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A Study on the POE (Post Occupancy Evaluation) according to the Residential Environment of Mixed-use Apartment Complexes In Seoul

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Abstract

In this study, POE(Post Occupancy Evaluation) evaluation indexes were selected into six categories through the consideration of theories and prior research. Therefore, qualitative supply can be achieved through POE according to the aspect of residential environment after the quantitative supply of mixed-use apartment complex by the population concentration in Seoul due to industrialization and urbanization. As the evaluation elements, detailed survey contents were selected for livability, convenience, comfort, safety, economy, and sociality. Based on the survey contents, six elements were evaluated and analyzed using Data coding and Likert scale after surveying 12 complexes (Urban areas and non-urban areas) in Seoul. As a result of the study, six categories selected as the POE showed that importance of quality of life and safety was developed in high recognition according to high satisfaction with convenience and safety. Sociality showed the lowest satisfaction in the following order : livability, comfort, economy and sociality. Residents' sense of community, interaction with neighborhood, etc., showed low satisfaction, and it seems that it is necessary to improve and supplement the system for the development of mixed-use apartment complex in the future. The detailed characteristics of livability showed high satisfaction of the living room, the front door and the main room which are main uses of housing, and low satisfaction in storage size. The analysis of convenience is that convenient public transportation was the highest, and educational environment and additional facilities were the lowest, showing the advantages and disadvantages of location characteristics. As a result of the analysis of comfort, satisfaction with the landscape area was low and it seems that green space is needed for the development of mixed-use apartment complex in the future. Lastly, regarding the safety, the satisfaction of the access control, the location of security office, etc. were high, however separation of circulation was low. Therefore, it is necessary to clearly separate the circulation between the residence and other facilities in the mixed-use apartment complex.

Keywords: Mixed-use Apartment Complex, POE, Post Occupancy Evaluation, User Research Analysis

1. Introduction

1.1. Background and Purpose of the Study

In recent years, the national government sought to develop new housing to cope with the rising housing prices in Seoul. But the city government is taking issue with the plan. As an alternative, plans for urban regeneration and increased supply of mixed-use apartments are being presented.

Preceding studies [1)]noted that mixed-use apartments are easy to develop and doesn't take long for development. They also have easy access to public transport and is thus preferred by a wide range of people. Once profitability is met, the licesing procedure is simple and the houses are exempt from the application of housing act. But this has led to issues in terms of city management and lack of welfare facilities or educational facilities. While mixed-use partments have strengths and weaknesses, if proper policies are put in place to present a new housing model, it can help with the supply of housing.

Preceding studies have identified issues external to the apartment complex through a survey on the facilities surrounding mixed-use apartment complexes. In a second Preeding study[2)], the housing characteristics were identified.

This study conducted a satisfaction survey on the residents (users) and administrators of mixed-use apartment complexes in Seoul.

The satisfaction surveys on residents of mixed-use apartments in preceding studies were conducted in 2005 or before, and there are not a lot of such surveys. This is because the number of such apartments drastically increased since 2004. There were not many things to list as constraints of the study in preceding studies, either.

But at present, mixed-use apartments have increased signifcantly to the point where they are perceived as a

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1)Comparitive study on the characteristics of the borders to mixed-use apartment complexes in Seoul, April, 2012

2)Ha, M. J.(2020). Journal of the Korean Housing Association - A Study on the Residential Characteristics of Mixed-Use Apartment Complex in Seoul, Vol. 31, No. 1, 11-23

new form of housing. The increase was dramatic around year 2004. According to real estate portals such as "Naver Real Estate"[3] and "Real Estate 114"[4], as of October, 2018, there are 991 mixed-use apartment complexes (89,892 units). According to the consensus in 2015[5], there were 1,665,922 units of regular apartments in Seoul. Mixed-use apartments (as of October 2018) account for approximately 5.49% of regular apartments.

As such, in this study, satisfaction level was surveyed through a post occupancy evaluation to identify elements for developing mixed-use apartment complexes that meet users' demand in addition to supplying the volume needed.

1.2. Scope of the Study

In preceding studies, the scope was limited to mixed-use apartment complexes completed since 1967 in 25 districts of Seoul, based on the categorization of the 2030 City Basic Plan which divided the areas into urban and non-urban areas. Moreover, complexes were selected based on the complexes with fewer than 300 units in semi-residential areas and commercial areas. For continuity with preceding studies, sites were selected among the same complexes as in preceding studies.

1.3. Methodology

A satisfaction survey was conducted on residents of mixed-use apartment complexes. To acquire basic data on the supply policy and improvement of policies, the direction and methodology of the study were determined based on the related theses, literary review and statistical data.

The objective and methodology of the study are as seen in Table 1.

2. Theory and Review of Preceding Studies

2.1. Theoretical Review

The word residence or living[6] means to stay at one place and includes places of daily life as well as daily life itself. Meanwhile, housing refers to only the physical building itself. That is, residence includes the scope of physical housing, community life and social life in the place of everyday life.

The meaning of residential environment[7] is closely associated with the environment where resting, sleeping, eating, household chores and childcare take place, where these tasks are done safely, pleasantly and efficiently. This includes all services and facilities for health. According to the report by WTO on 'the expert committee on the public hygiene perspective of housing', there are regional and social conditions that form the basis of healthy living environments and healthy life.

Post Occupancy Evaluation (POE)[8] has many definitions

Table 1. Flow of the Study

Objective of the study	
To provide basic data for setting the development directions through satisfaction survey of residents focusing on the residential environment of mixed-use apartments	
↓	
Methodology	
1. Theory and review of preceding studies	2. Evaluation concept and criteria
Preceding studies (External/ internal characteristics of the complex). Post occupancy evaluation in this study	Evaluation material and elements after occupancy
↓	
Analysis framework for occupancy	
1. Mixed-use apartments in 25 districts of Seoul 2. Complexes with 30 − 300 units (12 complexes) 3. Statistical analysis of the survey results	
↓	
Post occupancy evaluation	
Content of the questionnaire – Favorable aspects of living, convenience, pleasantness, safety, economics, social aspects)	
↓	
Conclusion	
Summary of study results, limits of the study, future tasks	

[3]Naver Real Estate, http://land.naver.com
[4]Real Estate 114, http://www.r114.com
[5]2015 Census Survey results http://www.census.go.kr
[6]Basic skills and home economics for middle school students Shinwon Culture Co. Ltd.
[7]Doopedia, definition of residential environment.
[8]Craing M. Zimring and Janet E Reizenstein, "Post-Occupancy Evaluation : An Overview", 1980

Table 2. Trends in Preceding Studies on Residential Satisfaction.

Evaluation indicator	Preceding study
Youngki Park (2005)	Development of a post occupancy evaluation model for high-rise residential buildings
	Based on the POE data of high-rise buildings, a qualitative analysis was conducted to understand living culture and identify issues to suggest improvements of the environment
Jiyoung Jung (2003)	Study on the POE model of apartment residents in Busan
	Two phase POE of apartment residents (at the beginning of occupancy and after a certain period) to identify leading factors of satisfaction and direction for improvement
Handu Chang (2007)	Study on the factors affecting residential satisfaction and evaluation method of residential environments
	Suggestion of an evaluation item to address issues with the existing evaluation
Seongyeon Park (2007)	POE of high-rise mixed-use buildings from an architectural planning perspective
	POE of two high-rise mixed-use buildings from an architectural planning perspective using 13 categories to survey satisfaction and perception.
Sangdong Choi (2008)	Study on POE of living environment factors of low-rise communal housing complexes
	Satisfaction analysis and analysis of factors affecting residential satisfaction in residents of low-rise communal complexes to set improvement plans for the interior environment and present a new direction

but the majority of scholars define it as a survey on the efficiency of the user in a given architectural environment. In this study, the same meaning as the definition in the references was used.

Preceding studies on post occupancy evaluation were conducted on high-rise residential buildings, apartments, mixed-use apartments and low-rise communal housing. Based on the basic data as follows, POE was conducted on the aspects of the living environment.

Based on the preceding studies as above, the evaluation indicators and factors of POE from a living environment perspective were identified to be used as basic data for a study on POE.

2.2. Identification of Evaluation Indicators and Elements after Occupancy

Preceding studies by Manhun Ha et al. of 2012 and 2014 conducted a survey on the surrounding environments and infrastructure of mixed-use apartment complexes in Seoul. This helped with the understanding of the border areas and issues with external infrastructure. The study by Manjun Ha et al. in 2018 reviewed the charac-teristics of mixed-use apartment complexes in Seoul to understand the current status of the interior environment and complementary facilities. The characteristics and areas needing improvement were categorized into general and regional characteristics.

Unlike the exterior and interior elements used in preceding studies, this study seeks to survey residential satisfaction from the perspective of living environment. For POE of mixed-use apartments, the evaluation items and detailed materials for evaluation in existing literature were reviewed. WTO presents safety, health, efficiency and pleasantness as categories of basic function in a living environment. Based on these items, the satisfaction survey was carried out in various ways.[9)]

Mixed-use apartments have neighborhood life facilities, work facilities, commercial areas and housing administration facilities on the lower floors, while the residential areas on the higher floors. Based on the general evaluation indicators of living environments, efficiency, function, pleasantness and safety must be evaluated highly. The community facilities should provide social aspects to the residents and there should also be convenience in access

Table 3. Application of Evaluation Items of Residential Satisfaction to Theses[10)]

Survey	Evaluation items
Insik Park (1992,1995)	Safety, convenience, pleasantness, hygiene
Jeongsuk Yun (1996)	Safety, convenience, pleasantness, health
Jeongsuk Jin (1996)	Safety, hygiene, convenience, pleasantness
Jiyeon Huh (2000)	Safety, convenience, pleasantness, adaptability
Youngki Park (2004)	Liveability, pleasantness, convenience, economics, neighborhood, safety, familiarity
Jeong Eui Lee (2005)	Safety, convenience, pleasantness, neighborhood, economics

[9)] Youngki Park, Hyejeong Kim, Inho Kang, Study on the development of POE models for high-rise buildings, November 2005.
[10)]POE of high-rise mixed-use buildings from an architectural planning perspective, September 2007.

to transport facilities, educational facilities, and daily convenience facilities. Based on these items, the evaluation items are set as liveability, convenience, pleasantness, safety, economics and social aspects. The detailed items under each were identified.

The POE of this study and preceding studies will hopefully contribute to the housing policies of Seoul Government that will be developing mixed-use apartment complexes in the future.

2.3. POE indicators and elements

The detailed evaluation elements for indicators on the questionnaire for POE are as follows. Liveability was evaluated with a focus on the resident's experience with change, such as the size and structure of unit housing, facilities and storage space. Convenience was evaluated based on how well the convenience facilities such as the parking lot, elevators, and complementary facilities were laid out and how easy it is to access public transport, based on the resident's experience. Pleasantness was measured by surveying the perceived physical environment inside or outside the household unit, such as noise, light, ventilation and landscaping. In terms of safety, as crimes and natural disasters increase, the access of outsiders, the location of the security office, the separation of routes for the commercial and residential areas and safety against fires or earthquakes as perceived by residents were analyzed. In terms of economics, residents were asked how they felt about the administrative fees, heating or air conditioning expenses and whether they thought the costs were reasonable. In terms of social aspects, although it is planned as an apartment, the lower floors have commercial facilities with a low share of complementary or welfare facilities. As such, the surveyed focused on the residents' sense of community.

Finally, based on the evaluation items for residential satisfaction, residents' satisfaction with the apartments as a residential environment was analyzed. Table 4 shows the indicators of POE and evaluation elements.

3. Evaluation Framework for POE

3.1. Sites Evaluated

To secure reliability and continuity of the study, the same sites as the preceding study were selected in the urban and non-urban centers of Seoul. To study the post occupancy characteristics of residents in terms of the residential environment, categories of 30-100 households, 100-200 households and 200-300 households were used. There are 991 mixed-use apartment complexes in 25 districts of Seoul (as of October, 2018), with 170 in the urban center and 821 in uptown areas. Among them, six complexes each were selected.

3.2. Sites to be analyzed and timeline

This study collected basic data through a questionnaire on POE focusing on the mixed-use apartment complexes and their aspects of living environments. Based on preceding studies, the six items of liveability, convenience, pleasantness, safety, economics and social aspects were analyzed in detail. Each complex was visited twice from October 1, 2018 to November 9, 2018. A total of 240 copies of the questionnaire were retrieved (20 copies each from 12 complexes) to compile the data and analyze the

Table 4. POE Indicators and Elements[11)]

Evaluation indicators	Evaluation elements	
	Meaning	Survey content
Liveability	Whether the structure, facility, decoration, surrounding environment and social atmosphere of the housing are convenient and pleasant.	Entry point, living room, bedroom, kitchen, bath, dressing room and storage space
Convenience	Whether everyday convenience has been secured economically	Complementary facilities, convenience facilities, elevator size and speed, educational environment, access to public transport, appropriate parking space
Pleasantness	Whether it is convenient or pleasant to live there	Interlayer noise, surrounding noise, light, view, natural ventilation system, light pollution, landscaping area
Safety	Whether the entry point, human life and property are protected from natural disasters, fires and crimes.	Access control, fires, safety against earthquakes, location of the security office, location of CCTV, central entry control, separation of routes
Economics	Whether it is reasonable and provides the maximum benefit for the minimum cost.	Administrative costs, heating or air conditioning costs of the apartment
Social aspect	Whether it is an environment where ethics regarding relations with others can be learned	Community facilities, interaction with neighbors, a sense of community, exchanges with the local community

[11)]Standard Korean Dictionary

Table 5. Sites Surveyed (Grouped by Number of Household Units)

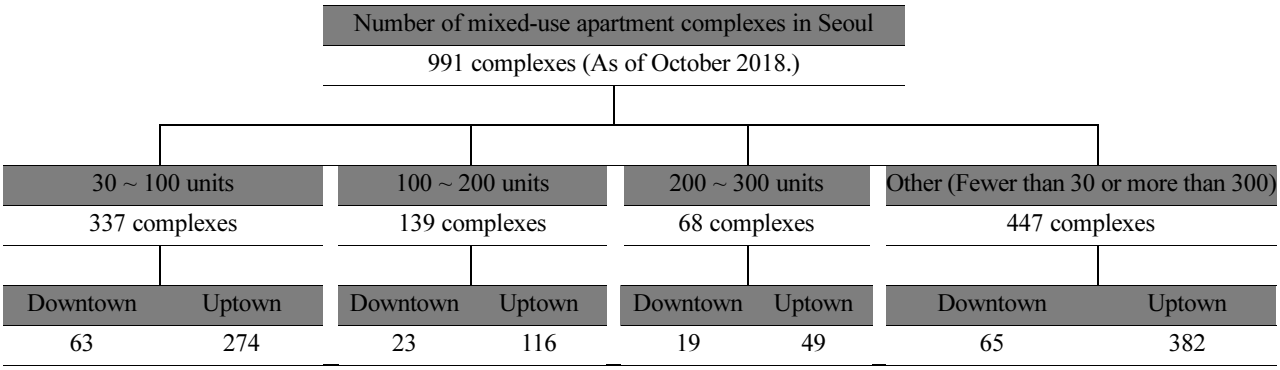


Table 6. Sites Surveyed (By Number of Households or by Group)

No	Households	Category	Area	Complex name	Year of completion	No. of households	Note
1	30 ~ 100	Downtown	Jung-Gu	Vabien 3	2006.11	84	
2			Jongno-Gu	Unhyun Sunhwa Tower	1998.03	64	
3		Uptown	Gangdong-Gu	Hive	2007.12	73	
4			Gangdong-Gu	Hyunjin Esperance	2004.04	30	
5	100 ~ 200	Downtown	Jung-Gu	Sinseong Sangga	1968.05	183	
6			Gangnam-Gu	I Ville Myeongmunga	2004.02	210	
7		Uptown	Gangsuh-Gu	Seniors Gayang Tower	2007.12	188	
8			Gangsuh-Gu	Gangsuh New Tower	2013.02	122	
9	200 ~ 300	Downtown	Jung-Gu	Namsan Lotte Castle Iris	2011.10	286	
10			Jung-Gu	Deoksugung Lotte Castle	2016.07	296	
11		Uptown	Gwangjin-Gu	Raemian Premier Palace	2017.1	264	
12			Mapo-Gu	Metro Dioville	2005.09	242	

satisfaction level. After data coding of the questionnaire, SPSS VER 21.0 was used for statistical analysis with a significance level of $p < 0.05$. Distribution analysis was applied to analyzing the difference across different categories of household numbers. For groups with a difference, a Duncan testwas conducted as a post test. For analysis of the difference across regions, an independent sample t-test was conducted. The liveability, convenience, pleasantness, safety, economics, and social aspects were measured on a 5 point Likert scale.[12] Each data was multiplied by 2 to make the full score 10. To analyze each household in the categoreis of downtown versus uptown, a statistical analysis was conducted to calculate the mean value.

4. POE Evaluation on users and Administrators

4.1. General characteristics

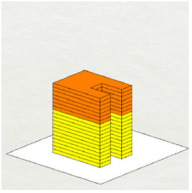
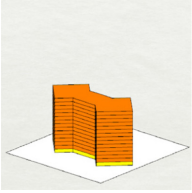
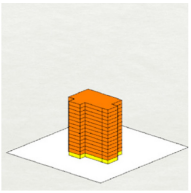
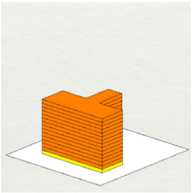
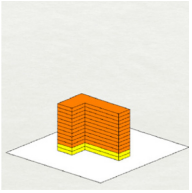
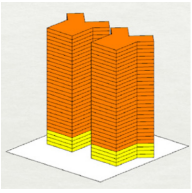
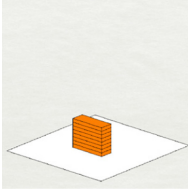
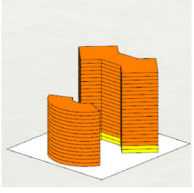
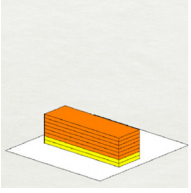
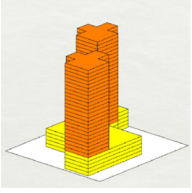
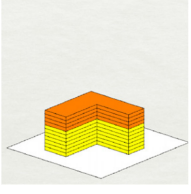
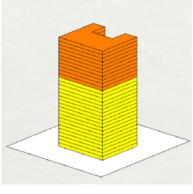
An analysis on the sites and residents shwo that the lower floors have neighborhood daily life facilities, offices, commercial facilities and housing administration facilities. The higher floors have residential facilities. Larger complexes have a separate entry path from the regular roads or would face the road on two sides. In addition, analysis on the number of household units was done in the order of households with two people, three people, one person and four people. Analysis of family member showed that the share of couples was the highest, followed by one child, one adult and two children. Next,

Table 7. Process of the Survey.

Survey details	Survey period	Purpose
Basic survey	Sept 1-27, 2018.	Questionnaire survey items
This survey	Oct. 1-9, 2018.	Survey
1st statistics	Nov. 19 – Dec. 7, 2018.	Statistical analysis with SPSS ver 21.0
2nd statistics	Jan. 22- 20, 2019.	Statistical analysis with SPSS ver 21.0, distribution analysis, t-test

[12]Likert scale: A scale to measure the attitude of respondents on a specific theme by having the respondents mark how much they agree with a statement. Translated by Minsik Kim (2001), Psychology Experiments, Sigma Press

Table 8. Survey of General Items Concerning the Sites.

	Area	Layout	Facilities		Area	Layout	Facilities
1	Jung-Gu, Vabien 3, 84 units, 13F~19F apartments, 36M road in the front, 4M road to the north, 11M road to the east.			7	Gangsuh-Gu/Seniors Gayang Tower 188 units 2F~15F apartments 7M road to the north, 12M road to the west, 10M road to the south		
2	Jongnosu/Unhyun Shinhwa Tower, 64 units, 2F~15F apartments, 6M road to the north			8	Gangsuh-Gu/ Gangsu New Tower 122 units 2F~15F apartments 10M road to the east and south		
3	Gangdong-Gu/ Hive 73 units 3F~13F apartments, 15M road to the north, 4M road to the east			9	Jung-Gu/ Namsan Lotte Castle Iris 286 units 5F~32F apartments 34M road to the east, 6M road to the north, 4M road to the south, 4M road to the east		
4	Gangdong-Gu/ Hyunjin Esperance 30 units 8F apartments 6M road to the east			10	Jung-Gu/Deoksugung Lotte Castle 296 units 3F~22F apartments 11M road to the west, 8M road to the north, 7M road to the east		
5	Jung-Gu/Sinseong commercial arcade 183 units 3F~8F apartments 15M road to the north, 4M road to the west or east			11	Gwangjin-Gu/ Raemian Premier Palace 262 units 6F~29F apartments 30M road to the south, 4M road to the west		
6	Gangnam-Gu/ I Ville Myeongmunga 210 units 7F~11F apartments 8M road to the north, 4M road to the east, 9M road to the west			12	Mapo-Gu/ Metro Dio Ville 242 units 4F~30F apartments 24M road to the south, 11M road to the east, 6M road to the west		

the most common age of the head of household was those in their 30s, followed by 20s, older than 60s and older than 50s. The most common monthly income was more than 5 million Won, followed by 3-4 million Won and 4-5 million Won. The most common was a couple in their 30s or 40s, with a monthly income of more than 5 million Won.

4.2. Evaluation of Liveability

4.2.1. Evaluation of Liveability from the user's Perspective
There was statistically significant difference in the size of the entry point ($F = 3.611$, $p < .01$) and size of dress room ($F = 7.761$, $p < 0.01$). Satisfaction was low in 20-100 households, while it was high in the categories of 100-200 households and 200-300 households. But there was no statistically significant difference in the size of the living room, size of the bedroom, size of the kitchen, size of the bathroom, and size of storage space.

Evaluation of liveability from the user's perspective by region showed there being no statistically significant difference in terms of entrance size, living room size, bedroom size, kitchen size, bathroom rize, dressroom size

Table 9. Survey on the General Matters Concerning Residents

		Frequency			Frequency
Number of house-holds	1 person	20.0%	Age of head of household	20s	4.2%
	2 people	32.9%		30s	30.0%
	3 people	23.3%		40s	27.9%
	4 people	20.0%		50s	17.9%
	5 people	3.8%		60s or older	20.0%
Family members	Respondent	20.8%	Monthly income	1~2 million Won	7.1%
	Couple	30.0%		2~3 million Won	18.8%
	1 child	22.5%		3~4 million Won	24.2%
	2 children	19.2%		4~5 million Won	18.3%
	Others	7.5%		5 million Won or more	31.7%

Table 10. Evaluation on the Liveability from users'Perspective by Number of Household Units

	20-100 Households(n = 80)	100-200 Households(n = 80)	200-300 Households(n = 79)	Sum	F
Enterance Size	6.77±1.21a	7.35±1.58b	7.29±1.63b	7.14±1.50	3.611*
Living room Size	7.07±1.19	7.28±1.57	7.37±1.22	7.24±1.34	.993
Bedroom Size	6.85±1.30	7.13±1.55	7.18±1.42	7.05±1.43	1.213
Kitchen Size	6.50±1.41	6.93±1.62	6.41±1.82	6.61±1.63	2.317
Bathroom Size	6.73±1.20	6.91±1.66	6.89±1.78	6.84±1.56	.333
Dressroom Size	5.50±1.44a	6.34±1.79b	6.51±1.89b	6.10±1.76	7.761**
Storage Size	6.22±1.56	6.35±1.98	6.76±2.16	6.44±1.92	1.693

Duncan test : a < b
*p < .05, **p < .01

Table 11. Evaluation of lIveability by Area

	Downtown (n = 119)	Uptown (n = 120)	Sum	t
Enterance Size	7.21±1.73	7.07±1.24	7.14±1.50	.736
Living room Size	7.18±1.48	7.30±1.18	7.24±1.34	–.713
Bedroom Size	7.06±1.56	7.04±1.30	7.05±1.43	.090
Kitchen Size	6.62±1.82	6.60±1.43	6.61±1.63	.103
Bathroom Size	6.82±1.79	6.86±1.29	6.84±1.56	–.166
Dressroom Size	6.02±1.98	6.19±1.50	6.10±1.76	–.760
Storage Size	6.35±2.17	6.53±1.63	6.44±1.92	–.726

and storage size.

An evaluation of the liveability indicator for each category of household units shows that for 20-100 households, the satisfaction with the living room size was the highest, followed by the entrance and bedroom. For 100-200 households, the satisfaction with the entrance size was the highest, followed by the living room, bedroom, kitchen, with the satisfaction with the kitchen and bathroom being the same. For 200-300 households, the satisfaction with the living room size was the highest, followed by the entrance and bedroom. In all number of households, the satisfaction with the dressroom size was the lowest, while the satisfaction with the living room size was the highest.

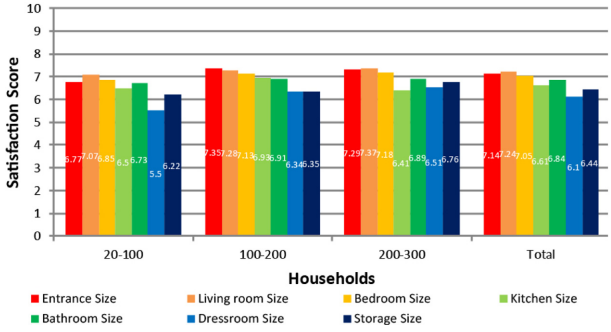


Figure 1. Comparison of satisfaction with liveability from the user's perspective in each category of number of households.

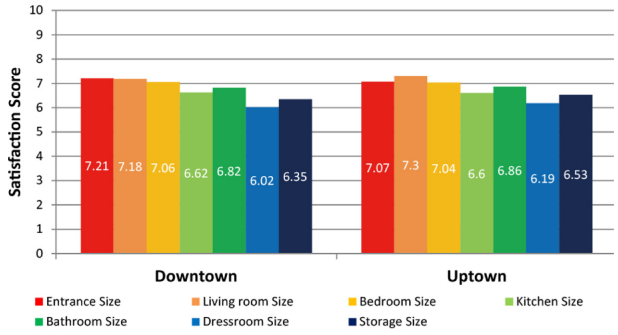


Figure 2. Comparison of satisfaction with liveability across areas.

Main usage areas of the living room, entrance, bedroom, bathroom and kitchen had an overall high satisfaction rate.

A liveability evaluation of downtown and uptown shows that in downtown, satisfaction with the entrance, living room and bedroom was the highest, while in uptown, satisfaction was highest for the living room, entrance and bedroom. Both uptown and downtown had the lowest satisfation for the dress room size and storage space size.

4.2.2. Interview on the Liveability from the Administrator's Perspective

"I haven't lived in the apartment myself but when I listen to the residents, the dress room size appeared to be appropriate when they moved in, but over time they realized there was not enough storage space."

- No. 1 administrator

"Those living in mixed-use apartments seem to spend more time inside the complex over the weekend rather than during the week. So the size of the bedrooms and living room would have to be made bigger."

- No. 3 administrator

4.3. Evaluation of Convenience

4.3.1. Evaluation of Convenience from the user's Perspective

Analysis of the convenience perceived by users shows statistically significant difference for complementary facilities ($F = 34.672$, $p < 0.001$), convenience facilities ($F = 15.582$, $p < 0.001$), elevator size ($F = 13.630$, $p < 0.001$), elevator speed ($F = 10.496$, $p < 0.001$), educational environment ($F = 8.535$, $p < 0.001$) and number of parking spots ($F = 17.951$, $p < 0.001$). In terms of complementary facilities and convenience facilities, satisfaction was lowest among 20-100 households, while satisfaction was highest among 200-300 households. In terms of elevator size and number of parking spots, satisfaction was highest in 200-300 households. For elevator speed and educational environment, satisfaction was highest in 100-200 households and 200-300 households. However, there was no statistically significant difference in the use of public transport.

Analysis of the convenience evaluation from the user's

Table 12. Evaluation of Convenience from the user's Perspective by Number of Households.

	20-100 Households(n = 80)	100-200 Households(n = 80)	200-300 Households(n = 79)	Sum	F
Amenities	5.03±1.60a	6.43±1.95b	7.29±1.57c	6.25±1.95	34.672***
Facilities	5.67±1.82a	6.60±1.75b	7.19±1.59c	6.49±1.83	15.582***
Elevator Size	7.07±1.27a	7.36±1.44a	8.13±1.21b	7.52±1.38	13.630***
Elevator Speed	6.82±1.26a	7.45±1.39b	7.82±1.51b	7.36±1.44	10.496***
Educational Environment	5.67±2.04a	6.68±1.31b	6.63±1.77b	6.33±1.78	8.535***
Public Transportation Convenience	8.38±1.32	8.40±1.37	8.38±1.67	8.38±1.45	.007
Parking Spaces	6.48±1.86a	6.57±2.33a	8.08±1.34b	7.03±2.02	17.951***

Duncan test : a < b < c
***p < .001

Table 13. Evaluation of Conveneince from the user's Perspective Across Areas.

	Downtown (n = 119)	Uptown (n = 120)	Sum	t
Amenities	6.29±1.96	6.22±1.94	6.25±1.95	.274
Facilities	6.44±1.89	6.53±1.77	6.49±1.83	–.390
Elevator Size	7.45±1.58	7.58±1.16	7.52±1.38	–.747
Elevator Speed	7.29±1.55	7.43±1.33	7.36±1.44	–.745
Educational Environment	6.80±1.64	5.87±1.81	6.33±1.78	4.156***
Public Transportation Convenience	8.39±1.52	8.38±1.38	8.38±1.45	.017
Parking Spaces	6.65±2.22	7.42±1.73	7.03±2.02	–2.987**

**p < .01, ***p < .001

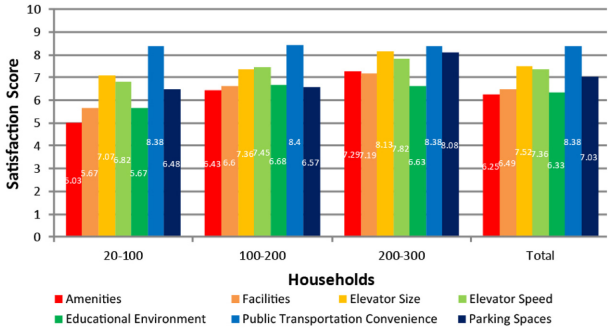


Figure 3. Comparison of satisfaction with convenience from the user's perspective across different numbers of households.

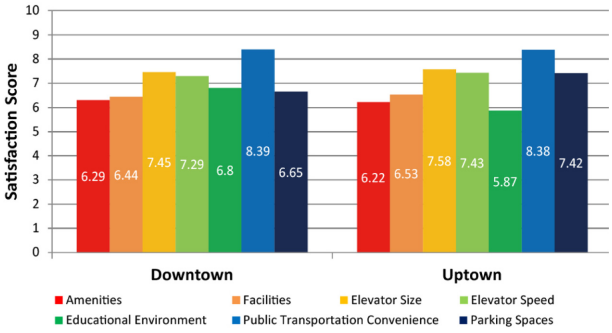


Figure 4. Comparison of satisfaction with the convenience from the user's perspective across areas.

perspective across regions shows statistically significant difference in educational environment ($t = 4.156$, $p < 0.001$) and number of parking spots ($t = –2.987$, $p < 0.05$). For educational environment, satisfaction downtown was higher but for number of parking spots, satisfaction uptown was higher. But there was no statistically signi-ficant difference in terms of complementary facilities, convenience facilities, elevator size, elevator speed and public transport.

The convenience of public transport was the highest for all numbers of households, followed by the elevator size, elevator speed, parking spots, complementary facilities, educational environment and convenience facilities. Convenience of complementary facilities was lowest for 20-100 households and 100-200 households, while for 200-300 households, the convenience of the educational environment was the lowest.

Analysis of the convenience in uptown and downtown showed that convenience for public transport was the highest for both uptown and downtown, followed by elevator size, elevator speed, number of parking spots, convenience facilities and the educational environment. In downtown, convenience of complementary facilities was the lowest, while in uptown, the educational environment ranked lowest.

4.3.2. Interview on the Convenience from the Administrator's Perspective

"Mixed-use apartments are located near subway or bus stations so it is convenient for commuting."

- No. 4 administrator

"The commercial facilities and offices nearby give the impression that the route for students going to school is not safe. In the evening there are many university students and office workers which may make the environment to have certain elements that are not child-friendly."

- No. 5 administrator

4.4. Evaluation of Pleasantness

4.4.1. Evaluation of Pleasantness from the user's Perspective

There was statistically significant difference across different complex sizes for noise between floors ($F = 4.700$, $p < 0.05$), noise from the environment ($F = 4.769$, $p < 0.01$), light ($F = 9.380$, $p < 0.001$), views ($F = 13.338$, $p < 0.001$), light pollution ($F = 3.395$, $p < 0.05$) and landscape area ($F = 12.015$, $p < 0.001$). While satisfaction was low for noise between floors and light pollution in complexes of 20-100 households, the satisfaction was highest for these two if there were 200-300 households. For noise from the environment, light and landscape area, satisfaction was lowest for 20-100 households, while satisfaction was

Table 14. Evaluation of Pleasantness from the user's Perspective for Different Complex Sizes.

	20-100 Households(n = 80)	100-200 Households(n = 80)	200-300 Households(n = 79)	Sum	F
Interlayer Noise	6.00±1.68a	6.49±1.91ab	6.91±2.02b	6.47±1.91	4.700*
Ambient Noise	5.60±1.64a	6.43±1.98b	6.43±2.21b	6.15±1.99	4.769**
Light	6.05±1.74a	6.73±1.69b	7.22±1.68b	6.66±1.76	9.380***
View	5.80±1.73a	6.00±1.56a	7.09±1.78b	6.29±1.78	13.338***
Natural Ventilation System	6.07±1.54	6.52±1.54	6.61±1.64	6.40±1.59	2.616
Light Pollution	6.27±1.82a	6.96±1.74ab	6.81±1.71b	6.68±1.77	3.395*
Landscape Area	5.00±1.46a	5.88±1.74b	6.18±1.51b	5.68±1.65	12.015***

Duncan test : a < b
*p < .05, **p < .01, ***p < .001

Table 15. Evaluation of Pleasantness from the user's Perspective Across Areas.

	Downtown (n = 119)	Uptown (n = 120)	Sum	t
Interlayer Noise	6.55±2.11	6.38±1.69	6.47±1.91	.677
Ambient Noise	6.25±1.99	6.05±1.98	6.15±1.99	.786
Light	6.94±1.64	6.38±1.84	6.66±1.76	2.472*
View	6.40±1.96	6.18±1.58	6.29±1.78	.957
Natural Ventilation System	6.12±1.67	6.68±1.46	6.40±1.59	–2.806**
Light Pollution	6.65±1.80	6.72±1.75	6.68±1.77	–.291
Landscape Area	5.68±1.58	5.68±1.72	5.68±1.65	.000

*p < .05, **p < .01

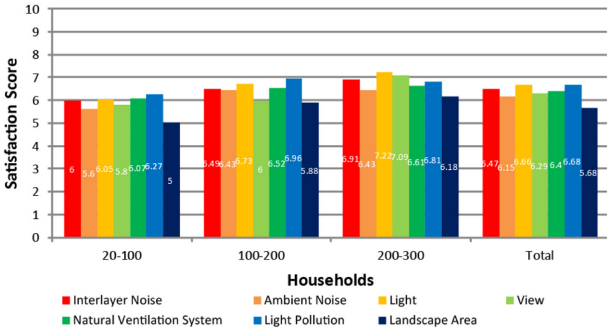


Figure 5. Comparison of satisfaction with pleasantness from the user's perspective across different complex sizes.

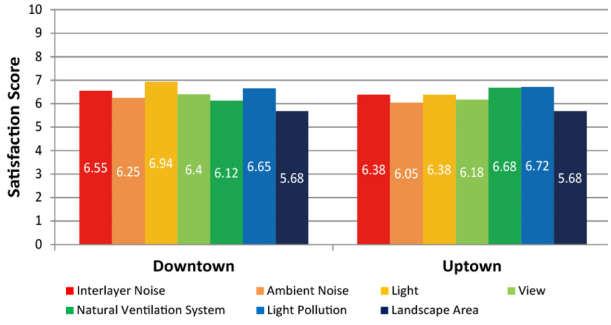


Figure 6. Comparison of satisfaction with pleasantness from the user's perspective across areas.

highest for 100-200 households and 200-300 households. In terms of views, satisfaction was low for 20-100 households and 100-200 households, while satisfaction was high for 200-300 households. However, there was no statistically significant difference in the natural ventilation system.

An analysis of the evaluation of pleasantness from the user's persective across areas showed there being a statistically significant difference for light ($t = 2.472$, $p < 0.05$) and natural ventilation system ($t = –2.806$, $p < 0.01$). For light, satisfaction was higher downtown, while for natural ventilation systems, satisfaction was higher uptown. However, there was no statistically significant difference in noise between floors, noise from the environment, views, light pollution and landscape area.

Satisfaction with light pollution was highest for 20-100 households and 100-200 households, followed by light, natural ventilation and noise between floors. For 200-300 households, the satisfaction with light was highest. In all complex sizes, satisfaction with light pollution and light was high and satisfaction with landscape area was low.

Analysis of downtown and uptown shoed that satisfaction with light was highest downtown, while satisfaction with light pollution was highest uptown. In both downtown and uptown, satisfaction with landscape area was the lowest. Overall, the satisfaction with pleasantness was 7 points or lower, which was lower than satisfaction with liveability and convenience.

4.4.2. Interview on pleasantness from the administrator's perspective

"Although it is located downside, there is distance from surrounding buildings so residents say they get a relatively good view. But the noise from vehicles cause annoyance."

- No. 6 administrator

"There is a lack of playing facilities for children. There needs to be more walking paths and outdoor resting spaces. The share of greenery is lower than other apartments. There is an absolute lack of resting space for children or the elderly."

- No. 8 administrator

4.5. Evaluation of Safety

4.5.1. Evaluation of Safety from the user's Perspective

There was statistically significant difference in access control ($F = 4.998$, $p < 0.01$), fires/ earthquakes($F = 6.154$, $p < 0.01$), security office ($F = 5.113$, $p < 0.01$), lighting in the parking lot ($F = 8.184$, $p < 0.001$), location of the CCTV ($F = 3.196$, $p < 0.05$), centry entance control ($F = 3.526$, $p < 0.05$), and separate routes for visitors ($F = 8.269$, $p < 0.001$). Satisfaction with access control was lowest for 100-200 households and higher for 20-100 households and 200-300 households. For fires/ earthquakes, security office, lighting in the parking lot, location of CCTV and central entry control, satisfaction was low for 20-100 households and 100-200 households, but was high for 200-300 households. Satisfaction with separation of routes for visitors was lowest for 20-100 households and high

Table 16. Evaluation of Safety from the user's Perspective Across Different Complex Sizes.

	20-100 Households (n = 80)	100-200 Households (n = 80)	200-300 Households (n = 79)	Sum	F
Access Control	7.38±1.41b	6.59±1.77a	7.11±1.59b	7.03±1.63	4.998**
Fire/Earthquake	6.62±1.49a	6.89±1.61a	7.42±1.25b	6.97±1.49	6.154**
Security Office	7.12±1.42a	6.96±1.45a	7.65±1.35b	7.24±1.43	5.113**
Parking Area Lighting	6.73±1.28a	6.59±1.85a	7.47±1.19b	6.93±1.51	8.184***
CCIV Placement	6.70±1.35a	6.64±1.58a	7.18±1.46b	6.84±1.48	3.196*
Central Access Control	7.05±1.42a	7.14±1.38a	7.59±1.37b	7.26±1.41	3.526*
Circulation Separation	5.90±1.80a	7.14±1.38a	6.91±1.72b	6.50±1.70	8.269***

Duncan test : a < b < c
*p < .05, **p < .01, ***p < .001

Table 17. Evaluation of Safety from user's Perspective Across Areas.

	Downtown (n = 119)	Uptown (n = 120)	Sum	t
Access Control	7.23±1.64	6.82±1.59	7.03±1.63	1.997*
Fire/Earthquake	7.00±1.59	6.95±1.40	6.97±1.49	.258
Security Office	7.33±1.40	7.15±1.46	7.24±1.43	.992
Parking Area Lighting	6.67±1.68	7.18±1.28	6.93±1.51	–2.663**
CCIV Placement	7.13±1.41	6.54±1.49	6.84±1.48	3.171**
Central Access Control	7.38±1.42	7.13±1.39	7.26±1.41	1.381
Circulation Separation	6.78±1.63	6.22±1.74	6.50±1.70	2.611*

*p < .05, **p < .01

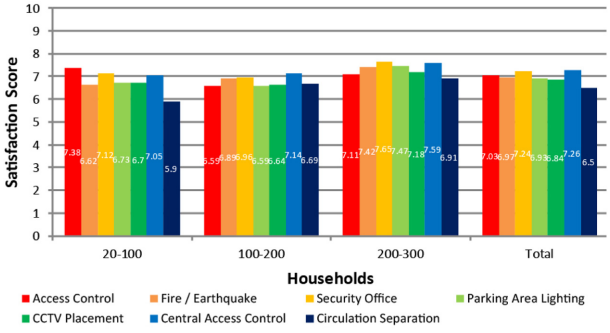


Figure 7. Comparison of satisfaction with safety from the user's perspective across different complex sizes.

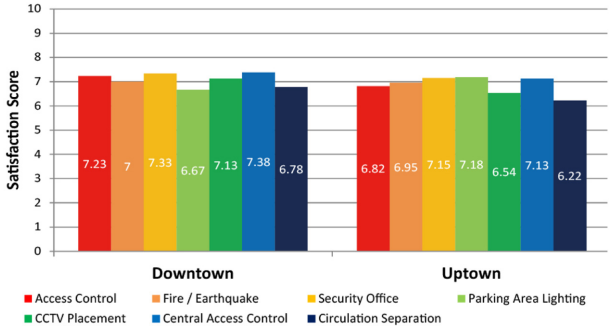


Figure 8. Comparison of satisfaction with safety from the user's perspective across different areas.

for 100-200 households and 200-300 households.

Evaluation of the safety from the user's perspective across areas shows statistically significant difference in access control ($t = 1.997$, $p < 0.05$), lighting in the parking lot ($t = -2.663$, $p < 0.01$), location of CCTV ($t = 3.171$, $p < 0.01$) and separation of routes for visitors ($t = 2.611$, $p < 0.05$). In terms of access control, location of CCTV and separation of routes, the satisfaction was higher downtown than in uptown. Satisfaction with lighting in the parking lot was higher uptown than downtown. However, there was no statistically significant difference in fires/ earthquakes, security office and central control of entry.

Analysis of the safety evaluation indicators across different complex sizes shows satisfaction with access control to be the highest for 20-100 households. For 100-200 households, satisfaction with the central entry control was the highest. For 200-300 households, satisfaction with the security office was the highest. For 20-100 households, the satisfaction with separate routes was the lowest. For 100-200 households, the satisfaction with the lighting in the parking lot was the lowest. For 200-300 households, satisfaction with a separate route for visitors was the lowest. Overall, satisfaction was high for central entry control, security office, access control and fires/ earthquakes.

Analysis of safety downtown and uptown shows satis-

Table 18. Evaluation of the Economics from the user's Perspective Across Different Complex Sizes.

	20-100 Households (n = 80)	100-200 Households (n = 80)	200-300 Households (n = 79)	Sum	F
Access Control	7.38±1.41b	6.59±1.77a	7.11±1.59b	7.03±1.63	4.998**
Fire/Earthquake	6.62±1.49a	6.89±1.61a	7.42±1.25b	6.97±1.49	6.154**

Table 19. Evaluation of Economics from the user's Perspective Across Areas.

	Downtown (n = 119)	Downtown (n = 119)	Sum	t
Management Cost	5.63±1.56	5.63±1.56	5.59±1.56	.414
Air-Conditioning Cost	6.33±1.52	6.33±1.52	6.18±1.46	1.593

faction with central entry control was highest downtown, while satisfaction with the security office and lighting in the parking lot were highest uptown. Downtown, satisfaction with separated routes and lighting in the parking lot was highest, while uptown, satisfaction with the location of CCTV and separated route were the lowest.

4.5.2. Interview on Safety from the Administrator's Perspective

"Mixed-use apartments have CCTV in key areas for 24 hour surveillance. Each building has a security office to keep strangers out. But it is difficult to distinguish between residents and outsiders."

- No. 7 administrator

"I think access control is done relatively well. But delivery people and outsiders cannot easily enter the buildings."

- No. 9 administrator

4.6. Evaluation of Economics

4.6.1. Evaluation of Economics from the user's Perspective

Analysis of the economics as perceived by users in each complex size did not show administrative fees, heating or air conditioning costs to have statistically significant difference.

There was no statistically significant difference in management cost, heating or air conditioning costs across different areas.

Analysis of evaluation on economics across different complex sizes shows satisfaction to be the highest for air conditioning or heating costs in all complex sizes. Overall, the satisfaction levels are 5-6 points on a 10 point scale which is generally lower than satisfaction with other categories.

Analysis of the economics between downtown and uptown shows in both areas, the satisfaction with heating/air conditioning costs was higher than the satisfaction with management costs. Heating/air conditioning costs and management costs were higher downtown than uptown.

4.6.2. Interview on economics from the administrator's perspective

"This is a newly built mixed-use apartment complexes so I think it has good economics. Heating/ air conditioning would be better than existing mixed-use apartments. Management costs may be higher as there are better services offered for complementary or welfare facilities."

- No. 10 administrator

"Although there are fewer households than regular apartment complexes, it is still a high number so the cost would not be too high. But it is higher because there are complementary, welfare or community facilities offered."

- No. 11 administrator

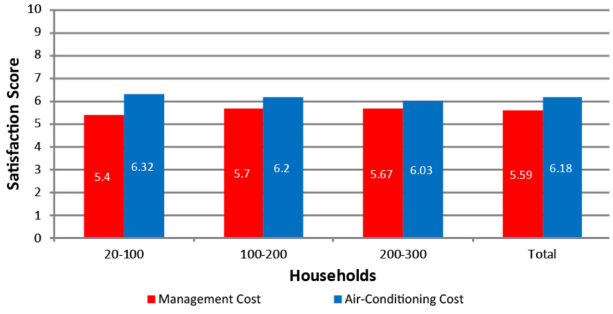


Figure 9. Comparison of satisfaction with economics from the user's perspective across different complex sizes.

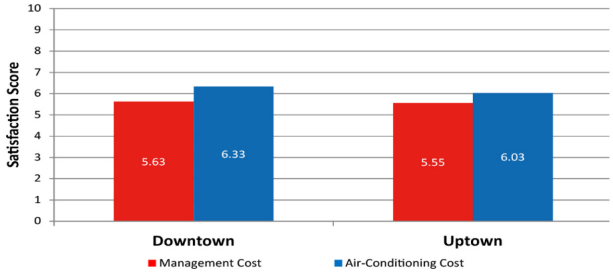


Figure 10. Comparison of satisfaction with economics from the user's perspective across different areas.

4.7. Evaluation of Social Aspects

4.7.1. Evaluation of Social Aspects from the user's Perspective

Analysis of the evaluation of social aspects from the user's perspective across different complex sizes shows there is statistically significant difference in community

Table 20. Evaluation of Social Aspects from the user's Perspective Across Different Complex Sizes.

	20-100 House-holds(n=80)	100-200 House-holds(n=80)	200-300 House-holds(n=79)	Sum	F
Community Facilities	4.50±1.54a	5.70±1.87b	6.03±1.74b	5.41±1.84	17.341***
Neighborhood Exchange	4.73±1.53a	5.41±2.11b	4.89±1.46ab	5.01±1.75	3.434*
Community Consciousness	4.75±2.26	4.77±2.16	4.53±2.33	4.68±2.24	.269
Sharing Facilities	4.92±1.39a	6.02±1.53c	5.49±1.56b	5.49±1.56	10.747***

Duncan test : a < b < c
*p < .05, ***p < .001

Table 21. Evaluation of Social Aspects from the user's Perspective Across Areas.

	Downtown (n=119)	Uptown (n=120)	Sum	t
Community Facilities	5.63±1.80	5.18±1.86	5.41±1.84	1.906
Neighborhood Exchange	4.85±1.75	5.17±1.73	5.01±1.75	–1.408
Community Consciousness	4.97±2.35	4.40±2.10	4.68±2.24	1.971*
Sharing Facilities	5.64±1.48	5.33±1.63	5.49±1.56	1.524

*p<.05

facilities (F = 17.341, p < 0.001), interaction with neighbors (F = 3.434, p < 0.05), and shared facilities (F = 10.747, p < 0.001). For community facilities, satisfaction was low for 20-100 households, while it was high for 100-200 households and 200-300 households. In terms of interaction with neighbors or shared facilities, satisfaction was lowest for 20-100 households, and satisfaction was highest for 100-200 households. However, there was no statistically significant difference in terms of sense of community.

There was statistically significant difference in sense of community(t = 1.971, p < 0.05), with the satisfaction being higher downtown than uptown. However, there was no statistically significant difference in community facilities, interaction with neighbors or shared facilities.

For 20-100 households and 100-200 households, the satisfaction with shared facilities was highest, while for 200-300 households, satisfaction with community facilities was the highest. For 20-100 households, satisfaction with community facilities was the lowest, while for 100-200 households and 200-300 households, the satisfaction with sense of community was the lowest. Overall, the ranking was from high to low: shared facilities, community facilities, interaction with neighbors and sense of community. Overall satisfaction was 5 points, which shows a low satisfaction with social aspects.

Analysis of the social aspects downtown and uptown shows that satisfaction with shared facilities and community facilities was high in both downtown and uptown. Downtown, the satisfaction with interaction with neighbors was the lowest, while uptown satisfaction with sense of community was the lowest.

4.7.2. Interview on Social Aspects from the Administrator's Perspective

"There are no facilities or programs where residents directly interact with the local community. There are simply facilities inside the complex that can be used by residents. That is how vibrant interaction takes place."

- No. 2 administrator

"In mixed-use apartment complexes, the focus is on exchanging opinions among residents regarding the safety and management of the complex rather than on joint activities. Interaction among residents usually occur in community facilities."

- No. 12 administrator

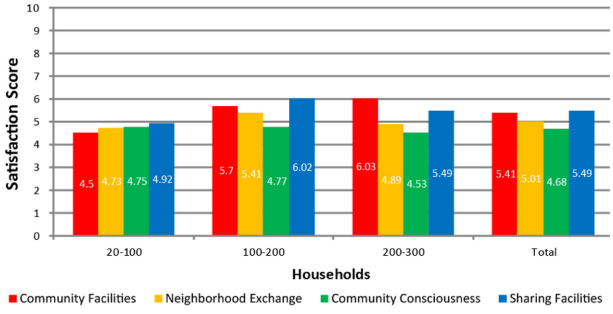


Figure 11. Comparison of social aspects from the user's persoective across different complex sizes.

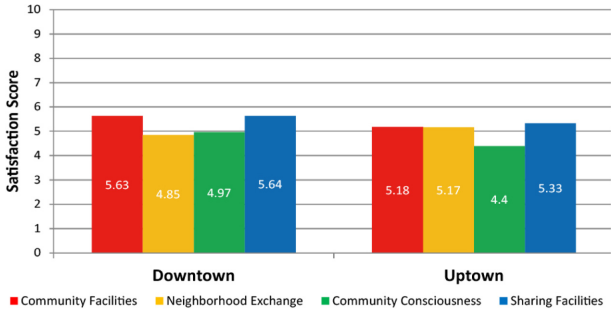


Figure 12. Comparison of satisfaction with social aspects from the user's perspective across areas.

Table 22. Evaluation of Overall Satisfaction from the user's Perspective Across Different Complex Sizes.

	20-100 Households(n=80)	100-200 Households(n=80)	200-300 Households(n=79)	Sum	F
Habitability	6.52±.77	6.90±1.34	6.91±1.26	6.77±1.16	2.923
Convenience	6.46±.99a	7.04±1.13b	7.65±.96c	7.05±1.14	26.391***
Comfort	5.83±1.02a	6.43±1.21b	6.75±1.15b	6.33±1.19	13.628***
Stablity/Safety	6.78±.99a	6.78±1.05a	7.33±.89b	6.96±1.01	8.368***
Economics	5.86±1.32	5.95±1.24	5.85±1.42	5.89±1.32	.141
Sociability	4.74±1.29a	5.48±1.58b	5.23±1.22b	5.15±1.40	5.997**

Duncan test : a<b<c
**p<.01, ***p<.001

Table 23. Evaluation of Overall Satisfaction from the user's Perspective Across Areas.

	Downtown (n=119)	Uptown (n=120)	Sum	t
Habitability	6.75±1.36	6.80±.92	6.77±1.16	–.311
Convenience	7.03±1.23	7.06±1.04	7.05±1.14	–.239
Comfort	6.37±1.22	6.30±1.16	6.33±1.19	.465
Stablity/Safety	7.07±1.11	6.86±.89	6.96±1.01	1.674
Economics	5.98±1.33	5.79±1.31	5.89±1.32	1.123
Sociability	5.27±1.35	5.02±1.45	5.15±1.40	1.406

4.8. Survey of Overall Satisfaction

Analysis of overall satisfaction from the user's perspective across different complex sizes shows statistically significant difference in convenience ($F = 26.391001$), pleasantness ($F = 13.628$, $p < 0.001$), safety and ($F = 8.368$, $p < 0.001$), social aspects ($F = 5.997$, $p < 0.01$). Satisfaction with convenience was lowest for 20-100 households, and highest for 200-300 households. For satisfaction with pleasantness and social aspects, it was lowest for 20-100 hosueholds and highest for 100-200 households and 200-300 households. In terms of safety, satisfaction was lowest for 20-100 households and 100-200 households, while it was highest for 200-300 households. However, there was no statistically significant difference in terms of liveability or economics.

Analysis of the overall satisfaction from the user's perspectove shows there being no statistically significant difference in terms of liveability, convenience, pleasantness, economics or social aspects.

Analysis of overall satisfaction with residential environment elements showed convenience to be the highest, followed by safety, liveability, pleasantness, economics and social aspects. Safety was the highest with 7.05 points out of 10, and social aspects the lowest with 5.15 points out of 10, indicating a big gap in satisfactiona cross elements.

Analysis of satisfaction with residential environment elements downtown and uptown shoed both safety and convenience to be high in downtown and uptown. Satisfaction with social aspects in both areas scored 5.27 points and 5.02 points out of 10, respectively.

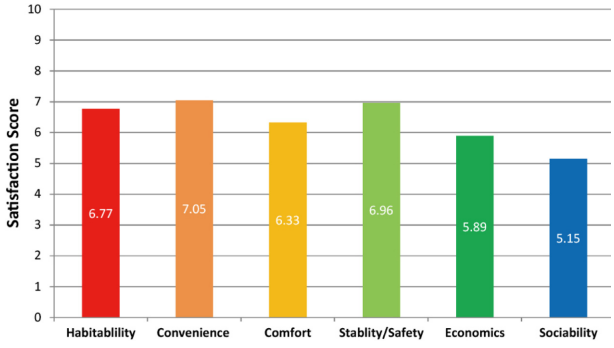


Figure 13. Survey on overall satisfaction from the user's perspective.

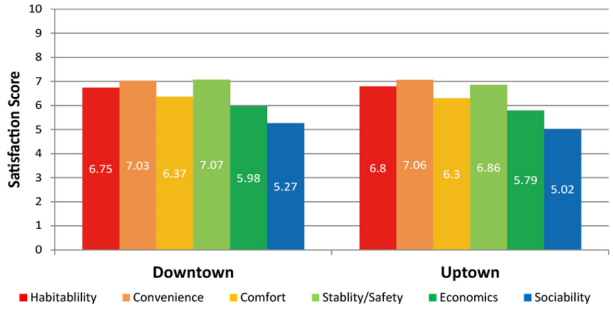


Figure 14. Comparison of overall satisfaction from the user's perspective across areas.

5. Conclusions

Since the establishment of Sewun Commercial Arcade

in 1967, Seoul City Government has been actively promoting the construction of mixed-use apartment complexes with industrialization and urbanization. This has somewhat contributed to the supply of housing and established a new form of housing. To develop mixed-use apartment complexes based on POE of the apartments as residential environments, improvement areas were concluded for better quality.

Distribution analysis, t-test and Likert scale were used to on the POE to identify areas of improvement through comparative analysis.

First, an analysis of the liveability by number of households, the entrance size and dress room size have statistically significant difference, with the satisfaction for these two elements high for 100~200 households and 200~300 households. Satisfaction was ranked, from highest to lowest: living room, entrance, bedroom, bathroom and kitchen. Satisfaction with storage space and dress rooom was low, indicating a need to increase the size of storage space in mixed-use apartment complexes.

Second, an analysis of the convenience for different sizes of complexes shows that for complementary facilities, convenience facilities, elevator size/ speed, number of parking spots and the educational environ-ment, satisfaction was high for 200~300 households, with statistically significant difference. From the user's perspective, the educational environment across areas had a high satisfaction downtown while the satisfaction for number of parking spots had a high satisfaction uptown.

Third, analysis of the pleasantness evaluation across different sizes of complexes showed the satisfaction with noise between floors, surrounding noise, light, landscape area and views to be high for 200~300 households, with statistically significant difference. Satisfaction with light was high downtown, while satisfaction with the natural ventilation was high uptown. There was no difference in terms of light pollution, noise between floors, views, surrounding noise and landscape area.

Fourth, analysis of the safety evaluation across different sizes of complexes shows satisfaction to be high for 200~300 households. Satisfaction was high downtown for access control, location of CCTV, and separation of visitor's routes, while satisfaction was low for lighting for parking lots. In terms of overall satisfaction, separation of route for visitors was ranked low.

Fifth, an analysis of the economics by size of complex or by area showed no statistically significant difference in the distribution analysis or T-test. On the Likert scale, the satisfaction level was 6 points out of 10, which was lower than other residential environment elements. This seems to indicate that the heating/ air conditioning costs and management costs were quite high.

Lastly, analysis of social aspects for each size of complex shows significant difference in terms of community facilities, interaction with neighbors and shared facilities. Satisfaction with communities was high for 200~300 households, while for other facilities, the satisfaction was high for 100~200 households. On a Likert scale, it scored 5 points out of 10, with satisfaction with a sense of community ranking the lowest at 4.68 points.

Based on these findings, the overall satisfaction was high for convenience, pleasantness, safety and social aspects for 200~300 households, with no significant difference in liveability or economics. Overall satisfaction on the Likert scale was highest for convenience, followed by safety, liveability, pleasantness, economics and social aspects. Due to the change in perception of convenience and safety of mixed-use apartment complexes, the residential environment has improved, while improvement is further needed for social aspects. There was no difference between Seoul and other regions.

This researcher hopes that based on the above findings, a high quality supply policy for mixed-use apartment complexes can be established.

In the preceding study, first the current status of the external infrastructure of mixed-use apartment complexes was reviewed and the issues outside the complex were presented, and second, the characteristics of the complex were presented.

This study conducted a survey on the satisfaction of residents living downtown or uptown in terms of liveability, convenience, pleasantness, safety, economics and social aspects. Based on the findings on the interior or exterior of the living environment, this study seeks to present a development model that can help with the tailored housing supply policies of Seoul.

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