

# A Study on the Analysis Interrelation mixed-used facility's Spatial configuration and Functions

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**Abstract**

*Development of the complex buildings creates the maximum returns in a way of a town inside a town, 24 hours operation a day and reflecting the complex concept to the facilities. Those which perform different functions are integrated one another but they execute their independent function and thus convenient use of them can be secured.*

*The space, however, becomes more complicated and they may feel it inconvenient to use as it has multiple applications and they may realize it difficult to get access to such space. It will eventually incur the economic loss. In order to avoid such loss, therefore, functions of the complex buildings should be arranged maintaining the connection among them.*

*I intend to find out the problems of the space arrangement of the facilities in mixed-use complex in Korea according to their functions along with finding out how to improve them. This study aims at realizing the necessity of strategic way arrangement of the facilities understanding the common allocation of the functions. In addition to the above approach, I would like to suggest how we should proceed with the facilities in mixed-use complex utilizing the result of the users' research on their contentment and its positive quantity analysis together with the evaluation of the actual users. Scope of this study covers the public and common area of the cubic and complex facilities in Korea such as the Central City, COEX, Lotte World and Yongsan I-Park Mall and its method shall be as follows : Firstly, I will examine the way of functional classification of the development on the complex application through the study of the literature concerned to re-adjust the categorization of functions. Secondly, I will perform the analysis of space configuration property for the positive quantity analysis comprehending the disposing shapes according to their functions. Thirdly, I will study the interrelation between their accommodating function and configuration.*

*According to my study, following are required to enhance the connection between each function of the facilities in mixed-use complex in the urban context. Firstly Public facilities like the public square are to be distributed not only to the middle of the buildings but also to the joining point with the external space of the city. Secondly size of the internal square and its exposing rate should be considered, which affects the composition and application of the functions. Also the linking axles among the accommodating functions should be considered and the axles should be arranged for*

*easy access to the public facilities. It may contribute to vitalizing the internal functions of the facilities enhancing the link between the city and its buildings and also among each function of the buildings.*

*The study is to understand the overall status of the facilities in mixed-use complex in Korea and their improvement and furthermore aims at promoting the perfection of developing such facilities in the future.*

## **Introduction**

### **1. Background and the purpose of this research**

Nowadays people don't go shopping solely for trading goods purpose. We can eat meals while shopping, and it has become able to get movie tickets and do the shopping until the start of the movie. And because of this advantage of convenience, increased number of people are now appreciating the mixed-used facility.

Today in many Korean cities, large-scale mixed-used facility plans and developments are actively taking place. Among many functions of mixed-used facility, especially the induction of entertainment facility's attraction function is widely recognized in order to appeal to people and gather consumers. As proven in many of previous researches, attraction facilities allow consumers to stay longer one place and produce synergy.

Mixed-used facility have distinctive characteristics in different nations. That means that mixed-used facility bears a significance as a place condensed with city lives based on the society's social characteristics and understandings on social aspects. Now I intend to examine the spacial backgrounds of the successful mixed-used facility and what their effects are.

The purpose of this study is to analyze the traits of mixed-used facility both in city structure and inside buildings, by analyzing overall spacial characteristics of mixed-used facility. In detail, I analyzed the spacial networks of attraction facilities and other ones (public area, food court, and consumption facilities), then analyze cultural traits based on that. The study is organized with two major analysis. Firstly, I analyzed how the paths to the attraction facilities are designed inside the mixed-used facility. Secondly, I analyzed the spacial arrangement of attraction facilities from others in mixed-used facility.

Mixed-used facility makes synergy effect by complementing and connecting various services, functions, and times in service in one large space. Main factors of functions compound commerce, accommodation, business, and cultures. Furthermore, it means a complex building that integrates cultural function, entertainment, attraction function, and public facilities. ULI in US requires Mixed-used facilities to have three or more services. Also, all the facilities should have spacial configurations. There exist many reasons for mixed-used facility being equipped with entertainment factors. They include weakening in competitive power of original facility, increase in demand for dining outside home, increase in leisure time, and increased demand for new experience. I begin this research because there is a great need for architecturally approached research today where entertainment factors in complex buildings are dramatical increasing. Therefore, we need use following three factors to analyze correlations through Space Syntax method. The three factors are overall spacial configuration, network of each facility's spacial configuration, and location of attraction facilities from nearby facilities.

## **2. Scope and Methodology**

### **1) The Scope of the Research**

This study classified, then examined several selected facilities which are located in the most hectic part of Seoul with large-scale mixed-used facility. Among those facilities, I have selected cases that are conveniently accessible by subway and also the ones that have various facilities including entertainment facilities. The selected cases are Central City, Coex, Lotte World, and I-park mall. First, we select sunken, courtyard, and front plaza available to reach from underground, subway

station, and the outside ground. These selected areas are the scope of this research. For the research of inside of buildings, we exclude upper stories, parking lots, and equipment facilities from the scope because they are practically individual in function.

## 2) The Methodology of the Research

First thing for this research, we figure out each facility's spacial network and each function through looking over the blueprints, then execute field studies. Secondly, by adopting Space Syntax methodology which is useful in analysis of space planning, we analyze depth by using spacial configuration J-graph. The analysis should be centered in public spaces with metropolitan means. In order to analyze the spacial configuration of mixed-used facilities in terms of metropolitan means, we use next three methods. First, analyze the connection to the city by figuring out accessibility to mixed-used facility. Second, analyze the spacial networks among funtions in mixed-used facility. Third, analyze the networks between attraction facilites in mixed-used facility and other functions. Finally, I will look into the problems of spacial configuration of mixed-used facilities based on previous analysis, then present the ways for configurational arrangement in mixed-used facility.

## Status Analysis on Selected Cases

### 1. Object of Analysis and Outline

Objects are limited to the facilities located in downtown and directly accessible from subway stations. Then, select four major UEC of Korea to have research on, which not only serve as attraction facilities for neighborhoods but for wide area. The four selected facilities are Central City, Coex Mall, Lotte World, and I-park Mall.

Coex Mall \_analysis on the Hierarchy of the Spacial function

		Coex Mall (2000) kangnamgu, Seoul, S.Korea		
		Function space	Name and scale	Location
Urban	Urban facility	subwqy	2 line	-
		terminal	O (urban center airport)	B6~26F
		underground shopping center	X	-
Intermediary open space	Pedestrian facility	plaza	approach plaza (O)	B1~1F
	Parking facility	parking lot	O	-
Inside building	Public facility	sunken	O	B1
		arcade	O	B1
		Public plaza	fountain plaza	B1
	Residential facility	-	-	-
	Business facility	office	-	-
		convention center	O (COEX convention)	B5~5F
	Commercial facility	department store	Hyndea department store, duty-free shop	B4~7F
		Shopping mall	Coex mall	B1
		Food place	Food court	B1
	accommodation facility	hotel	Grand intercontinental hotel(597room)	B4~33F
			Oakwood resident hotel	B6~29F
	Culture gathering facility	Cinema	Mega box cinema(17 room)	B1
		Exhibition	O (COEX galley, kimchi museum)	B4~4F
Leisure facility	aquarium	O (aquarium)	B1	
Management facility	-	-	-	

Central City \_analysis on the Hierarchy of the Spatial function

		Central City (2000) Seocho-gu, Seoul, S.Korea		
		Function space	Name and scale	Location
Urban	Urban facility	subwqy	3,7 line (9 line prearrangement)	B3~B1
		terminal	Kang-nam bus terminal	1F
		underground shopping center	Kang-nam terminal underground shopping center	B1
Intermediary open space	Pedestrian facility	plaza	approach plaza (O)	1F
	Parking facility	parking lot	O (1500대)	1F
Inside building	Public facility	sunken	O	B1~1F
		arcade	Auto mal arcade (conected floor)	1F
		Public plaza	O	1F
			fountain plaza	B1
	Business facility	-	-	-
		office	-	-
		convention center	millennium hall	6F
	Commercial facility	department store	Shinsegae department store	B2~
		Shopping mall	Yong Plaza	B1
			Theme mall	1F~3F
	Food place	Food court	1.5F, B1	
	Accommodation facility	hotel	Marriott hotel (497 room)	B5~
	Culture gathering facility	cinema	cinus central (6 room)	B1
		Wedding hall	central Wedding hall (4hall)	5F
Exhibition		O	5F	
Leisure facility	Spa	Central spa(in auto mall)	1F	
Management facility	-	-	-	

Lotte World \_analysis on the Hierarchy of the Spatial function

		Lotte World (1990) Songpagu, Seoul, S.Korea		
		Function space	Name and scale	Location
Urban	Urban facility	subwqy	2,8 line	B1
		terminal	X	-
		underground shopping center	Jamsil underground shopping center	B1
Intermediary open space	Pedestrian facility	plaza	approach plaza (O)	1F
	Parking facility	parking lot	O	-
Inside building	Public facility	sunken	X	-
		arcade	-	-
		Public plaza	O	B1
			fountain plaza	B1
	Residential facility	-	-	-
	Business facility	office	-	-
		convention center	-	-
	Commercial facility	department store	Lotte department store, duty-free shop	B1~
		Shopping mall	O	B1~3F
		Food place	Food court	B1
	Accommodation facility	hotel	Lotte hotel (533 room)	1F~
	Culture gathering facility	cinema	Lotte-world cinema (3 room)	B1
		Wedding hall	O	6F
	Leisure facility	swimming place	O	1F~2F
ice-rink		O	B1	
Lotte World theme park		O	B1~	
Management facility	-	-	-	

		I-park mall (2006) Yongsan-gu, Seoul, S.Korea		
		Function space	Name and scale	Location
Urban	Urban facility	subwqy	1line	3F
		Rail station	Yong-san station	3F
Intermediary open space	Pedestrian facility	plaza	Front plaza	1F~3F
	Parking facility	parking lot	O	-
Inside building	Public facility	sunken	X	-
		arcade	X	-
		Public plaza		Public plaza
			Court yard	3F~6F
			Foot plaza	7F
	Residential facility	-	-	-
	Business facility	office	-	-
		convention center	-	-
	Commercial facility	department store	I-park department store	1F~6F
		Shopping mall	Yong-san electronic machine mall	1F~6F
		Food place	Food court	3F~6F
	Accommodation facility	hotel	X	-
Culture gathering facility	cinema	O (10 room)	6F~7F	
	Wedding hall	O	6F	
	Culture center	O	5F	
Leisure facility	fitness center	O	7F	
Management facility				

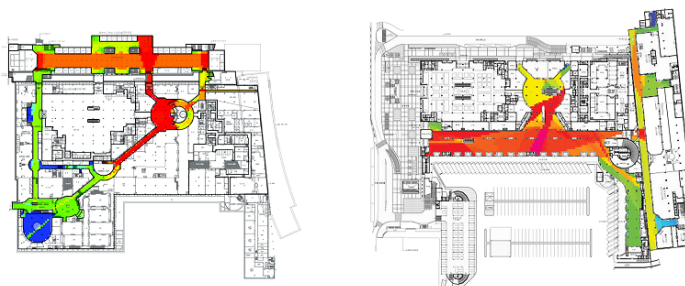
**Tables**

Function Hierarchies

**Analysis on relationship between function and arrangement, applying Space Syntax**

**1. Building a Space Syntax Model**

The space structure analysis is performed by applying Space Syntax methodology. Space structure analysis by Space Syntax defines accessibility based on visibility and permeability in structural relationship among facilities. The modeling's range has to meet either of following two conditions. First, it includes floors readily accessible by subway and have direct network or sunken which connects G.L to the facilities. Second, it has attraction facilities around public spaces such as hallway, hall, sunken, plaza, arcade, etc.



**Figure**

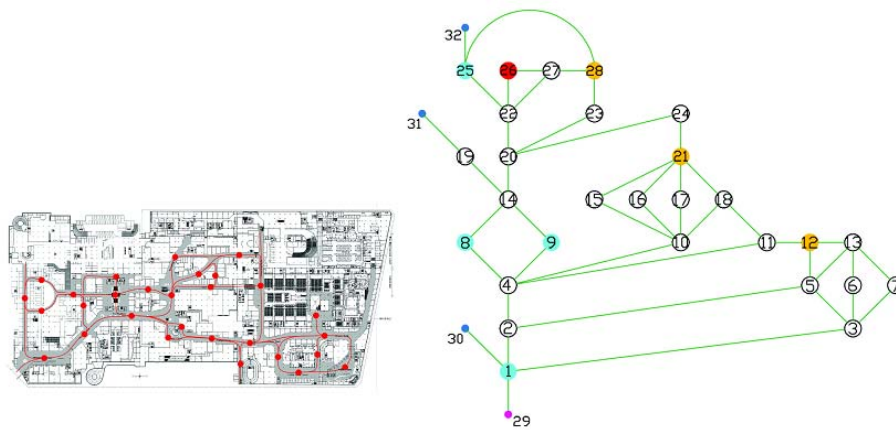
Analysis spacial configuration (EX\_ Central City B1(left), 1F(left),)

Therefore, we set the first basement (where subway and attraction facilities are located) and the public spaces on the ground floor as the scope for Central City, Coex Mall, and Lotte World. And for I-park mall, the analysis will be centered in public spaces from third floor to seventh floor where attraction facilities are located.

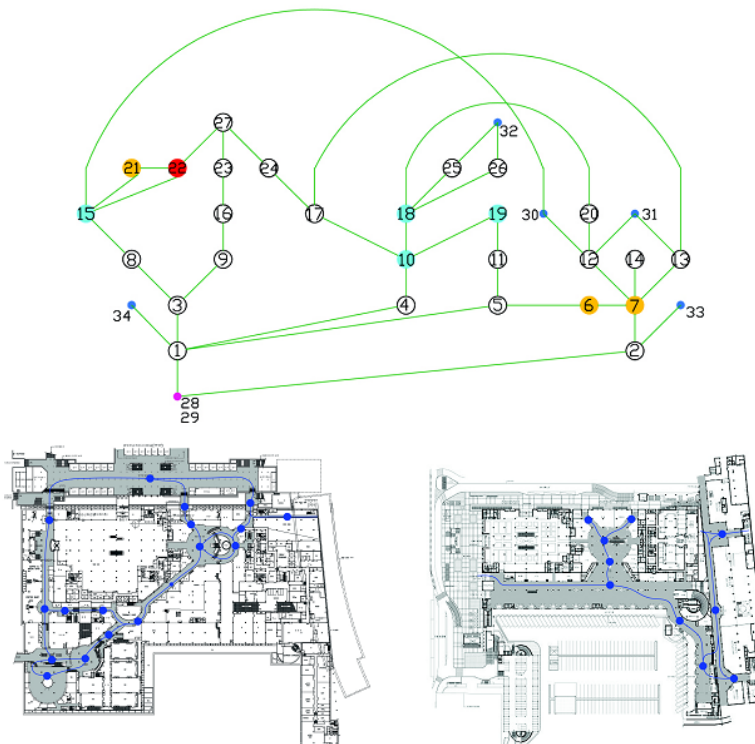
For building the model, when spaces divided by convex space meet within 45 degrees, it is seen as continuity space. Exception are when three or more convex spaces meet. we make interface map by numbering on convex space and inking the adjacent spaces. Then, analyze with J-graph in order to figure out the depth and links.

## 2. The Characteristics of Space Arrangement Network shown from the Space Syntax Model

### 1) Analysis of Metropolitan Links



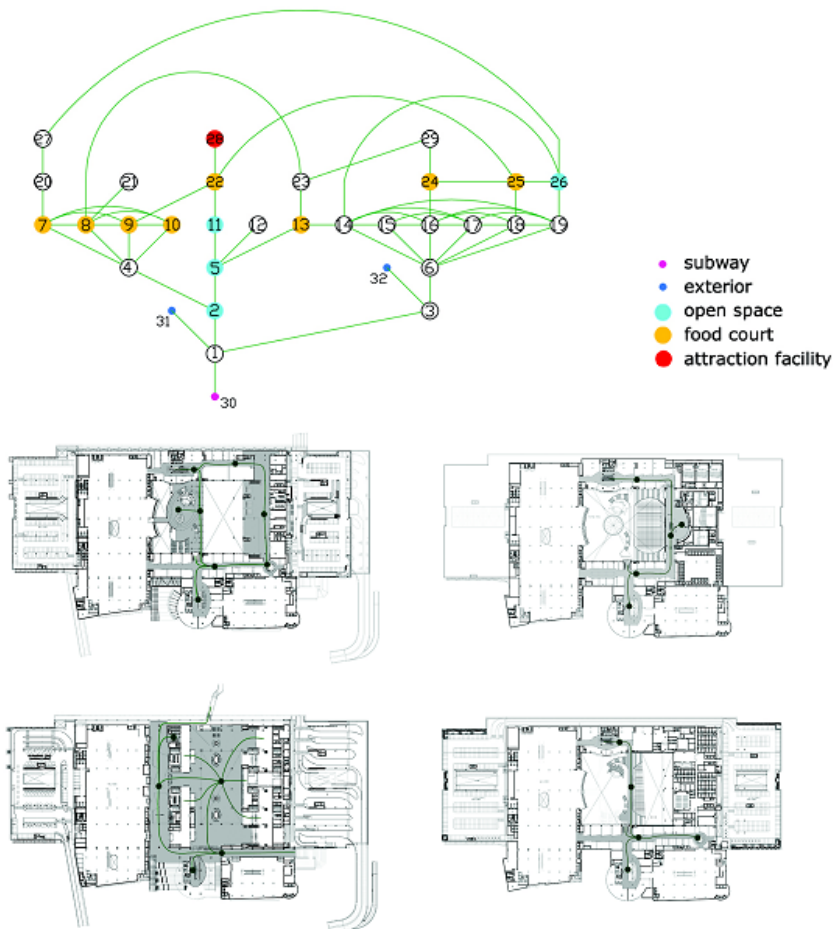
Coex Mall B1 Interface map & J-graph



Central City B1(left), 1F(right) Interface map & J-graph



Lotte World B1 Interface map & J-graph



I-park mall 3(left down), 4(left up), 5(right down), 6F(right up) Interface map & J-graph

**Figure 1**

The figure show the result of analysis on each facility's structure arrangement. The analysis is done by building J-graph of Space Syntax methodology. This allows analysis of accessibility from not only the nearby neighbors but also wide area. The four facility's accessibility shows lower integration value than average integration measure. The details for each facilities are demonstrated below.



	Coex Mall	Central City	Lotte World	I-park mall
Integration average	0.713	1.056	0.949	1.450
Subway Integration average	0.581	0.818	0.582	0.954
exterior Integration average	0.524	0.893	0.653	0.939

**Table**

*Analysis for urban access*

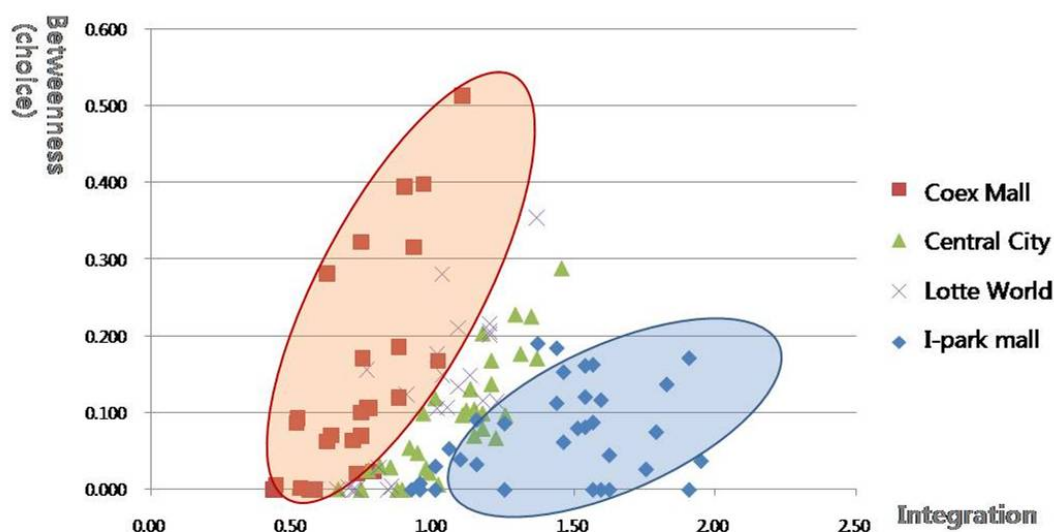
In other words, taking subway shows higher accessibility to any other spaces than approaching on ground. For Central City on the other hand, Subway's integration average(0.818) is lower than exterior integration average(0.893). Also for Lotte World, subway's integration average is lower than exterior integration average(0.653). Lastly for I-Park and exterior, the integration averages are about the same, leading us to conclude that different means to approach doesn't affect the accessibility.

Interpreting the results over again, Coex is more accessible by subway while Central City and Lotte World is more accessible by ground. The result suggests that arrangement of the access have great influence on accessibility to the building.

**2) Analysis on correlation of each mixed-used facility**

While each four case shows different spacial characteristics, the most contrasting ones are Coex and I-Park Mall. Coex has low integration overall and shows large standard division on Choice value. On the other hand, I-Park shows high integration overall and shows small standard division on Choice value. In other words, Coex has very distinct major network but not structurally centralized. On the contrary, I-Park Mall is structurally centralized while not having distinct major route that people use. These results are inferred from integration and choice value.

In addition to the understandings, several spaces in Coex shows high Choice value with larger than 0.3. Those spaces are where paths meet together. These spaces are very likely to be passed as they work as the bridges to combine many paths.



**Figure**

*Correlation graph for Integration and Choice of each facility*



	Coex Mall		Central City		Lotte World		I-park mall	
	Integration value	Choice value	Integration value	Choice value	Integration value	Choice value	Integration value	Choice value
1	0.750	0.171	1.292	0.228	0.763	0.157	1.287	0.184
2	0.931	0.316	1.008	0.119	1.031	0.281	1.398	0.171
3	0.638	0.071	1.207	0.169	1.200	0.207	1.287	0.149
4	1.103	0.514	1.176	0.100	1.050	0.107	1.351	0.117
5	0.765	0.107	1.146	0.105	1.031	0.150	1.501	0.139
6	0.529	0.002	1.176	0.080	0.840	0.000	1.474	0.139
7	0.529	0.002	1.456	0.289	1.089	0.134	1.247	0.072
8	1.016	0.168	1.207	0.138	0.852	0.004	1.398	0.127
9	1.016	0.168	0.917	0.055	1.176	0.116	1.398	0.092
10	0.878	0.186	1.349	0.226	1.200	0.202	1.175	0.000
11	0.878	0.120	0.986	0.022	0.726	0.000	1.192	0.031
12	0.743	0.070	1.310	0.177	1.130	0.149	0.965	0.000
13	0.623	0.063	1.256	0.097	1.367	0.355	1.655	0.154
14	0.966	0.398	1.223	0.067	1.013	0.106	1.689	0.169
15	0.788	0.024	1.132	0.131	1.225	0.115	1.308	0.000
16	0.788	0.024	0.771	0.026	1.200	0.217	1.351	0.051
17	0.788	0.024	1.369	0.171	0.904	0.124	1.308	0.000
18	0.729	0.021	1.176	0.204	1.089	0.212	1.501	0.089
19	0.715	0.065	0.975	0.028	1.013	0.177	1.398	0.037
20	0.898	0.395	1.118	0.104	0.700	0.003	1.039	0.043
21	0.772	0.106	0.873	0.000	0.805	0.029	0.921	0.000
22	0.441	0.006	0.945	0.048	0.717	0.000	1.422	0.156
23	0.743	0.323	0.811	0.031	0.582	0.000	1.398	0.105
24	0.743	0.100	1.105	0.097	0.582	0.000	1.228	0.043
25	0.518	0.094	0.849	0.029	0.660	0.000	1.422	0.105
26	0.436	0.000	0.849	0.029	0.717	0.000	1.192	0.066
27	0.515	0.087	0.965	0.100			1.001	0.041
28	0.623	0.282	0.890	0.000			0.932	0.000
29	0.581	0.000	0.745	0.000			1.111	0.020
30	0.581	0.000	1.146	0.071			0.872	0.000
31	0.560	0.000	1.019	0.007			0.872	0.000
32	0.432	0.000	0.664	0.001			0.872	0.000
33			0.745	0.000			1.008	0.000
34			0.890	0.000				
standard deviation	0.181	0.138	0.203	0.078	0.223	0.101	0.300	0.060

**Table**

*Analysis on the comparison for Integration and Choice*

**3) Analysis on correlations among functions of each mixed-used facility.**

Focusing on the public spaces, we enumerate the "numbered" spaces in order. Then, take out spaces with distinct purposes among all. Common spaces found in four selected cases are subway, outside, attraction facilities (cinema, theme park), Intermediary open spaces (sunken, plaza, courtyard), and food court. First to be excluded are where many functions exist together or, secondly, simply the paths. For instance, leti's assume that space 2 is pathway adjacent to other functions. The space 2 is not to be called to have distinctive function because restaurants and stores coexist.

We re-arrange the orders of spaces and measure how unified each is. The contents are shown in the table below.

	For key to zone around facilities, see figure	Mean Integration
Coex Mall	8 = 9 > 1 > 12 > 28 > 29 = 30 > event court event court sunken food court1 food court2 subway exterior1 1.02 1.02 0.75 0.74 0.62 0.58 0.58	0.71
	31 > 25 > 26 > 32 exterior2 Asem plaza theater&aquarium exterior3 0.56 0.52 0.44 0.43	
Central City	7 > 10 > 18 > 30 > 15 > 31 > 22 > food street plaza B1 plaza1F exterior1 sunken exterior2 theater 1.39 1.27 1.12 1.10 1.08 0.99 0.90	1.06
	21 > 28 > 29 = 33 > 32 food court subway(3th line) subway(7th line) exterior4 exterior3 0.83 0.82 0.71 0.71 0.63	
Lotte World	15 > 18 > 4 > 8 > 6 > 24 > 1 > theme parkadventure' glass fountain plaza2 food street food court theater fountain plaza1 &ice-link dome 1.37 1.08 1.05 0.85 0.84 0.81 0.75	0.95
	26 > 25 > 24 = 23 exterior3 exterior2 exterior1 subway 0.72 0.66 0.58 0.58	
I-park mall	5 > 2 = 13 > 11 > 24 > 8 > 25 > courtyard4F courtyard3F food street 4F courtyard5F food street 5F food street 4F food street 6F 1.95 1.91 1.91 1.76 1.63 1.57 1.54	1.45
	10 = 9 > 7 > 26 > 28 = 33 > 30 = food street 5F food street 6F food street 7F food court 7F theater6F food court 6F highway3F 1.51 1.51 1.44 1.25 1.01 1.01 0.92	
	31 > 32 exterior1 exterior2 0.92 0.89	

**Table**

*Integration order for major functions of each facility*

- The 8,9(event court) located in the center of underground level has the highest Integration value(1.02) and the next in order is 1(sunken) which is connected with the subway Even though Coex has narrow and long spacial configuration, it is easily available because of above two spaces.

Two attraction facilities, the cinema and the aquarium, have relatively low Integration value(0.44) which is even lower than average overall Integration value(0.71). Because Coex is developed horizontally, it is considered to attract consumers to even spaces with low mobility. J-graph is used to find out relationship between the cinema and other facilities. Depth is 1 from 26 to 25(Asem plaza), it is 2 at 28(Food Court 2).

- In Central City, the food court connecting underground plaza and the first floor has highest Integration value(1.39), however, lacks recognition from people. That is because the space is narrow and not visible. The next in order is underground plaza, and ground floor plaza, respectively. Central City's attraction facilities, theater, also has Integration value(0.90) which is lower than the average(1.056). J-graph shows the only spaces available to go from space 22 without passing through other spaces are 15(sunken) and 21(food court). Facilities around the cinema are arranged to be used conveniently.
- For Lotte World, The theme park and the central facility located at the entrance of the ice-rink have the highest Integration value(1.37). The next in orders are glass dome, water fountain plaza. There are various attraction facilities in Lotte World, but the most active ones are theme park and ice-rink. Places connected from 15 are 18 and 4 which have depth 2. Open space has been designed around to make it easier to find the location of theme park. Adventure glass-dome works as a courtyard connecting theme park and ice-rink. In the case of theme park, it contains many other facilities and people tend to stay longer than cinemas. Therefore, none of the food selling facilities are located nearby.
- I-Park mall has horizontal structure, thus all spaces are connected directly. It is very distinctive from previous three cases. This may arise confusion to people, since there is no standard path to the attraction facilities. However, the facilities overall have high correlations and Integration value. Investigating Integration value allows us to find that the each courtyard(5, 2, 11) are the center for each floor(fourth, fifth, and sixth) it is located. The theater, a attraction facility, has Integration value(1.01) lower than the average(1.45). Again, lets look into nearby facility arrangement. Space directly connected from 28 is the food court(33), restaurants(25, 9) and courtyard(11). Depth from the cinema is 1 each. This means that it is readily available to use as nearby facilities are directly connected with the theater. However, there may be some inconvenience because the restaurants are too far from each other.
- Attraction facilities are located in places with low Integration value. This phenomenon is shown in all cases excluding Lotte World. People using the attraction facilities can get the information for other facilities as they try to reach their destination. Facility synergy effects are also produced.

Open spaces or food court are located maximum depth 2 from the complex building's attraction facilities. They are located nearby because they are the means to provide rest and meals for attraction facilities' consumers. They also often be the meeting place. They serve as the landmarks as they are located in spaces with high Integration value.

## Conclusion

### 1. Summary of the Research's Outcome

The research started with studies on mixed-used facility, a hallmark of urban life, on the basis of cultural understanding. The research went on to figure out the correlation between each function and spacial arrangement of mixed-used facilities. In order for an efficient research, the scope of the study was limited on floors that are equipped with attraction facilities, and also accessible from subways or directly from the outside. For detailed analysis, the selected floors were separated in to many zones.

The below is the outcome of the research which include characteristics of spacial configuration and applicable process for improvements.

- Looking at the overall space structure for each case, they differ according to development planning. Because Coex adopted horizontal planning, major networks used by consumers are distinct while it's not centralized. To help recognition of other spaces, Intermediary open space with high integration value are planned in several spots. On the other hand, I-Park Mall has perpendicular planning and lacks major networks. So intermediary spaces with high integration value work as the center in each floor. It seems that intermediary spaces diminishes the disadvantage of lacking major network in each floor.

- Looking at the relationship between the attraction facilities and overall arrangement, we can find that Coex is very active despite its long and narrow structure and low integration value of the theater. That is because the attraction facilities are located deep inside with low mobility, thus drawing people to every space evenly. Also the arrangement of intermediary spaces (event court, sunken) on the way to the theater helps people to find their ways.

In the case of Central City, attraction facilities are well connected with nearby facility, but lack accessibility. That is because intermediary spaces on the way to the attraction facilities are too narrow that they are not visible. Intermediary space in each floor should be more visible for more availability to overall facilities.

- Looking at the arrangement of attraction facilities and nearby functions, intermediary spaces and restaurants are located near attraction facilities within depth 2 the maximum for all the mixed-used facility with an exception of Lotte World. However, the current status shows that open space dining places are separated and lacks ant connection. We should plan to connect these facilities and make these spaces as part of attraction spaces themselves.

## 2. The Significance of the Research and Application

First, as the research dealt with various facilities with different functions, we facilitated the procedure by zoning the spaces. The significance of zoning methodology have proven in this research. It is certain that this methodology will be worthwhile for any other following researches related to analyzing mixed-used facilities.

Second, this research demonstrates how SCs in different country survive with their own characteristics and shows the ways for mixed-used facilities.

Third, this research reminds the need for further research, and encourages further considerations on urban association and functional space arrangement for mixed-used facility plans. This research analysed space arrangement, and need to be verified by actual architectures through study on pedestrian behavior and following comparison-analysis

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