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## The Analysis on the Changes of Commercial Areas by development of Innovation City

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# The Analysis on the Changes of Commercial Areas by development of Innovation City<sup>1</sup>

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## Abstract

The first stage in the Innovation City(IC) project that public agencies move into local to create a stronghold of the future growth is almost done so municipalities and citizen including researchers are interest in the growing effect of the existing cities after the formation of IC.

We expect that the development of the IC will bring about some positive effects such as growth of local cities, the revitalization of the economy and the increase of employment. In this regard, this study aims to analyze the effect of existing city in the revitalization of commercial areas after developing this project.

The distance from the commercial areas to the central points of each district that used UCL Depthmap to select the main road with connectivity was measured with a view to establish the database of the Huff's model and established the Huff's model.

Lastly, the number of actual customers in two commercial areas which had investigated the inside data was compared by applying the Huff's model as of 2013 to calculate the value of  $\alpha$  and  $\beta$ . This method analyzes to decline or grow between the existing commercial areas and IC commercial area after developing.

Actually, the existing commercial areas was declined as a result of analysis, so this study intends to suggest the activation methods of the existing city through the development of IC to prevent the decline of existing city due to the development of the IC by identifying the commercial areas and present the coping strategies with the decline of the city.

## Keywords

Innovation City, Commercial Area, Huff's Model, UCL Depthmap

## JEL classification

O18, R11, R15, R58

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## **I . Introduction**

The Innovation City Project, which has started in 2007 to vitalize regional development by moving public institutions to regional locations, consists of three steps: 1<sup>st</sup> step of settling existing public institutions, 2<sup>nd</sup> step of settling industry and university research institutions, and 3<sup>rd</sup> step of innovation expansion.

Innovation City (IC) is a futuristic city development plan that aims to balance national development and boost competitiveness by collaboration between outstanding talent in industry, university and research institutions, in order to create a high-tech city that leads the knowledge-based society. There are currently 11 cities being developed under this plan. As the completion of the 1<sup>st</sup> step nears, both hopes and concerns exist regarding the impact innovation cities can have on existing cities.

Despite these concerns, existing research has concentrated exclusively on the effects such as spatial composition, development of local industries and development direction. Very little research has been done on the impact of innovation cities on existing city centers.

Therefore, this research focuses on changes in commercial areas caused by innovation city development, and studied how the target population of innovation cities and creation of new large commercial areas can affect existing city commercial centers.

We have chosen the Jinju innovation city and Jinju city center as the physical area of our research, among the 11 innovation cities. We used the Huff model, which is often used to analyze the commercial area of commercial facilities, to predict the change of commercial areas of select 9 commercial areas in Jinju city and a planned commercial area in the Jinju innovation city.

First, in order to predict commercial shares, we created a Huff model database by measuring the per-dong population, area size of main commercial area and the distance between the commercial area and each dong. Next, we used the internal information of each commercial area to investigate the number of actual customers, and compared it with predicted values to calculate  $\alpha$ ,  $\beta$  values to create a 'Jinju 2013 Huff model'.

Lastly, we added the target population and planned commercial area of the

innovation city to create a ‘Jinju 2014 Huff model’ to analyze the commercial area changes due to the innovation city development.

## **II. Theoretical Study**

### **1. Concept of Innovation City**

The innovation city plan is a plan pushed by the government in order to recognize and solve the problem of polarized development of the country due to capital city based growth and regional decline.

Innovation cities, developed under the “Special act on the construction and support of innovation city by moving public institutions to regional cities”, comes in four different themes: (1) Regional strongpoint cities with collaboration between industry, academy, research and government facilities, (2) Specialized cities with regional themes, (3) Eco-green cities and (4) Educational and cultural cities that facilitate learning and creative exchange.

Planned population is approximately 20,000 to 50,000, and development is planned in three phases. The scale of city development is planned to be low-density, around 250~350 people/ha, in consideration of preserving nature and comfortable living environment. It will be sized appropriately, including the relocated public institutions and academic/industry/research clusters, according to the average level of Korean new cities, with 82.6m<sup>2</sup>~165.3m<sup>2</sup> per person, adding up to 1.65km<sup>2</sup>~3.31km<sup>2</sup> for 20,000 people and 4.96km<sup>2</sup>~8.26km<sup>2</sup> for 50,000 people.

### **2. Huff’s model**

In view of the analysis of commercial zones by the Huff's model based on the theoretical grounding of Luce’s choice axiom, Huff (1962: 1964) adopted the utility theory into the existing stochastic gravity model, indicating that commercial areas can be explained by the choice probability model from the perspective that probabilistic approach is needed rather than the deterministic approach of Reilly and Converse. In addition, since consumers are likely to use various stores rather than using one particular shop when a large number of alternative stores or commercial areas exist, Huff set up the hypothesis that they are liable to choose each store or commercial area, which is fit for them, within the fixed region in a probabilistic way as indicated in the Formula (1) below by transferring the law of retail gravitation which was analyzed on a basis of the city to the

law of retail probability.

$$U_{ij} = \frac{S_j^\alpha}{D_{ij}^\beta} \quad P_{ij} = \frac{\frac{S_j^\alpha}{D_{ij}^\beta}}{\sum_{j=1}^n \frac{S_j^\alpha}{D_{ij}^\beta}}$$

Annotation  
 Uij: the utility of customer i to the commercial facility j  
 Sj : Store size of commercial facility j  
 Dij: Distance from customer i to commercial facility i  
 α : The sensitivity coefficient of customer about store size  
 β : The sensitivity coefficient about distance  
 Pij: The visit probability of i customer to j  
 n : The number of stores considered by customers

Formula.1 Huff's Model

### 3. Space Syntax

Space syntax is a method of investigating spatial complexes in order to objectively and quantitatively assesses each space's importance and social impact. Hiller asserted that the space usage pattern is a social attribute of spatial complexes that has a deep impact on the users' social relationships, and also asserted that the spatial complex means not only the relationship between two connected spaces, but connection between all spaces.

Also, the importance in terms of spatial complexes is analyzed according to accessibility from all spaces, and this accessibility is defined as 'Integration'. A space with high integration means it has good accessibility from other spaces.

Much prior research has been done on space syntax, and it was possible to connect all spaces in a single line and calculate the sum of distances from a particular space to all other spaces. (Yong-Soo Jin, 2004) However, this method is difficult to rid of subjective noise resulting in different results from different researchers, so we used the UCL Depthmap, which was developed to allow a more objective analysis.

Also, this research used the UCL Depthmap to determine the route with the highest integrity and connectivity and to calculate the actual distance, so we omit the detailed academic aspects of the Depthmap.

### 4. Previous work

#### 1) Previous work on innovation cities

Research on innovation cities has been done ever since early 2000s, before innovation cities have started development yet.

Hang-jip Kim (2010) has conducted research on creation of cultural areas in innovation cities and how to increase the demand for culture, choosing

the Naju innovation city as the target. He also proposed the creation of a complex cultural belt using the cultural education facilities of the innovation city as an alternative to the traditional distributed cultural facility planning methods.

Gun-Sub Sohn et.al., (2007) analyzed the economic effects of transplanting public institutions to regions and predicted the economic effects of the public institutions that will be moved to Daegu and Gyungbuk area. By comparing the two situations of before and after the public institutions are moved, it was predicted that the economic effects of public institutions moving to Daegu and Gyungbuk area is very large.

Heeyeon Hwang et.al., (2006) have constructed a basic model of the innovation system to develop and objectify a city construction program that approaches industry location and city development in an integrated fashion. They defined basic models as innovation basis, innovation function, innovation type and governance, in order to research a multi-dimensional plan and strengthen the consistency between material and immaterial research areas and the completeness of planning.

Man-Hyung Lee et.al., (2005) conducted research on settlement of urban functions due to innovation city construction by studying the dynamic characteristics of similar cases, in order to develop a logic for policies related to multi-dimensional issues on innovation city construction and management.

Most existing research concentrated mainly on development of innovation cities, such as the effects of relocation of public institutions, space organization and direction of city construction, and lacks research on estimating effects by realistic analysis.

## **2) Previous work on Huff model**

Studies on commercial and market share using the Huff model have proven the usefulness of the Huff model, and there is ongoing research on additional variables to allow more accurate analysis.

Sang-Gyu Lee (2004) have configured commercial areas as concentric circles, and configured the factors of large department stores as population, economy, transportation, land usage and growth potential, and conducted multiple regression analysis to conclude that most commercial areas exist within the area of 2~5kms.

Nam-Woo Kim (2002) studied methods to estimate market shares, the key factor in analyzing commercial areas of commercial facilities, in a more objective and effective fashion, and demonstrated the possibility of its actual deployment. He especially applied the Huff statistical model, which has been used to delineate commercial areas to estimate market share, and generated a regression model as objective information and compared it against actual sales numbers to study the possibility of deployment.

Suk-Hwei Lim et.al., (2000) introduced a way to objectively and effectively estimate market share in analyzing market and commercial areas of commercial facilities, and used the Huff model to estimate market share. While estimating market share, they used distance and facility area, the most basic variable in analyzing market share of commercial areas, to provide an efficient analysis tool, and compared the estimated values to actual sales numbers from department stores to demonstrate its effectiveness.

Research on commercial area analysis using the Huff model focus on analyzing market shares, and does not go beyond its limitations imposed by fixing the  $\alpha$ ,  $\beta$  values to 1 and 2. They also do not study cases when new commercial areas are created.

### **3) Existing research on spatial syntax**

Research using spatial syntax has mainly focused on analyzing the change in space as change in street environment by studying the street characteristics, shape of the street network and periodical characteristics of street structure.

Gyung-Hwan Yeon et.al., (2008) used space syntax to quantify the characteristics of the street network of Chungju city, and analyzed the structure of the city as a process where the downtown expands every period, and showed that the city structure prohibited smooth connection between existing areas and the newly created suburb street networks.

Heeyeon Hwang et.al., (2007) analyzed Chungju city's Wongeungi eco-park's street network to see if it is a good fit with an eco-park's characteristics, using spatial syntax. They have concluded that the park has good accessibility as required of a neighborhood park, while the internal street network is aptly positioned according to area to be preserved and to be accessed. The data they collected using spatial syntax and questionnaires showed that the park's streets were apt for the eco-park that

the citizens wanted, and also showed that further research is needed on improving the logic, by using assumptions about the shape, size and configuration of space.

Gyung-Hwan Yoo et.al., (2006) analyzed Seoul city's balanced development plan, which plans to improve Gangbuk region's lacking residential environment and develop key areas of each residential area in order to diversify the city structure. They estimated the spatial-structural impact of such a plan and concluded that despite its goals, the positive effects of such plans might be minor.

This study alluded that in order to effectively accomplish the goals of the plan, it is not enough to plan only for the physical improvements, but also to improve the infrastructure considering the spatial connection with surrounding regions. However, the balanced development plan was still only a plan and not a fixed project, so the study lacked realistic validation.

Dong-guk Jang (2004) selected 6 areas among metropolitan cities and analyzed their spatial structure, and studied its relations with the space usage patterns based on traffic amount, to see if this analysis can be applied to Korean cities.

### **3. Differences with existing work**

According to our study on existing work, there has been no previous work on commercial area changes due to innovation city construction, and research using the Huff model mostly focused only on intra-area commercial areas' market shares. In the area of research using spatial syntax, modelling techniques were becoming more effective, and other studies such as traffic prediction were being done alongside spatial structure analysis.

This study differentiates itself from previous studies by using spatial syntax to select a route with high integration, and applying it to the Huff model to determine the effects of innovation city construction and development of new commercial areas on existing commercial areas, and predict commercial areas that might decline.

We also used the UCL Depthmap's integration and mean depth to determine an objective route, and applied the actual distance of the determined route to the Huff model to provide a different method compared to existing Huff model studies. We predict the impact of innovation city construction using



such analysis frameworks.

### **III. Status of target areas, and analysis framework configuration**

#### **1. Status of target areas**

Due to the Shi-Gun integration program starting January, 1995, Jinju-shi and Jinyang-gun has been integrated, and the current Jinju city center consists of 21 dong. Its total area is 712,84km<sup>2</sup>, making it the 50<sup>th</sup> largest city among 234 local government in Korea and 6<sup>th</sup> largest among Gyungnam local governments. As of December 2013, the population of Jinju is 341,201.

Jinju is also the central area of western Gyungnam, and shares borders with many cities including Sancheong, Euiryeong, Haman, Changwon, Gosung, Sacheon and Hadong. It is also located on the cross point between the Namhae highway and Tongyeong-Jinju-Daejeon highway, making it a hub city connecting multiple key cities in Korea.

According to a detailed per-dong status analysis of population change, the dong that are continuously declining were found to be in the order of Shinan-dong, Hadae-2-dong, Sangdae-1-dong, Sangbongseo-dong, Okbong-dong, Sangdae-2-dong, Hadae-1-dong, Sangpyong-dong Pyeonggeo-dong and Gangnam-dong. Shinan-dong showed especially steep decline.

On the other hand, the dong that were growing were in the order of Gaho-dong, Chojang-dong, Ihyeon-dong and Bongan-dong, where Gaho-dong was growing the most rapidly. In the case of Jinju as a whole, due to population growth and improvement of various economic indicators, Jinju was categorized as the only growing city in west Gyungnam, and is turning into a lively industrial cultural city by bringing in many promising industries to improve local economy and create jobs.

The Jinju innovation city is located in Munsan, Jinju and plans to become the mechatronics hub of Korea, by becoming the intelligent robot industry cluster, which is the core of prominent domestic industries such as mechanics and aviation.

Starting with the public institution migration plan in April, 2004, the directions for innovation city construction has been chosen to be; differentiation of functions, complementary relations with existing Jinju

city industries, core function development to increase wide-range innovation capabilities and green water-friendly construction. The public institutions currently preparing for relocations include three housing construction institutions and three industrial institutions, and add up to a total of 11 public institutions.



Fig.1 Jinju Innovation City

## 2. Analysis framework configuration

Before using the Huff model to configure the commercial area change analysis framework, we first used ArcGIS 9.3 to determine the center of 21 dong on the map like <Fig.2>, and measured the size of 9 representative commercial areas in order to construct the basic framework of the model.

Table. 1 Huff's model database

(Unit : m<sup>2</sup>, km)

구분	Households	A	B	C	D	E	F	G	H	I	J
<b>Total Floor Area*</b>	-	<b>1,233</b>	<b>9,427</b>	<b>13,213</b>	<b>23,584</b>	<b>2,062</b>	<b>2,373</b>	<b>2,160</b>	<b>6,579</b>	<b>10,708</b>	<b>29,976</b>
Panmun-1	3,488	4.19	5.89	5.2	4.8	4.28	9.36	10.34	10.31	10.47	13
Ihyon-2	899	5.31	3.01	4.2	3.33	2.77	7.57	9.22	8.77	8.21	10.75
Pyeonggeo-3	2,284	3.39	2.24	3.37	3.54	3.04	5.99	7.27	8.09	6.99	9.93
Sinan-4	725	2.14	1.5	2.21	2.66	1.76	4.74	6.02	7.76	6.15	8.68
Sangbong-east-5	1,194	3.31	2	2.52	2.01	1.51	5.78	7.19	7.45	7.32	9.86
Sangbong-west-6	2,243	3.74	2.4	2.91	2.41	1.91	6.22	6.86	7.16	7.44	10.25
Bongan-7	1,881	2.26	1.04	1.55	1.05	0.54	4.95	6.35	7.31	6.34	8.08
Seongji-8	1,147	1.6	0.41	1.06	1.81	1.15	4.21	5.49	6.56	5.61	8.28
Bongsu-9	1,556	1.71	1.56	1.26	0.41	1.16	3.84	5.12	6.42	5.24	8.13
Joongang-10	2,144	1.09	1.03	0.35	0.85	1.57	3.7	5.33	5.95	5.1	6.9
Okbong-11	1,049	2.14	2.01	1.31	1.71	2.53	3.25	4.53	4.91	4.65	7.19
Gangnam-12	1,960	0.87	1.98	1.31	1.93	2.23	3.48	4.76	5.83	4.88	7.68
Manggyeong-13	1,096	2.1	3.49	2.81	3.45	3.19	3.18	4.46	5.69	4.59	7.38
Chiram-14	2,030	0.69	2.33	1.81	2.43	3.03	2.21	3.49	4.56	3.61	6.41
Chojang-15	818	4.87	6.54	5.98	6.31	7.08	2.53	0.97	0.87	1.35	4.37
Hadae-1-16	1,709	4.91	6.31	5.73	6.35	6.72	2.42	1.73	1.06	1.08	5.33
Hadae-2-17	1,591	4.85	6.52	5.96	6.29	7.06	2.51	0.95	0.85	1.34	4.35
Sangdae-1-18	1,770	2.54	3.85	3.28	3.89	4.22	0.89	1.4	2.42	1.52	5.74
Sangdae-2-19	3,717	3.92	5.7	4.91	5.35	6.24	1.57	0.82	1.43	1.73	4.15
Sangpyeong-20	2,059	3.57	5.25	4.69	5.17	5.95	1.23	2.2	3.21	2.32	4.83
Gaho-21	1,592	4.41	6.2	5.52	6.14	6.74	4.75	4.81	5.63	4.93	7.44
혁신도시	4,769	6.93	8.72	8.04	8.37	9.26	4.59	4.19	4.79	4.75	0.36

\* : Statistics



Fig.2 The center of 21 dongs and Commercial Areas

Next, we used the integration factor of the UCL Depthmap to determine the main routes between each dong's center to each commercial areas, and the measured the actual distance to create the database for the Huff model, which is listed in <Table 1>.

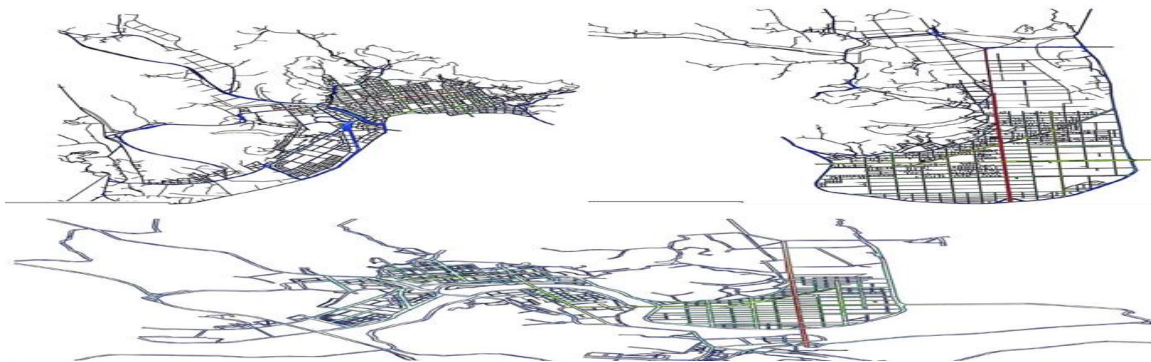


Fig.3 Determine the main routes

Furthermore, we used the Jinju city statistics from the 2013 household survey to apply spending on items available in the 9 commercial areas including groceries, liquor and clothing to the number of households in each dong to calculate the average visitor per day. The reason in applying the data to per-dong household count is because due to the usage patterns of commercial areas, usage happens per household, and when only per-dong population is taken into account, information regarding children and senile citizens might introduce errors in the analysis.

The Huff model is an analysis method that calculates the market share in a certain commercial area, and not per points-in-time. Therefore, we restricted overall analysis to per-day average market share and generated a Huff model database. In order to verify the results from the Huff model, we compared the actual per-day visitor count from internal data to determine  $\alpha$ ,  $\beta$  values and configured the 2013 Jinju model.

Lastly, we further took into account the target population of innovation

cities and planned area of new commercial areas to configure the model of Jinju after the construction of the innovation city, and compared it against the 2013 model. This is how we predicted the commercial area change and analyzed the existing commercial areas that might be affected by it.

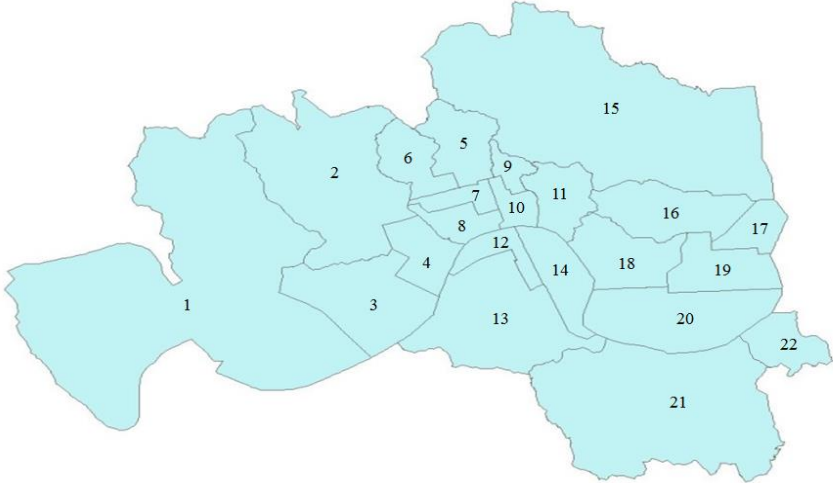


Fig.4 Each Dong number

**IV. Actual analysis**

**1. Determining  $\alpha$ ,  $\beta$  values based on actually measured data**

In order to generate the Huff model that can be applied to Jinju, we first applied the hypothesis of the modified Huff model, ‘ $\alpha=1$ ,  $\beta=2$ ’, and configured the ‘2013 Jinju Huff model before modification’. Then we measured the per-day average visitor count using internal data from two representative commercial areas in Jinju.

We then compared the actually measured visitor number against the Huff model with the ‘ $\alpha=1$ ,  $\beta=2$ ’ hypothesis and calculated the  $\alpha$ ,  $\beta$  values with the smallest error to create the 2013 Jinju Huff model. We discarded data with too large error rates because we cannot accurately measure the change in commercial areas between 2013 and 2104 using this data, and therefore statistically useless.

The result of this calculation gave values  $\alpha=1.5$ ,  $\beta=2.6$ , and compared to actual per-day visitor count, the error was -17 for C, which is -0.36%, and 6 in H, which is 0.10% error. Both values showed less than 1% error, which showed that both  $\alpha$ ,  $\beta$  values can statistically be applied. Therefore we applied this data to the 2013 Huff model.

Table. 2 Calculate  $\alpha$  and  $\beta$  for applying to the Huff's model ( Unit : household )

Commercial Area		Average Customers*		Commercial Area		Average Customers*	
B		4685		I		5862	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$	
Value	1.4	1.5	1.4	1.6	1.4	1.7	
B	4838		4880		4924		
I	5785		5837		5881		
Error	B	-153	B	-195	B	-239	
	I	77	I	-19	I	-19	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$	
Value	1.5	1.5	1.5	1.6	1.5	1.7	
B	4660		4702		4746		
I	5790		5856		5913		
Error	B	25	B	-17	B	-61	
	I	72	I	6	I	-51	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$	
Value	1.6	1.6	1.6	1.7	1.6	1.8	
B	4573		4561		4606		
I	5355		5926		5987		
Error	B	112	B	124	B	79	
	I	507	I	-64	I	-125	

Annotation \* : Inside data

## 2. Analysis of commercial area change

In order to analyze the commercial area change before and after innovation city construction, we applied the  $\alpha$ ,  $\beta$  values to the '2013 Jinju Huff model before modification' to create the '2013 Jinju model after modification', and analyzed the per-commercial area customer share for each commercial area.

Table. 3 the decrease of households and the largest decrease of household visitors at the Galleria

Classification	Decline of households	Rate	Classification	Decline of Customers	Distance of Commercial area
Gaho-21	1,040	29.81%	Gaho-21	419	7.44 km
Sangpyeong-20	656	30.60%	Pyeonggeo-3	189	9.93 km
Sangdae-2-19	521	19.85%	Manggyeong-13	168	7.38 km
Pyeonggeo-3	415	11.16%	Panmun-1	145	13.00 km
Manggyeong-13	369	16.17%	Ihyon-2	130	10.75 km
Chojang-15	364	21.28%	Chiram-14	79	6.41 km
Sangdae-1-18	360	16.04%	Sangbong-west-6	71	10.25 km
Hadae-2-17	335	21.04%	Sinan-4	68	8.68 km
Hadae-1-16	329	16.00%	Sangbong-east-5	44	9.86 km
Panmun-1	253	14.28%	Okbong-11	38	7.19 km
Ihyon-2	227	11.19%	Gangnam-12	27	7.68 km
Chiram-14	184	11.58%	Bongan-7	25	8.08 km
Sinan-4	162	8.29%	Bongsu-9	7	8.13 km
Sangbong-east-5	120	7.69%	Sangpyeong-20	181	4.83 km
Okbong-11	75	6.82%	Sangdae-1-18	89	5.74 km
Sangbong-west-6	73	6.35%	Seongji-8	5	8.28 km
Gangnam-12	60	6.67%	Joongang-10	5	6.90 km
Bongan-7	40	3.33%	Sangdae-2-19	93	4.15 km
Seongji-8	26	2.53%	Chojang-15	38	4.37 km
Joongang-10	14	1.67%	Hadae-2-17	35	4.35 km
Bongsu-9	8	1.07%	Hadae-1-16	33	5.33 km

Next, we applied the planned innovation city population as a detail of the Huff model, and used the area size of commercial areas that is predicted to purchase commercial land to create a similar category, as well as using the Depthmap in the same way we did to measure the distance between each dong to existing commercial areas to create the ‘2014 Jinju Huff model’ and started analysis.

First, according to analysis on the decrease of households using commercial areas, the number of users of existing commercial areas is projected to decrease by 5,630 households, and the dong with the highest decrease is Gaho-dong, where among the 3,488 households in Gaho-dong, 1,040 households will stop visiting existing commercial centers, which add up to 29.81% of the entire households. In terms of percentage, Sangpyong-dong’s decrease is projected to be 30.60%.

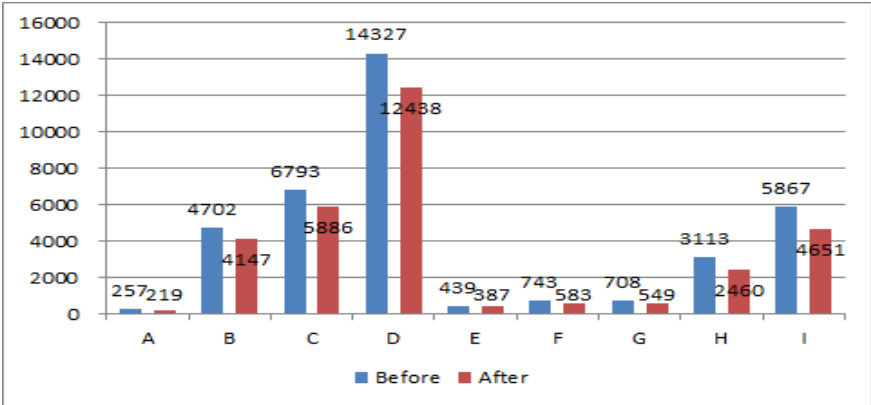


Fig. 5 The analysis on the change of commercial areas

Comparing the top 3 dongs with the highest decrease, and bottom 3 dongs with the least amount of decrease, one of the top 3 areas, Gaho-dong’s nearest commercial facility is at 4.41km(Cheonjeon market), and most commercial facilities are located over 4kms away. Because of this, even though the distance between Gaho-dong and commercial areas in the innovation cities are more than 7kms, the households visiting the new commercial facilities is projected to increase. Sangpyong-dong and Sangdae-2-dong are located within 5kms of the planned commercial areas. In the case of Sangpyeong-dong, the nearest commercial facility is Jayu market 1.23km away, and for Sangdae-2-dong, Gongdan market is 0.82km away. However, these facilities are very small, so it is projected that 26.69% and 19.85% of households will move to the new commercial area, respectively.



Table 4. Decline of each commercial area (unit: km)

Classification	households	Distance of Commercial area
A	0	6.93
B	5	8.72
C	10	8.04
D	21	8.37
E	0	9.26
F	2	4.59
G	2	4.19
H	8	4.79
I	16	4.75
J	4705	0.36

On the other hand, among the bottom 3 areas, Seongji-dong and Bongsoo-dong is located over 8kms away from the planned commercial area of the innovation city, and large commercial facilities such as Galleria, Joongang market and E-mart is located within 1km to 2km. Joongang-dong is located 6.9km away from the planned commercial area, which is a bit closer compared to the other two, but like Seongji-dong and Bongsoo-dong, large commercial areas are nearby, making the decrease small.

Next, as shown in Figure 8 and Table 4, the commercial facility with the largest decrease of household visitors is the Galleria(D), where 13.19% of existing households, total of 1,889 households are projected to migrate to new commercial areas. Gongdan market(G), Jayu market(F), Top-mart(H) and Homeplus(I) is projected to lose 20% of existing customers. Like such, the new commercial area in the innovation city is projected to have a large impact on existing commercial areas.

In the case of the Galleria, customers from Gaho-dong, Pyeongeo-dong, Sangpeong-dong, Manggyeong-dong, Panmun-dong Ihyeon-dong are projected to decrease greatly, and compared to other commercial areas, the number of visitors from 13 dong, Gaho-dong, Pyeonggeo-dong, Manggyeong-dong Panmun-dong, Ihyeon-dong, Chilam-dong, Sangbongseo-dong, Shinan-dong, Sangbongdong-dong Okbong-dong, Gangnam-dong, Bongan-dong and Bongsoo-dong. And since the distance between these dong and the new commercial area range from 6.41km (Chilam-dong) to 13km (Panmun-dong), it can be seen that the commercial area change of Jinju city is effected more by the area of the commercial facility rather than the distance.

However, in the case of the new households to be developed in the innovation city, among the 4,769 households, 98.65%, or 4,705 households are predicted to use the new commercial area, and only 64 households will

use the existing commercial areas such as the Galleria, Homeplus, Joongang market Top-mart, E-mart, Gongdan market and Jayu market. Furthermore, commercial areas that are small in area and far, such as Cheonjeon market(6.93km) and Seobu market(9.26km) will be visited by zero households, the Galleria (8.37km) and Joongang market(8.04km) will be used by 0.44% and 0.2% of households. It can be seen that in the case of new households, commercial areas are divided more by the size of the facilities rather than their distance.

Such effects might accelerate decline of existing commercial areas, and goes against the initial goal of spreading innovation by developing key regions, and requires countermeasures.

Table 5. Share of the K commercial area (unit: km)

Classification	households	Distance of Commercial area
A	0	6.93
B	5	8.72
C	10	8.04
D	21	8.37
E	0	9.26
F	2	4.59
G	2	4.19
H	8	4.79
I	16	4.75
J	4705	0.36

## V . Conclusion

This study first applies the modified Huff model hypothesis of ‘ $\alpha=1$ ,  $\beta=2$ ’ to develop the ‘Jinju Huff model’, and compares the predicted data against actually measured data from two existing commercial areas to calculate new ‘ $\alpha$ ,  $\beta$ ’ values. Next, we applied the calculated values to Jinju to reconstruct the ‘2013 Jinju huff model’, and analyzed the commercial market share of each commercial area in 2013, before the innovation city is constructed.

Also, by measuring the distance between the center of each dong and the planned new commercial areas, we created the ‘2014 Jinju Huff model’ to analyze the change in commercial areas. According to the analysis of commercial area change after innovation city development, the visitors to existing commercial areas in Jinju will decrease from the total number of households of 36,950 in 2013, by 15.24%, or 5,630 households, who will visit the new commercial area that will be developed in the innovation city.



Furthermore, more than 50% of existing commercial areas such as Galleria, Gongdan-market, Jayu-market, Top-mart, Homeplus are projected to decline sharply. To counteract this, not only countermeasures from commercial areas themselves, but facility improvement such as improving physical area around the commercial areas, improving roads and parking, installing arcades and resting areas, modernized management practices such as management education, price and produce origin displays are required.

This is because in the case of Gongdan market and Jayu market, they are not a single commercial entity but a collection of small shops, and decline of traditional market might lead directly to the decline of mid-lower class economics. Also larger commercial areas such as Galleria, Homeplus and Top mart are key commercial areas of Jinju, and their decline might have detrimental effects on Jinju economy.

Therefore, provisions for the commercial sector and the region to survive together must be made, such as providing convenience for citizens by opening parking garages and recommending new renewable energy facilities such as solar.

Since the initial goal of the innovation cities is developing key cities for a balanced development of the country, if the development of innovation cities accelerates the decline of existing city commercial areas, restrictions on commercial area development must be put in place. And since the interests of the government, industry, small businesses and traditional markets are intertwined in this issue, a more detailed counteraction and policies need to be researched and applied.

This research focuses on the oft-overlooked negative effects the construction of innovation cities may have on the existing city, despite the many projected benefits of the project, such as balanced development of the country and job creation. We differentiate ourselves from previous research on the innovation city or the usage of the Huff model by analyzing the actual effect of the innovation city by analyzing the change in commercial areas.

However, because we focused on the larger commercial areas, and failed to sufficiently take into account the effects on small businesses of Jinju, it is not sufficient to determine the detailed commercial market shares in Jinju. Also because we used the population data from 2013, it is possible that

after the city construction plans are finished and the population of each dong change dramatically, the accuracy of analysis might be compromised.

This research was conducted to predict the actual effects of innovation city construction based on current perspectives, and expect future research to overcome such limitations.

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