysis, it can be seen that the way entrance, living room and corridor are connected has a decisive effect on the overall spatial structure. Furthermore, such differences become the uniqueness of each country's apartment unit plans.

As mentioned in 3.1, the spatial characteristic of a spatial structure can be defined by which space is the central space (space with the highest integration except for the corridor) of an apartment unit plan. Additionally by looking into the spatial connection structure we will be able to focus on more accurate characteristics of the spatial structure.

4.1 Korean Apartment Units

In Korean apartment units, the entrance is connected to the corridor and in the center is the living room and the kitchen/dining room. Unlike apartment plans of most countries, the living room and the kitchen/dining room are connected as an open structure. Also bedrooms and bathrooms are connected to the corridors. Such living room centered spatial composition is understood to have its roots in the Hanok; the Korean traditional house. Such a claim can be made based on the drastic changes found in Korean houses during the modern era. With the introduction of western culture of the late 19th century, through the Japanese colonization, various housing types from the west, Japan and China were introduced, causing changes in domestic houses. However, the spatial configurations remained pretty much unchanged and are conserved in the apartment units.
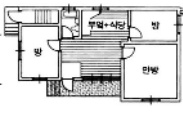
The 'Urban Hanok' is a housing type in which the original Hanok evolved by absorbing the social conditions such as increase in population density, decrease in buildable land in urban areas, and decline of the agrarian society. Though the Urban Hanoks are compact in size with several spaces losing their functional significance, the overall configuration where the 'madang (court)' is at the topological center remains consistent. This topological consistency is found even in foreign housing types with exotic materials and façades. (Jeon, B. and Kwan, Y. 2012)

For a Hanok, the madang is an external space in the form of a courtyard. In the agrarian society, it was the place for various events. It was the scene of agricultural production and storage, venue of major domestic events such as marriages and funerals, and even a gathering place for the local community.

However, in modern society, such productive and cultural functions are institutionalized to other urban spaces, thus reducing the functions of a madang and even internalizing it into what is in apartment units a living room. The living room partially inherits the public functions of the madang by allowing nondaily activities and hospitality. (Jeon, N. 2009)

Moreover, such configurational resilience can be confirmed through the fact that 'western style apartment unit plans' with the living room off the topological

Table 7. Traditional House and Apartment in Korea

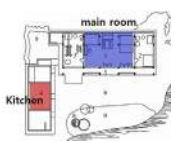| Traditional House	Modern house	Apartment
Urban Hanok (1920')	Western style house (1960'~80')	Hyundae Town (2005) 101m²

center were introduced in the 70s but were very short-lived. Therefore, it can be said that the living room centered unit plan is the most appropriate unit plan for Korean apartments.[6]

4.2 Vietnamese Apartment Units

In Vietnamese apartment units, the dining rooms and kitchens are separated with the dining rooms placed at the topological center of the unit plan. They are directly accessed from the entrance and must be passed by to reach the living rooms. In some samples, the corridors to the bedrooms and bathrooms originate from the dining room, thus intensifying the centrality of the dining rooms. This has to do with the climate and Vietnamese food culture; Hoang Duc Anh (2008) reviewed that the dining room is separated from the interior in order to remain unaffected by the odor, smoke and heat caused by cooking[7]. This characteristic can also be found in traditional Vietnamese houses.[7] According to previous studies, kitchens were placed at segregated locations, both in traditional tube houses and traditional rural houses. Another constant is that the kitchens are adjacent to a courtyard; a rear court for the traditional tube houses, and a central court for the traditional rural house. Traditionally, courtyards were the places where various domestic activities took place. They also had climate control functionalities as the only way of providing daylight and air ventilation, (Jeon, B. 2005) thus reinforcing the interpretation that cutting off the odor, smoke and heat from the kitchen was a key factor in deciding the location of the kitchen.

However, with the introduction of mechanical climate control facilities, i.e. air conditioners, modern tube houses no longer depend on the courtyards for climate control. This results in the internalization of the courtyards; either by installing a roof over the existing courtyard, inserting a small annex building in the courtyard, or altogether omitting the courtyard from the design of modern tube houses. (Kim, J. 2007)

Table 8. Comparison of Traditional Houses and Apartments in Vietnam

Traditional Tube House	Traditional Rural House	Apartment

While contemporary apartment units in Vietnam follow the traditional layout regarding the kitchen, the topological significance of the courtyard seems to be weakening. This change should be understood in light of the changes that already appear within tube houses of different periods. Though the layout of dining space differs between apartments (dining rooms being separated (but not segregated) from main living room) and traditional houses (dining room being integrated into living room), considering that traditionally dining took place in the main living rooms, it can be said that the spatial openness between the dining and living rooms found in apartments inherit the spatial structures of traditional houses. It is this inheritance of traditional spatial structure that explains the LD-K format which differs from the LDK or L-DK format of the other two countries.

4.3 Kazak Apartment Units

Kazak apartment units were found to have entrances in centered spatial structures. Public spaces such as kitchen/dining rooms and bathrooms can be approached directly from the entrances, while corridors from the entrances (and sometimes living rooms) lead to the bedrooms. This spatial characteristic is known to reflect the Soviet apartment unit plans of the 60's. Kazakhstan, with its vast homeland, was influenced by various cultures.[8] In the mid-17th century, as the Russian Empire expanded its boundaries to central Asia, Kazakhstan was colonized. Russian cultures were introduced in the 1850s with the migration of Russians. Throughout the 20th century, the area was a part of the Soviet Union and declared independence in 1991. Due to this background, socialist influence can be witnessed in various aspects, including domestic houses.
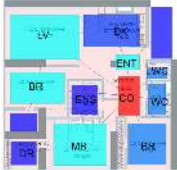
The apartment and house unit plans in the former Soviet Union have a hall in front of the entrance and from there, other spaces are connected. (Table 9.) The terrace and utility room near the entrance for easy access for things needed in outdoor activities in a detached house are assumed to be similar to the modern unit plans where closet, bathroom and utility room are placed near the entrance.

The traditional Kazak house can be defined as a 'Yurt,' a mobile house, reflecting the nomadic identity of the Kazak culture that goes back beyond the Soviet era. Following the logical process of the other two countries, one can ask; "Can the characteristics of a yurt be found in apartments?" However, given the temporary nature of the yurt, this seems unlikely. It is rather more likely that houses from the Soviet period, with strong ideological identities, had the biggest influence on Kazak apartments.

Recent studies have revealed that the above-mentioned spatial configurations are changing. Studies by Choi *et al*. (2014) show examples where the spatial quality of the living rooms were improved by modifying the structure to enlarge the living rooms and create open rooms. The study goes on to claim that if

the entrance centered layout was a manifestation of the Soviet era, the living room centered layout should be understood as a restoration of the traditional nomadic culture.
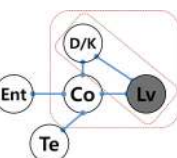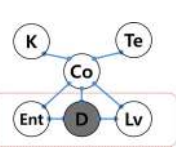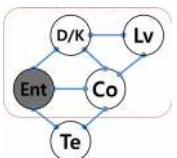
Table 9. Comparison of Houses and Apartments in the Soviet Union and Modern Apartments

House in the Soviet period	Apartment in the Soviet period	Modern Apartment

5. Conclusion

Korea, Vietnam, and Kazakhstan are included in different climate zones and cultural areas, which is an influential factor concerning spatial structures. Specifically, particular public areas that are defined as central spaces differ according to the surrounding environment. Living rooms in Korea, dining areas in Vietnam, and entrance spaces in Kazakhstan are central spaces in the spatial structures of apartment units.

Table 10. Comparison of Spatial Structure

Korea	Vietnam	Kazakhstan
Living Room	Dining Room	Entrance

This spatial characteristic can also be seen in traditional houses and other houses in the past. Apartments are the representative housing type of Modernist internationalism and most modern architecture has been criticized for its homogeneity. However, this study revealed how contrasting housing cultures can be reflected in this housing type to create a spatial structure with regional characteristics. Meanwhile, the layout modifications found in Kazak apartment units show the resilience of a traditional living culture. From this understanding, the Vietnamese apartment units should be seen as a housing type that is, due to its short history, yet to be localized in accordance with the local housing culture.

While this study has its limitations due to the rather small number of analysis samples picked from a small number of countries, it has its contribution in that apartment units from different regions were quantitatively analyzed to shed a different light on apartments, a housing type known to disregard locality, by demonstrating the existence of the locality of the apartments' respective locations.

Acknowledgements

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Notes

1　Hillier, B. (1996) Space is the Machine: a Configurational Theory of Architecture. UK: Cambridge University Press.
2　Hanson, J. (1998) Decoding Homes and Houses, UK: Cambridge University Press.
3　For each country, samples were collected via the "Encyclopedia of Apartments" for Korea, academic papers, brochures, and websites for Vietnam, and brochures and websites for Kazakhstan.
4　The kitchen, dining, and kitchen/dining are spaces which have both characteristics of the public and service area. Therefore, these spaces are separately categorized as the 'Kitchen Area'.
5　The significance probability of the bedrooms and dressing room was .000 and .019 according to ANOVA analysis. However through a homogeneity test, the result was less than .05. Therefore, the significance level has not been satisfied, which means that the results cannot be considered as significant. The significance probability of corridors showed 0.047. However, according to the Scheffe post-hoc test, which is used to compare sample means with different sizes, the significance probability was Vae-Kaz: 0.056, Vae-Kor: 0.765 and Kor-Kaz: 0.224, resulting in the conclusion that no differences have been shown.
6　Jeon. N, (2009) Hanguk Jugaeui Meesisa (Microhistory of Korean Housings). Korea: Dolbegae, p.262.
7　Traditional Vietnamese houses include rural courtyard houses as well as urban tube houses. Minor ethnic houses are also considered as being traditionaly Vietnamese.
8　Choi, J. et al. (2014) Understanding the Living Demands of Kazakh Apartments through Plan Alteration Cases. Korea: Journal of the Korean Housing Association. 25(1).