Journal of Engineering and Applied Sciences 14 (5): 1462-1468, 2019
ISSN: 1816-949X

Analysis of Importance in the Selection of Location for a Sports Complex with Analytic Hierarchy Process

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Abstract: This study went through four stages to identify and analyze evaluation items to select a location for a sports complex. Stage 1 reviewed the theories of location selection and evaluation items. Stage 2 identified items of location selection based on major cases and chose main evaluation items based on previous studies and literature. Stage 3 sorted out the items by the evaluation areas based on the analysis results from the first two stages. The last stage estimated the importance of the final evaluation items. The analysis results show that access recorded the highest importance, followed by economy, balanced development, sports infrastructure, usability of local resources, environmental performance and land use in that order.

Key words: Sports complex, selection of location, evaluation item, case study, analytic hierarchy process, sports infrastructure

INTRODUCTION

Since, the introduction of the 5 days work week system, most people spend their leisure time watching sports or taking part in them (Sung, 2003). As for sports activities for workers they need a new domain of activity to escape the overload of business and responsibility at work and find important, significance in physical activities for self-realization and better health, since they have the desire to escape from complicated work and the living environment of daily life and to confirm the true value and existential meaning of life (Yong-Bae *et al*., 2013). There is no ignoring the considerable importance of various sports activities in society but the facilities and safety criteria lag behind the rising demand for sports (Ministry of Culture and Tourism). The selection of location which is the initial stage of a real estate development plan has an extremely important impact, so that, real estate facilities such as sports facilities, fulfill their original purposes after completion. In the science of real estate, the selection of location refers to the discovery of a lot with the location conditions sought after by the subject and sometimes plays a role in determining the proper use for the given real estate (Mook *et al*., 2005). Locations are mainly divided into residential, commercial, industrial, agricultural and public facility locations (Hong and Hong, 2009). Sports facilities belong to the category of physical training facilities to which the Act on the Installation and Utilization of Sports Facilities is applied but their characteristics fit those of commercial locations in the science of real estate considering the importance of guaranteeing profitability according to facility development and operations. In terms of commercial location in particular, the top priority of development goals should be commercial viability because it is critical to secure a source of profit to retrieve the investment and maintain, improve and repair the facility through the management of the sports facilities (Coates and Humphreys, 2003). At the same time, it is also important not to neglect the public benefits of such facilities. Taking into consideration the categorization of real estate locations based on the above-mentioned definitions in the dictionary, it is important to have the minimum profitability guaranteed for the smooth management of the facility including enough users after completion regardless of whether the subject of a new sports facility development project is a public agency or private capital. The selection of a commercial location should come first to maximize the economic effects such as profit generation in order to activate the utilization of the facility. If a proper location is not selected, it can have adverse effects on retrieving the investment and generating profit (Siegfried and Zimbalist, 2000).

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This study, thus, set out to investigate and analyze a location fit for the original purpose that is as good as a business idea or item in the establishment or development of all types of commercial facilities including sports complex facilities, since, the identifying elements that would require field application could serve as an important criterion to decide the success or failure of facility management. The study proposes an evaluation system that should be taken into account when selecting a location for a sports complex and presents the evaluation results of major items based on the system.

Definition and location selection of a sports complex: A sports complex is a term for "a total complex of sports arenas including the main stadium for outdoor sports such as soccer and track and field, gymnasiums for indoor sports such as basketball and volleyball, swimming pools, sports facilities for various events and related auxiliary sports facilities" (Chapin, 2004). In modern times, however, a number of public and private physical training facilities have been built which raises a need to sort out the meanings based on size and purpose. Of the so-called mixed-use physical training facilities, a total stadium refers to a sports complex of the biggest size in the nation. A sports complex is smaller than a total stadium, being a physical training facility with its unique features for the users in the community. A total stadium should contain large-scale sports facilities such as a track and field and soccer arena, whereas a sports complex is an intensive physical training facility fit for local features to host various events other than track and field and soccer. When trying to select a location for a sports complex, one must take into account the followings: first, its appropriateness. A sports complex should secure its appropriateness in urban space to serve its roles fully. The next is logicality which means a hierarchical and connected logical structure for the interest of hosting the facility among the communities. It is also needed to consider objectivity which means a fair process of selecting a location based on political criteria. Participation is a process of ensuring necessity by gathering opinions from the participating subjects, including citizens, to guarantee objectivity. The last one is syntheticity that represents a process of determining various elements and participating subjects for the selection of location based on a total system. These five conditions of location selection need to narrow down potential lots according to the legal requirements even though the entire space of the area is set as the scope for the selection of location. An official map contains potential lots for a sports complex in the basic urban plan for the concerned area and selects a location based on the priority. The final potential lot is selected through multiple stages to guarantee the transparency of the selection process and used to establish a structure for the local government to make a decision from the policy point of view. Lastly, a location is selected for rational and efficient space by taking into consideration the spatial structure and regional conditions of the area. Both quantitative and qualitative elements are examined in the selection of location to evaluate potential lots. Based on the results, an integrated suitability analysis model is built to select a location.

Literature reivew

Review of previous studies: The scope of previous studies reviewed in this study was restricted to the ones on the location factors of sports facilities. A recent study analyzed the location factors of a sports facility and addressed its local base, reporting that a culture or sports facility had impacts on the local economy of Milyang city with the case of a museum. Its findings show that the establishment of a museum contributed to the expansion of tourist demands thanks to the connected development with the neighboring tourist destinations and generated considerable effects of stimulating production and creating jobs. Another study categorized the locations of baseball stadiums, part of the professional sports infrastructure, among the cities and evaluated a case area (Feng and Humphreys, 2012). It presented a set of indicators comprised of natural environments (land use, geological feature, topography, available land, weather, and gradient), location environments (infrastructure, connection to the neighboring facilities and surrounding conditions) and social and economic environments (public transportation, parking, floating population, safety and legal regulation). Its analysis results show that the location of a spots facility should be decided based on the objectivity of the indicators according to the local characteristics rather than political decisions and raised a need to establish some criteria about objectivity in the future (Whitson and Macintosh, 1996). A couple of researchers examined the optimal location conditions of a college sports facility for spectators with GIS and found an optimal location by applying the variables reflecting the characteristics of the concerned area such as topographic conditions, access and distance from neighboring facilities to the analysis of space (Newsome and Comer, 2000). One major overseas study on the location of sports facilities in particular, confirmed the sports facilitie's effects in local development based on their connection to large cities and their positive influences on individual lives (Coates and Humphreys, 2003). Another overseas study investigated whether the

assistance of public financial resources would have positive impacts on the economic development of the concerned area before the supply of a sports facility and found that the local government lavished its support on sports facilities to expand the sources of tax revenue rather than their effects on local economy (Sangwon *et al*., 2015). It was reported that sources of public finance resources were invested in the construction of sports facilities to stimulate local development with sports facilities as catalysts by introducing large-scale facilities into the deteriorating downtown area and improve the image of the deteriorating area (Zhang and Chang, 2017). They examined connections between sports facilities and housing prices and found that when there was a sports facility within a certain distance from a house, the price of the house would rise (Melia, 2002).

Based on previous studies and the development plans of sports facilities this study aims to identify the location factors of sports complex facilities based on the above-mentioned conditions of location selection and provide the analysis results of location factors of sports facilities to planners in the stage of planning a sports facility or reviewing its location based on the survey results and the importance of the analysis results (Table 1 and 2).

Identification and analysis of location items of a sports complex: There is a wide variety in the size of sports complexes according to local features which should be pointed out before investigating the location factors of sports complexes. One good example established by a local government in the nation is the Hwaseong Sports Complex whose goal was to promote the health of citizens through spectator sports and diverse programs. The

Table 1: Procedures of identifying and analyzing the items of location selection

Process	Steps
Analysis process	Step 1: Reviewing the theories of location selection and figuring out the items Step 2: Identifying the items of location selection Step 3: Determining the items of location selection Step 4: Estimating the importance of location items

Table 2: Comparison of evaluation items based on cases

Basic categories	Jeju complex sports town	Daejeon complex sports town	Multifunctional administrative city
Access	Access to a trunk line Good traffic conditions on the island	Regional and local access	Access
Environmental performance	Weather conditions Possibility of connecting with resources Environment friendly nature/symbolicity	Natural conditions and impacts on the surrounding environment	Environment friendly nature
Land use	Possibility of using state and public owned land Easiness of securing a lot		
Social	Density of surrounding population		Sedentary
Economic		Development costs and economy	
Balanced development	Legal limits Compatibility with a higher order plan	Growth management style balanced urban development Consistency in urban planning	Balanced development
Basic categories	Innovation city	Corporate city	New capital city of Gyeongbuk Province
Access	Access to a trunk traffic line	Access	Access outside the province Access inside the province Localcentered
Environmental performance	Possibility of an environment friendly location	Preservation of natural and ecological environments A rough review of environmental performance and the validity of an environment preservation plan	Natural environment
Land use	Easiness of urban development	Easiness of securing land	Scope of urban development
Social	Fitness as an innovation base Possibilities of using the old urban infrastructure and amenities	Ripple effects on local economy	Innovativeness growth potential Conditions to secure the infrastructure of industrial resources Local identity
Economic	Economy	Reliability of demand estimation Financial feasibility of the project the financial burden of the government Reliability of an investment plan financial soundness of a participating company stable land price management	Easiness of securing land Costs of building a foundation of a city
Balanced development		Location in the area requiring balanced development ripple effects on local economy Connections to the national plans Resident's opinions and the local government's determination for the project	Effects of distributing the population Connected development Possibilities of facilitating the development of a backward area

complex can host track and field and soccer games according to international standards and also basketball and volleyball games in its indoor arena. Another example is the Ryu Keun-Chul Sports Complex at KAIST which established to promote the health of the school members and cultivate talents. Even though its size is small, it can host indoor events such as basketball and volleyball in its main arena and contains a fitness center, golf driving range and lecture hall. The size of a sports complex depends on its users and purpose. In some cases, a private company may have a difficult time building a multi-purpose facility capable of hosting various events because there is greater emphasis on public welfare such as the health of citizens and users over profitability.

In the present study, the elements of location selection were identified based on the location theory to figure out a set of location evaluation items. The evaluation indicators from previous, similar studies were consulted and necessity was guaranteed with a survey with experts on the items of location selection (Veeramacheneni, 2015).

Review of theories of location selection and understanding of items: Before identifying the items of location selection this stage reviewed multiple project lots and other cases of suitable lot selection and found theoretical ground and analysis items for them. A total of six conditions of selecting a suitable lot were examined to put together in an evaluation processes and items: Jeju Complex sports town, Daejeon sports town, multifunctional administrative city, innovation-city, corporate city and new capital city of Gyeongbuk Proince.

MATERIALS AND METHODS

Items of location selection: The elements of location selection for a sports complex were based on the content put together above. The ones that reflected the local conditions as well as the spatial structure were chosen first in which the process of the spatial aspect (land use) and the social and cultural aspects (sports infrastructure and usability of local resources) were set based on the most basic criteria: access, environmental performance and economy. There was a special need for the analysis items about balanced development among areas. A second batch of elements was selected based on analyzable items. Ÿ access represented the degree of efficiency to approach the target lot and was examined at the local (internal access) and regional (external access) level. The resulting criteria were as follows: Highways (the shortest distance to the target lot on the main road from a highway), the road distribution rate (the ratio of the administrative unit area and road area within the area), prediction of traffic volume (the service level on the main road in the target area), convenience of mobility (number of two-land roads (8 m)), environmental performance (preserving the area with quality nature and minimizing the urban topography in facility construction to create a sustainable urban environment), average slope (the average slope of the concerned administrative district), degree of green naturality (the percentage of area of grade 7 or higher in the degree of green naturality in the administrative district), rare and protected species (the number of habitats of rare and protected species and their distance from the boundary of the target lot), pollution and noise (the measurement of pollution and noise in the concerned district), land use (both the current land use of the target lot and that of surrounding areas will be considered to promote the realistic utilization of the surroundings), usable area (the percentage of usable area in the concerned administrative district), land suitability assessment, state- and public-owned land (the percentage of state and public-owned land in the concerned administrative district), average land prices (the official mean of the land prices in the concerned administrative district), scalability, current state of use areas (the current state of use areas according to the urban plan), sports infrastructure (based on the elements to secure connections to the sports infrastructure scattered around Cheongju city), neighboring physical training facilities (number of physical training facilities in the concerned administrative district), easiness of clustering (the degree of location of sports-related facilities), usability of local resources (based on the elements to generate synergy effects with other functions as well as the effects of attracting visitors unlike the old sports complexes), local commercial zone (the size and distance of the nearby local commercial zone in the concerned administrative district), tourism and themes (the kinds and distance of nearby tourism and themes in the concerned administrative district), history and culture (the kinds and distance of nearby history and culture facilities in the concerned administrative district), economy (based on the management costs of a sports complex as well as its construction costs for the financial independence of the local government), development costs (estimation of individual official land prices and construction costs), surrounding influences (influences of the development project on the surrounding real estate), maintenance (estimation of maintenance costs after development), balanced development (taking into consideration the deterioration of the area), degree of development (the degree of development in the region), data analysis,

Table 3: Analysis content of the items of location selection

Criteria of location selection	Analysis content	
Access	Highways	O
	Road distribution rate	O
	Prediction of traffic volume	X
	Convenience of mobility	O
Environmental performance	Average slope	O
	Degree of green naturality	O
	Rare and protected species	X
	Pollution and noise	O
Land use	Usable area	O
	Land suitability assessment	X
	Percentage of state- and public-owned land	O
	Scalability	X
	Current state of use areas	O
Sports infrastructure	Nearby physical training facilities	O
	Easiness of clustering	X
	Degree of location of sports-related facilities	O
	Local commercial zone	O
Usability of local resources	Tourism and themes	O
	History and culture	O
Economy	Development costs	O
	Surrounding influence	O
	Maintenance	O
Balanced development	Degree of development	O
	Policy determination	O
	Residents' will	O

policy determination (reflecting the official map and policy determination) and the resident's will (reflecting the resident's will by forming a consultative group of residents).

Determination of items of location selection: Final items of location selection were determined by identifying the items of location selection and considering each of the items in terms of measurability and sensitivity (Revathi, 2015). Once the items were determined, they were put through the objectification process based on the analysis criteria and setting.

Of the criteria of location selection, 19 were finally chosen. Thirteen of them, including access, environmental performance, land use and social criteria were to be analyzed with GIS in the future. Economic and balanced development criteria were analyzed through economy analysis and review of previous studies, respectively. The old elements of location selection, sports infrastructure and usability of local resources were combined together and analyzed according to social elements such as the current state of physical training facilities, local commercial zones and history and culture (Table 3).

RESULTS AND DISCUSSION

Estimation of importance of the location items: A survey was conducted with experts to estimate the importance of the location items. Its goals were to estimate the importance of the analysis elements by the evaluation items to select a location and collect the important data according to the opinion of the experts. A questionnaire was distributed to professors and researchers in related fields, executives of engineering firms, public servants in related fields, executives of city and construction-related firms, technicians in related fields, architects, sportsmen and professional athletes. The content of the questionnaire covered the convenience of public transportation, areas of predicted traffic jams, duration of a visit, convenience of a visit, image of the area, local connections, attraction of tourists and visitors, the predicted area of the greatest preference, alternative to the area of preference, access, environmental performance, land use, sports infrastructure, usability of local resources, economy, balanced development and appropriate facilities. The survey lasted for 2 weeks from June 14~30, 2016. Random sampling was applied and 63 of 100 questionnaires distributed to experts were returned (valid questionnaires: 63). In the final analysis, the SPSS 20.0 statistical analysis program was used. The importance of each factor was calculated with the Analytical Hierarchy Process (AHP) and two items of location selection were compared to estimate their importance (Fig. 1).

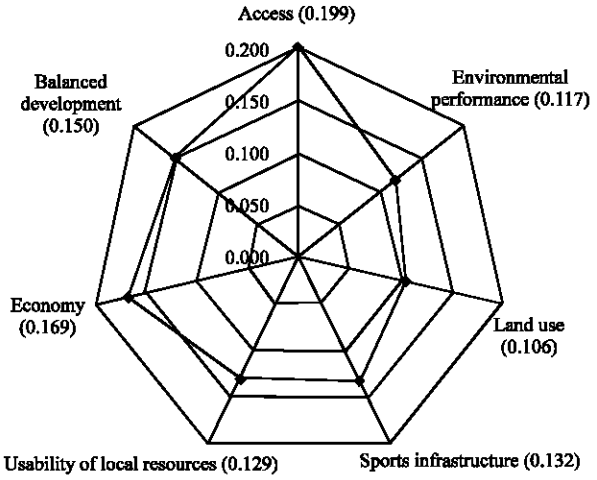

Fig. 1: Analysis result

The analysis results of the seven evaluation items in the selection of a sports complex location show that access (0.199) scored the highest points which indicates that an access route to sports facilities is the most important, like other facilities. Access was followed by economy (0.169) which results show that they placed as much importance on the development costs of a sports complex, its impacts on nearby real estate after development and its maintenance costs as access. This

was followed by balanced development (0.150) which implies that the ripple effects of a large-scale complex facility should properly reflect the backwardness, developmental direction, policies and resident determination of the area. Sports infrastructure (0.132) followed which suggests that they should take into total consideration connections with nearby physical training facilities, easiness of clustering and crowding of sports-related facilities. Given that sports infrastructure came in fourth place of the seven evaluation items, it appears that the process of selecting a location for a sports complex has similar characteristics to that of other purpose facilities. It was followed by the usability of local resources (0.129) which results indicates that sports complex facilities should seek after mutual survival with local commercial zones and be taken into account consistently with tourism and themes and history and culture. Environmental performance (0.117) held a low rank in importance as it represented the standards related to the physical combination with the concerned facility and took into account environmental changes during construction including average slope, degree of green naturality, rare and protected species, pollution and noise and also the ecological environment after the completion of construction. Land use (0.106) came in last which represented the assessment of the validity of land suitability, percentage of state and public-owned land, scalability and connections to the use areas and can be understood in the same context as environmental performance and land use. The last two items recorded the bottom rank. In conclusion, the location selection factors of sports complexes showed a similar pattern to the evaluation content considered in the selection of a suitable improvement in the old large-scale development projects.

CONCLUSION

This study identified and analyzed evaluation items in four stages to select a location for a sports complex. Stage 1 involved reviewing theories of location selection and figuring out their evaluation items. Stage 2 identified items of location selection based on six similar cases and chose the ones of higher frequency by comparing them with those of previous studies and literature. Stage 3 sorted out the items by the evaluation areas based on the analysis results from the first two stages. The final stage applied AHP to the final seven evaluation items. The analysis results show the descending order of access, economy, balanced development, sports infrastructure, usability of local resources, environmental performance and land use. Since, the study restricted analysis only to seven evaluation items there is a need for a discussion in a more minute scope of analysis. There should be additional analysis of evaluation elements of each evaluation item. If minute detailed analysis is added to, it will provide various meanings including the selection of location and estimation of economic effects before the development of a sports complex. It will also create an opportunity to establish the location pattern of special-purpose real estate among the improvement types that are real estate development facilities.

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