ANALYSIS OF ELEMENTS TO IMPROVE THE WALKING ENVIRONMENT IN KOREAN TRADITONAL MARKETS USING ANALYTIC HIERARCHY PROCESS

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ABSTRACT

In this paper, we evaluate elements to improve pedestrian mobility in order to revitalize traditional markets in South Korea. The objective of this study is to analyze the priority of elements for pedestrians in traditional markets using the Analytic Hierarchy Process (AHP). This paper used a two level hierarchy structure to achieve the objective. The first level was composed of four elements and the second level was composed of 28 sub-elements. The questionnaire used pairwise comparison. The data for analysis was collected through a survey of university students. The AHP process produced the results of this study as follows. The elements in the first level of element priority are interest, convenience, comfort and safety. The sub-elements in the second level of element priority are pitchmen, street vendors, shopping, price negotiation, paving, landscape, street lights, benches, people watching, trash bins, street vegetation, obstacles, information signs, illegal parking, cul-de-sacs, noise, sidewalk width, crowdedness, lack of sidewalk, sidewalk slope, activities, public transportation, traffic, pedestrians, stalls, billboards, vehicle speed, parking lots, speed bumps, and bicycle roads.

Keywords: AHP; traditional market; revitalization; pedestrian environment

1. Introduction

1.1 Traditional markets in Korea

A market, or marketplace, is a location where people regularly gather for the purchase and sale of provisions, livestock, and other goods (Oxford, 2016). The government agencies of Korea define a market as "a specific facility or place to carry out commodity trading between buyers and sellers". The same definition is used in "The Market Law" that was enacted in 1961. The term 'traditional market' (TM) is widely used in South Korea, but it is difficult to clearly define. 'The Special Act to Improve TMs and Shopping Districts' defined it as "a building or place over a certain size that supports both buyers and sellers, is a permanent or regular market that was built before 1980, when modern distributions facilities were opened, and has a need for redevelopment or modernization of aging facilities". So, the concept of a TM includes the implication that

the market needs redevelopment of aging buildings and modernization to improve slumping retail performance. The act decided on the time criterion, 1980, considering normal re-development time and construction quality of buildings in that era.

In other words, the TM is defined by convenience for shoppers, market traditions and the need for re-development and modernization of the buildings and facilities. Therefore, the TM concepts are as follows:

1. The TM is formed by a social consensus and is comprised of people, physical elements, time and space.
2. The TM is a place where commodity trading between buyers and sellers is carried out.
3. A TM is a place where old infrastructure needs repairs or maintenance and it is necessary to promote business improvement and modernization of commerce to improve weak distribution function.

The functions of the TM in modern society are job creation, direct trading, the formation of local community, a venue for local culture and a center of the local economy (Kim & Park, 2006). The TM benefits the welfare of citizens, provides a place for social exchange, and serves as the local economic base.

Since 1960, many regular TMs were built due to increasing demand for goods, along with a population explosion in Korea. The consumer's demand for minimum movement to make purchases and the supplier's interest in dominating the market led to a boom of TMs. However, the TM started declining by the late 1970s due to stores opening outside the TMs, changes in consumer purchasing behavior, and internally aging buildings and antiquated management of the market.

The TM is the backbone of the city's core business and is located near local city centers. Therefore, the main focus of the urban development in Korea is improving TMs. The Korean government made a law to revitalize TMs in 1995 and improved it further in 2002, 2004, 2006 and 2010. The government also supported the effort to improve the facilities such as adding arcades, toilets, parking lots and trader training (Small and Medium Business Admin. in Korea, 2006). These laws and policies focused on facility improvements to revitalize TMs. The government has made many laws to focus on improving the market environment to revitalize TMs without verifying the effects. There are many studies about acts, management and case studies, but seldom studies of the effect of market environment improvement (Chung, 2012).

1.2 Walking space at TMs

Walking is the easiest and most basic way for people to move around and is the basic means of transportation at the final stage of travel. There are two types of walking, the objective and the non-objective type. Commuting, attending school, shopping and recreation are objective walking activities, while jogging and walking with children are non-objective walking activities. The former seeks the short course, the later uses the interesting course. With this view, walking is not simply transportation or a way to reach a destination, but it can provide vitality and freshness in outdoor spaces. Walking is slower than other forms of transportation, and this characteristic creates an opportunity for people to come in contact with the environment and other people to grow their social,

economic and cultural networks. In other words, walking spaces have social significance that supports an eco-friendly environment and city, stimulates the economy, improves connectivity and accessibility of transportation, promotes health of citizens and ensures the safety of the city.

Walking space is an important outdoor space for people and is a main element of any city. The five primary functions of a city street are place, movement, access, parking and utilities (The Department for Transport, 2007). In addition, there are many functions of walking spaces as listed in the following table.

Table 1
Functions of walking space (street)

Function elements of walking space	Source
Place, Movement, Access, Parking, Utilities	Department for Transport (2007)
Place, Comfort, Connectivity and Ministry of Culture, Symbolism, Progressive	Choi, Kim (2009)
Conviviality, Convenience, Connectivity, Conspicuousness, Comfort	Gardener (1996)
Safety, Comfort, Convenience, Interest	Chung (2012)

Most people in Korea recognize that walking in TMs is uncomfortable, confusing and crowded, and therefore do not want to go there. This makes walkability the critical factor in the revitalization of TMs. There are many activities and objects on narrow streets in TMs which include walking, sitting, shopping, pitching, price negotiation, cars, cycles and billboards.

Most TMs in Korea are located nearby a residential area or CUB where there are many pedestrians. However, current policies and legislation for TMs in Korea don't consider the walking space for consumers, but only concentrate on the seller's needs. Therefore, the effectiveness of TM improvement projects to revitalize TMs is minimal. Effective revitalization of traditional markets that value local culture requires research of pedestrian space based on fundamental human behavior rather than physical improvement of buildings and structures.

The TM is a commercial space created to serve a buyer's needs, and it is typically located in a place where there is a lot of walking traffic and it is convenient to meet people. Characteristics of the markets are such that the walking areas include not only walking and shopping, but also waiting, negotiating, and various other commercial activities. As a result, there are commercial activities and general pedestrian elements (safety, landscape, amenity and convenience) to consider in the walking areas of traditional markets (Gardner, 1996).

The restoration of the pedestrian areas in traditional markets can most easily revitalize the economy of downtown areas, where it is impractical to change the current organization of urban space. Therefore, characteristics of the traditional market and pedestrian areas should be understood in order to revitalize the traditional markets located in old city centers. In summary, the main goal of this study is to improve the pedestrian experience

and thereby revitalize traditional markets. The present paper deals with the priority of elements to improve walking areas in traditional markets using AHP.

Table 2
Hierarchy of walking environment elements in traditional markets

Top	Level 1	Level 2
Improvement Elements of Walking Environment	Safety	sidewalk width, lack of sidewalk, illegal parking, obstacles, sidewalk slope, billboards, bicycle roads, speed bumps
	Comfort	street vegetation, street lights, landscape, pedestrians, cul-de-sacs, traffic, vehicle speed, stalls
	Convenience	paving, benches, trash bins, information signs, public transportation, parking
	Interest	shopping, price negotiation, pitchmen, street vendors, people watching, crowdedness, activities, noise

2. Analysis of elements for walking environments in traditional markets

2.1 Survey

This study utilizes elements for improving the pedestrian experience in traditional markets from the literature review (Table 1). A questionnaire was made containing 28 elements: sidewalk width, lack of sidewalk, illegal parking, obstacles, sidewalk slope, billboards, bicycle roads, speed bumps, street vegetation, street lights, landscape, pedestrians, cul-de-sacs, traffic, vehicle speed, stalls, paving, benches, trash bins, information signs, public transportation, parking lots, shopping, price negotiation, pitchmen, street vendors, people watching, crowdedness, activities and noise. These elements were grouped into one of the four main groups: safety, comfort, convenience and interest. The purpose was to identify priority elements for improving the pedestrian experience. The survey was conducted on January 10, 2016 with 20 students at Chonnam University in South Korea.

2.2 Analysis process of AHP

The questions using the fundamental scale were made by hierarchy decomposition (Saaty, 2000). The four main elements were used from the previous study and the results were produced using pairwise comparison. Those four elements were also used for the basis column comparison using the transitivity of preference relation to reduce the number of questions. Each respondent's value was different, and the weight to comparison matrices was made by geometric mean.

Comparison matrices of elements were calculated by the Harker method that can calculate the weights without unknown comparison estimates. The Harker's algorithms can be described as follows (Gao, Zhang & Cao, 2010; Dave, Desai & Raval, 2012):

1. Construct a derived reciprocal matrix of comparison matrix.
2. Calculate the largest eigenvalue of reciprocal matrix and its associate eigenvector.
3. Normalize the eigenvector into a priority weight vector.

This means that missing datum in an incomplete comparison matrix change to 0, diagonal components change to numbers of counters of zero plus one. In the Harker method, missing components in the comparison matrix change to zero and diagonal components change to one plus numbers of the missing components. That means the maximum eigenvector of the pairwise comparison matrix is to be the weight.

After this, the analysis proceeds by normal AHP as follows (Saaty, 2008):

1. Structure the hierarchy from the top (improvement elements of walking environment), then the objectives from a broad perspective, through the intermediate levels (Level 1) to the lowest level (Level 2).
2. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to itself.
3. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority.
4. Test consistency with the number of elements: n, Consistency Index (C.I.: λ_{max}-n / n-1), R.I., Consistency Ratio (C.R.: C.I./R.I.) and maximum eigenvalue (λ_{max}). According to Saaty and Vargas (1982), if the calculated C.R. is lower than 0.1, the judgment matrix is considered consistent (Saaty, 1980).

3. Results

In summary, this study deals with ways to improve the pedestrian experience in order to revitalize traditional markets. The objective of this paper is to find the priority of elements to improve walking areas in traditional markets using AHP. The hierarchy of four main elements and 28 sub-elements were taken from previous research. The survey, pairwise comparison and the AHP process led to the following results.

The results of the prioritization of Level 1 elements from the AHP process for walking environments are shown in Table 3. In descending order of importance, the elements are interest, convenience, comfort and safety. This suggests that Korean traditional markets can be best revitalized by upgrading the elements related to interest.

Table 3
Comparison matrix of walking environment in TMs

	Comfort	Convenience	Interest	Safety	Priority
Comfort	1.000	0.688	0.377	1.919	0.182
Convenience	1.453	1.000	0.304	1.109	0.183
Interest	2.652	3.288	1.000	3.800	0.508
Safety	0.521	0.902	0.263	1.000	0.127
C.R.	0.027				
C.I.	0.030				

The walking environment in TMs has eight elements of safety. The element with the highest priority of the safety elements is Obstacles.

Table 4
Comparison matrix of safety

	Sidewalk width	Lack of sidewalk	Illegal parking	Obstacles	Sidewalk slope	Billboards	Bicycle roads	Speed bumps	Priority
Sidewalk width	7.000	0.000	0.000	0.000	1.643	0.000	0.000	0.000	0.132
Lack of sidewalk	0.000	7.000	0.000	0.000	1.460	0.000	0.000	0.000	0.127
Illegal parking	0.000	0.000	7.000	0.000	1.767	0.000	0.000	0.000	0.136
Obstacles	0.000	0.000	0.000	7.000	2.076	0.000	0.000	0.000	0.145
Sidewalk slope	0.609	0.685	0.566	0.482	2.000	2.474	2.765	0.000	0.141
Billboards	0.000	0.000	0.000	0.000	0.404	6.000	0.000	2.305	0.127
Bicycle roads	0.000	0.000	0.000	0.000	0.362	0.000	7.000	0.000	0.095
Speed bumps	0.000	0.000	0.000	0.000	0.000	0.434	0.000	7.000	0.097
C.R.	0.051								
C.I.	0.036								

The walking environment in TMs has eight elements of comfort. The priority of these elements and the comparison matrix is shown in Table 5.

Table 5
Comparison matrix of comfort

	Street vegetation	Street lights	Landscape	Pedestrians	Cul-de-sacs	Traffic	Vehicle speed	Stalls	Priority
Street vegetation	7.000	0.000	0.000	0.000	1.251	0.000	0.000	0.000	0.121
Street lights	0.000	7.000	0.000	0.000	1.986	0.000	0.000	0.000	0.145
Landscape	0.000	0.000	7.000	0.000	2.098	0.000	0.000	0.000	0.149
Pedestrians	0.000	0.000	0.000	7.000	0.427	0.000	0.000	0.000	0.094
Cul-de-sacs	0.799	0.504	0.477	2.342	2.000	2.770	4.148	0.000	0.186
Traffic	0.000	0.000	0.000	0.000	0.361	6.000	0.000	2.624	0.127
Vehicle speed	0.000	0.000	0.000	0.000	0.241	0.000	7.000	0.000	0.088
Stalls	0.000	0.000	0.000	0.000	0.000	0.381	0.000	7.000	0.090
C.R.	0.066								
C.I.	0.047								

The walking environment in TMs has just six elements of convenience. The priority of these elements is shown in Table 6.

Table 6
Comparison matrix of convenience

	Paving	Benches	Trash bins	Information signs	Public transportation	Parking lots	Priority
Paving	5.000	0.000	0.000	0.000	5.429	0.000	0.289
Benches	0.000	5.000	0.000	0.000	4.074	0.000	0.242
Trash bins	0.000	0.000	5.000	0.000	2.691	0.000	0.195
Information signs	0.000	0.000	0.000	4.000	2.466	2.947	0.189
Public transportation	0.184	0.245	0.372	0.405	2.000	0.000	0.072
Parking lots	0.000	0.000	0.000	0.339	0.000	5.000	0.013
C.R.	0.106						
C.I.	0.085						

The walking environment in TMs has eight elements of interest. The priority of these elements and the comparison matrix is shown in Table 7.

Table 7
Comparison matrix of interest

	Shopping	Price negotiation	Pitchmen	Street vendors	People	Crowdedness	Activities	Noise	Priority
Shopping	7.000	0.000	0.000	0.000	1.944	0.000	0.000	0.000	0.132
Price negotiation	0.000	7.000	0.000	0.000	1.539	0.000	0.000	0.000	0.121
Pitchmen	0.000	0.000	7.000	0.000	3.538	0.000	0.000	0.000	0.176
Street vendors	0.000	0.000	0.000	7.000	2.610	0.000	0.000	0.000	0.150
People	0.515	0.650	0.283	0.383	2.000	2.280	3.681	0.000	0.132
Crowdedness	0.000	0.000	0.000	0.000	0.439	6.000	0.000	1.698	0.107
Activities	0.000	0.000	0.000	0.000	0.272	0.000	7.000	0.000	0.087
Noise	0.000	0.000	0.000	0.000	0.000	0.589	0.000	7.000	0.094
C.R.	0.069								
C.I.	0.049								

Table 8
Priority of walking elements at TM

Elements on Level 1	Elements on Level 2	Priorities	Overall priorities	Ranking
Safety	Sidewalk width	0.179	0.023	17
	Lack of sidewalk	0.159	0.020	19
	Illegal parking	0.193	0.025	14
	Obstacles	0.226	0.029	12
	Sidewalk slope	0.109	0.014	20
	Billboards	0.051	0.006	26
	Bicycle roads	0.039	0.005	30
	Speed bumps	0.043	0.005	29
	Consistency Ratio	0.011		
	Consistency Index	0.008		
Comfort	Street vegetation	0.161	0.029	11
	Street lights	0.255	0.047	7
	Landscape	0.270	0.049	6
	Pedestrians	0.055	0.010	24
	Cul-de-sacs	0.129	0.023	15
	Traffic	0.055	0.010	23
	Vehicle speed	0.031	0.006	27
	Stalls	0.044	0.008	25
	Consistency Ratio	0.015		
	Consistency Index	0.010		
Convenience	Paving	0.336	0.061	5
	Benches	0.252	0.046	8
	Trash bins	0.167	0.030	10
	Information signs	0.153	0.028	13
	Public transportation	0.062	0.011	22
	Parking lots	0.030	0.006	28
	Consistency Ratio	0.033		
	Consistency Index	0.027		
Interest	Shopping	0.163	0.083	3
	Price negotiation	0.129	0.065	4
	Pitchmen	0.296	0.151	1
	Street vendors	0.219	0.111	2
	People watching	0.084	0.043	9
	Crowdedness	0.042	0.021	18
	Activities	0.023	0.012	21
	Noise	0.045	0.023	16
	Consistency Ratio	0.009		
	Consistency Index	0.007		

Table 8 shows the priorities and rankings of all sub-elements of the walking environments in TMs. For all sub-elements, the descending order of importance is

pitchmen, street vendors, shopping, price negotiation, paving, landscape, street lights, benches, people watching, trash trash bins, street vegetation, obstacless, information signs, illegal parking, cul-de-sacs, noise, sidewalk width, crowdedness, lack of sidewalk, sidewalk slope, activities, public transportationation, traffic, pedestrians, stalls, billboards, vehicle speed, parking lots, speed bumps, and bicycle roads.

By far the most impactful element in Level 1 is interest, but some sub-elements such as people watching, crowdedness, activities and noise are relatively low in the overall order compared with shopping, price negotiation, pitchmen and street vendors. Further research is needed with more refined sub-elements in the hierarchy model to improve traditional markets in Korea.

First, the order of priority for the main elements is interest, convenience, comfort and safety. This means that upgrading elements related to interest will have the greatest impact on the revitalization of Korean markets. Second, the order of priority for the sub-elements is pitchmen, street vendors, shopping, price negotiation, paving, landscape, street lights, benches, people, trash trash bins, street vegetation, obstacless, information signs, illegal parking, cul-de-sacs, noise, sidewalk width, crowdedness, lack of sidewalk, sidewalk slope, activities, public transportationation, traffic, pedestrians, stalls, billboards, vehicle speed, parking lots, speed bumps, and bicycle roads.

4. Discussion

This study showed that AHP was an efficient method to identify priorities of elements of walking environments in TMs in Korea. These priorities may help designers define and focus on certain elements in improving walking environments. AHP was an effective technique for dealing with the fussy system associated with quantitative and qualitative elements at TMs in Korea. However, too many reduced pairwise comparisons and the distortion of relative priority between elements should be considered further. It should be taken into account that reduced pairwise comparisons for respondent's convenience and the following distortion of relative priority between elements remained a problem. It is also necessary to compare studies between TMs to reduce the error of generalization. The results of this study should be verified in practicality with case studies as well.

5. Conclusion

In this study the priority of elements of the walking environment at TMs in Korea was described. The priority was easily calculated by decomposition hierarchy and pairwise comparison. AHP was an effective technique for dealing with the fussy system associated with quantitative and qualitative elements at traditional markets in Korea.

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