

An Analysis of Users' Cognition Difference on Urban Design Elements in Waterfronts

Sook-Yeon Shim, Hwan-Su Seo, Tae-Hyun Kim and Hongkyu Kim

Abstract—The purpose of this study is to identify ideal urban design elements of waterfronts and to analyze the differences in users' cognition among these elements. This study follows three steps as following: first is identifying the urban design elements of waterfronts from literature review and second is evaluating intended users' cognition of urban design elements in urban waterfronts. Lastly, third is analyzing the users' cognition differences. As the result, evaluations of waterfront areas by users show similar features that non-waterfront urban design elements contain the highest degree of importance. This indicates the difference of users' cognition has dimensions of frequency and distance, and demonstrates differences in the aspect of importance than of satisfaction. Multi-Dimensional Scaling Method verifies differences among their cognition. This study provides elements to increase satisfaction of users from differences of their cognition on design elements for waterfronts. It also suggests implications on elements when waterfronts are built.

Keywords—Cognition Difference, Multi-Dimensional Scaling, Urban Design Elements, Waterfront

I. INTRODUCTION

GIVEN that water is an essential element for maintaining human life and even an entire society, it can be said that it is through water that human civilization has been formed. However, although the need for leisure has increased, such areas are still insufficient to meet the rising demands. In case of the redevelopment of waterfronts in many countries, such projects only followed the example of successful cases without considering the specific context of each city where a project is to be implemented. However, some buildings that have been built along the bank have been constructed without regard for the river. This could be because waterfronts are not yet fully recognized as a "public space."

As part of the effort to solve this problem, the city of Seoul initiated in 2009 a Han River Renaissance Project with the purpose of creating well-designed parks along the riverbank. These parks aim to emphasize the city's own set of design policies. In addition, the Project aims to create many cultural places for citizens through the combined efforts of many experts, such as professional designers, planners, and policy makers who all participated in creating the project. Due to the fact that there may be different perspectives from both ends of the spectrum—the users and the designers—in terms of the

design elements to be used in urban waterfronts¹, there is a need to identify and consider the user's perspective, which should then be reflected in the new project.

A. Research Scope

The spatial scope of the study is the first stage area of the Han River Renaissance Project—the Yeouido, Nanji, Ttukseom, and Banpo river parks. These are important community sports facilities that have added to the urban tourism and cultural activities among the city's residents. These waterfronts emphasized the design features identified by the experts, resulting in the construction of various facilities. This is different from previous water parks because it is a proper space where one can evaluate the urban design elements from the users' point of view. [1][2][7][8][9][10]

II. RESEARCH DESIGN AND METHOD

A. Research Design

When a waterfront is created, a decision maker decides the type of waterfront that can distinguish it from other waterfront spaces. In the case of Han River, Yeouido, and Banpo, these were planned as an urban-core type. Ttukseom Park was planned as a sports and recreation type, while Nanji Park was planned as an eco-friendly entertainment type. Each park has its own meaning given by the decision maker, and they are planned in a variety of themes. Therefore, this study starts from a question of whether or not the users are satisfied with the planner's intention of park themes. This study deduces the urban design elements result, this study evaluates the design elements focused on users, and analyzes the differences in results between types of users and the reason behind the differences.

B. Yeouido Han River Park

Yeouido Han River Park is located in Yeouido, which represents the center of politics, finance, and media. It has a good accessibility of public transportation such as subways and buses. Along the Han River, the total length of the park is about 3.8 km, and its area is around 801,100 m². The park is composed of sports facilities such as a soccer field, a swimming pool, a badminton court, and a physical training area, and infrastructure such as pedestrian road, biking trail, inline skate road, square, and so on. A shelter area is planned to provide fun and entertainment during various events like Spring Flower Festival, Seoul International Firework Festival, various

Sook-Yeon Shim is with Korea Environment Institute, Seoul, South Korea (phone: 031-250-3548; e-mail: syonlysj@hanmail.net).

Hwan-Su Seo is with Yonsei University, Seoul, South Korea (phone: 02-2123-3569; e-mail: shs7068@naver.com).

Tae-Hyun Kim is with Yonsei University, Seoul, South Korea (phone: 02-2123-3569; e-mail: thkim1981@naver.com).

Hongkyu Kim is with Yonsei University, Seoul, South Korea (phone: 02-2123-2891; e-mail: kimhong@yonsei.ac.kr).

¹ CABE (Commission for Architecture and the Built Environment), 2001, The value of urban design

Kim, 2009, An Analysis of Waterfront Urban Design Criteria for Urban Regeneration

Performances, marathon events, and so on. Since Bamseom and Saetgang in Yeouido area are preserved in its natural condition, Yeouido Han River Park can be known as an ecological park or an eco-friendly park.

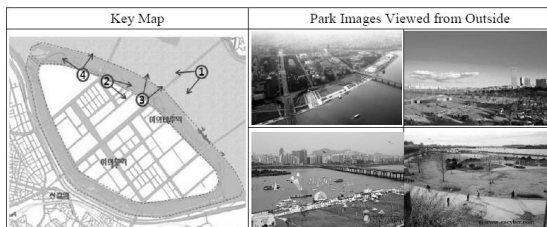


Fig. 1 Park Images Viewed from Outside of Yeouido Han River Park

C. Banpo Han River Park

Based on Banpodaegyo Bridge (Jamsugyo), the Banpo Han River Park is located in the southern riverside between Hannamdaegyo Bridge and Dongjakdaegyo Bridge. Its length is about 7.2 km next to Banpo-dong, Seocho-gu, Heukseok-dong, and Dongjak-gu. The Han River Renaissance Project aimed to build a Moonlight Rainbow Waterjet on both sides of the Banpodaegyo Bridge, and its total length is about 1,140 m (570 m for each of the upper and down waters of the river). In 2008, the waterjet was on the Guinness World Records as the world's longest bridge fountain and every time the water sprinkles, beautiful sights like the seven colors of rainbow are shown. In contrast to the business and commercial districts in Yeouido area, Banpo area is composed of mostly residential districts especially of apartments and schools(8 of them). People who reside in this area can easily get to the park on foot or by riding bikes. The rainbow waterjet provides things to see for Banpo residents and users of Gangbyeon Expressway and Olympic Expressway. Shinbanpo apartment complex 3 which faces directly to the park has an advantageous view of Banpo Han River Park.

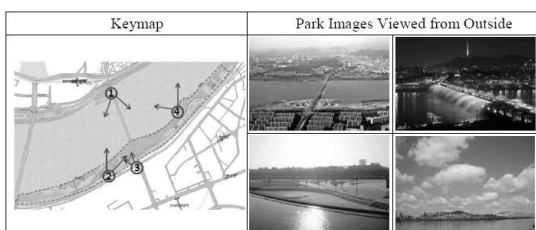


Fig. 2 Park Images Viewed from Outside of Banpo Han River Park

D. Ttukseom Han River Park

The Ttukseom Han River Park has been famous as a riverside resort before the Han River Renaissance Project began its operations. A variety of water sport facilities and observatories were built as the project proceeded; the park had a total length of 11.5 km with an area of 825,000 m2. Recreation and leisure spaces for citizens were created to provide sports facilities such as a soccer field, a basketball court, a tennis court, fishing

places, a swimming pool, a floating restaurant, a wind surfing facility, an excursion ship, and so on. The park has good accessibilities from Gangbuk area with Gangbyeon Expressway which is adjacent to the park. Mostly residential districts with apartments and semi-detached houses are located in northern area of the park and a lot of schools are also located nearby the area in similar to Banpo district. Ttukseom park is linked with Gangnam area by Cheongdamdaegyo(Bridge) and Youngdongdaegyo(Bridge). Since a subway station is nearby the park, public transportations are easily accessed to people and the view of park is also seen from Olympic Expressway and apartments in Gangnam area.

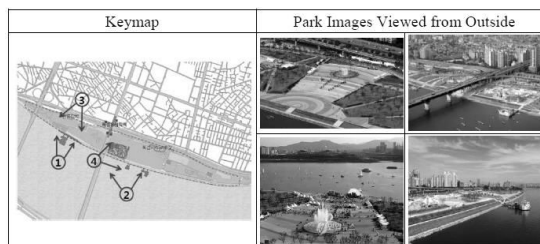


Fig. 3 Park Images Viewed from Outside of Ttukseom Han River Park

E. Nanji Han River Park

The Nanji Han River Park is located between Hongjecheongyo Bridge and Nanjicheongyo Bridge. Its total length is about 4.02 km and the area is about 776,000 m2. It is located in Sangam-dong, Mapo-gu. The park was renovated through the Han River Renaissance Project. Accessibility was improved by building the central link bridge connecting Noeul and Haneul Park, another link bridge for the Peace Park, and complex connecting pathways. Compared with other Han River Parks, the Nanji Han River Park has maintained an advantage of big open spaces neighboring Haneul, Noeul, and the Peace Park. The World Cup Stadium is within 1 km and is easily accessible from the Gangnam area through the Gayangdaegyo Bridge. Since Nanji Park is adjacent to the Gangbyeon Expressway, road access is satisfactory; however, its pedestrian access is not well organized. People need to walk across adjacent parks or go around Nanji Park. The Nanji Han River Park is visible from the Olympic Expressway, as well as from apartments in Yeomchang-dong and Han River-dong in the Gangnam area. It is more eco-friendly than other Han River Parks because of trees in surrounding parks.

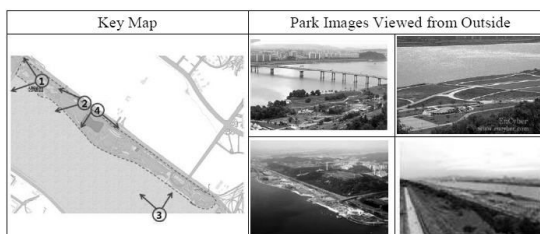


Fig. 4 Park Images Viewed from Outside of Nanji Han River Park

F. Method to Deduce Design Elements

Steps of Expert Survey in creating a waterfront are basic conception, final design, and management and supervision. Each step collects data from experienced experts on design elements the waterfront needs. This study collects data from researchers and engineering business experts for the basic conception step, engineering business experts for the final design step, and government-affiliated organizations for the management and supervision. It is important to investigate available design elements of waterfronts rather than considering importance or priority because this step aims to deduce as many design elements as possible.

This study surveyed users of waterfronts, the user survey, what they liked, and what they remembered. This is because what users liked can be reasons to return and can be deduced as design elements the waterfront needs from the user point of view. Different from expert research, user research suggests multiple choices in design elements of waterfronts from the user perspective. Design elements will be separated by visit frequency and range, thus questions asking how users go to waterfronts are separated from visit frequency and range of walkability. After the literature review, expert research, and user research, design elements of the waterfront will be deduced, and similar factors will be categorized to understand design elements easily.

G. Method to Evaluate Design Elements

With main research-user survey, types of users will be divided into visit frequency and distance from the waterfront to determine the differences between daily and non-daily users despite having the same purpose. Based on the result, users will be divided into types, and each park will be evaluated to determine how each group evaluates design elements. This evaluation result will be analyzed to determine whether results are based on difference in recognition using MDS.

Multi-dimensional scaling is an analysis that converts one data matrix of similarity (or dissimilarity) in a visual space. Therefore, it can analyze the similarity (or dissimilarity) of data about various imagery stimulations by a decision maker, or express a multi-dimensional space by analyzing an averaged or summed data of similarity (or dissimilarity) decision, which are made by a group of decision makers. When averaged or summed data made by a group of decision makers are used, MDS assumes that decisions of similarity (or dissimilarity) are identical for each individual. Therefore, individual differences of decision are ignored. This study analyzes MDS using the average value of each type of waterfront. To reduce error, this study analyzes detailed groups of waterfront types, user types, gender, and visit frequency.

This dissertation has followed the mixed methodology. First, after acquiring quantitative data from finding the elements of the waterfront of the survey, the qualitative research is then used to determine why.

Importance-performance analysis (IPA) was developed in marketing to analyze simultaneously how consumers realize the importance and performance of major factors that products or

services have. It is an appropriate method to investigate expectation before usage and satisfaction after usage. [3][4][5][6][10][11][12]

III. EVALUATION OF DESIGN ELEMENTS AND ANALYSIS OF USERS' COGNITION DIFFERENCE

A. Evaluation of Design Elements in Waterfront

a. Evaluation as Waterpark – Yeouido

The elements of Accessibility to Public Transportations, Rest Area, Recovery and Maintenance of the Nature, Various Cultural and Event Facilities relatively presented the low satisfaction than importance. These elements need to improve.

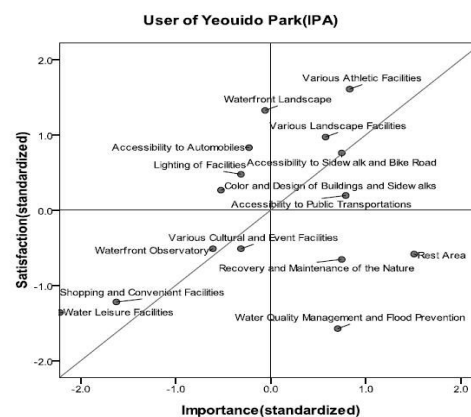


Fig. 5 Result of IPA, user of Yeouido Park

b. Evaluation as Waterpark – Nanji

The elements of Accessibility to Public Transportations, Rest Area, Recovery and Maintenance of the Nature, Water Quality Management and Flood Prevention, relatively presented the low satisfaction than importance. Otherwise the elements of Various Landscape Facilities, Accessibility to Sidewalk and Bike Road are have high satisfaction so need to keep going the elements in Nanji Park.

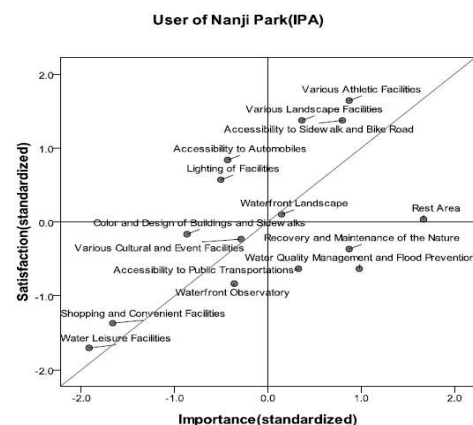


Fig. 6 Result of IPA, user of Nanji Park

c. Evaluation as Waterpark – Tutkseom

The elements of Accessibility to Public Transportations, Rest Area, Recovery and Maintenance of the Nature, Waterfront Observatory, Water Quality Management and Flood Prevention, relatively presented the low satisfaction than importance. These elements need to improve. Otherwise the elements of Waterfront Landscape, Various Landscape Facilities, Various Athletic Facilities, Various Landscape Facilities Accessibility to Sidewalk and Bike Road are have high satisfaction so need to keep going the elements in Tutkseom Park.

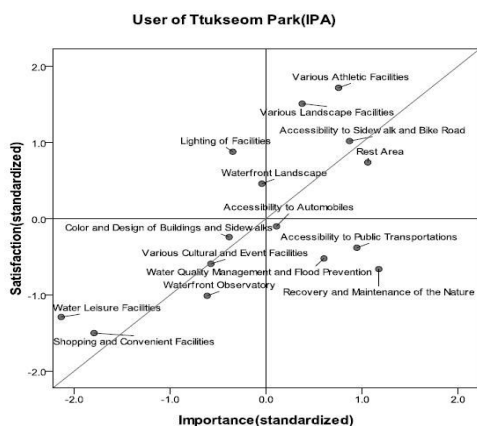


Fig. 7 Result of IPA, user of Tutkseom Park

d. Evaluation as Waterpark – Banpo

The elements of Accessibility to Public Transportations, Rest Area, Recovery and Maintenance of the Nature, Waterfront Observatory, Water Quality Management and Flood Prevention, relatively presented the low satisfaction than importance. These elements need to improve. Otherwise the elements of Waterfront Landscape, Various Landscape Facilities, Lighting of Facilities, Various Athletic Facilities Accessibility to Sidewalk and Bike Road are have high satisfaction so need to keep going the elements in Banpo Park.

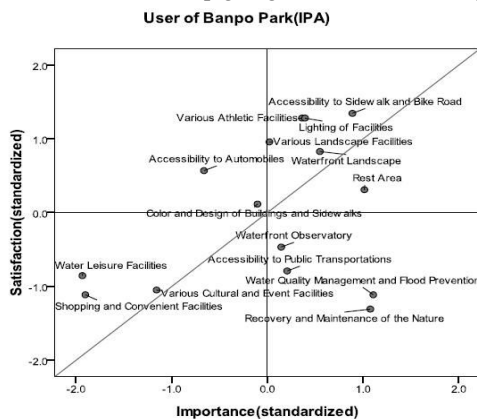


Fig. 8 Result of IPA, user of Banpo Park

B. Evaluation as User

a. High Frequency User

The elements of Accessibility to Public Transportations, Rest Area, Waterfront Observatory relatively presented the low satisfaction than importance. Especially the elements of Water Quality Management and Flood Prevention, Recovery and Maintenance of the Nature show the most low satisfaction. These elements need to improve. Otherwise the elements of Various Athletic Facilities, Waterfront Landscape, Various Landscape Facilities are showed high satisfaction so need to keep going the elements to high frequency user.

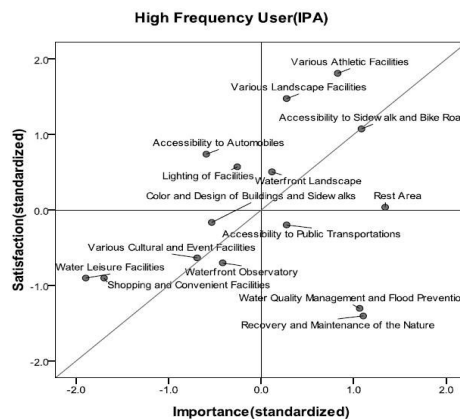


Fig. 9 Result of IPA, user of High Frequency

b. Low Frequency User

The elements of Accessibility to Public Transportations, Rest Area, Waterfront Observatory, Recovery and Maintenance of the Nature, Rest Area relatively presented the low satisfaction than importance. These elements need to improve. Otherwise the elements of Various Athletic Facilities, Accessibility to Sidewalk and Bike Road, Waterfront Landscape, Various Landscape Facilities, Color and Design of Buildings and Sidewalks are showed high satisfaction so need to keep going the elements to low frequency user.

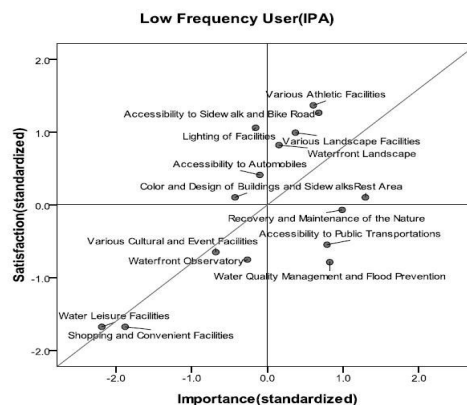


Fig. 10 Result of IPA, user of High Frequency

c. User by Walk

The elements of Accessibility to Public Transportations, Rest Area relatively presented the low satisfaction than importance. Especially the elements of Water Quality Management and Flood Prevention, Recovery and Maintenance of the Nature show the lowest satisfaction. These elements need to improve. Otherwise the elements of Various Athletic Facilities, Accessibility to Sidewalk and Bike Road, Various Landscape Facilities, are showed high satisfaction so need to keep going the elements to User by Walk.

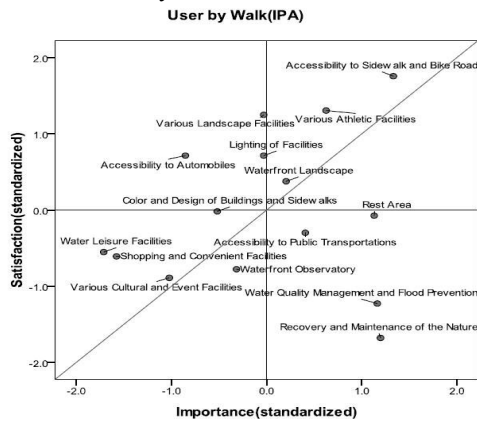


Fig. 11 Result of IPA, user of Walk

d. User by other Transportation

The elements of Accessibility to Public Transportations, Rest Area, Water Quality Management and Flood Prevention, Recovery and Maintenance of the Nature relatively presented the low satisfaction than importance. These elements need to improve. Otherwise the elements of Various Athletic Facilities, Accessibility to Sidewalk and Bike Road, Various Landscape Facilities, Lighting of Facilities are showed high satisfaction so need to keep going the elements to User by Walk.

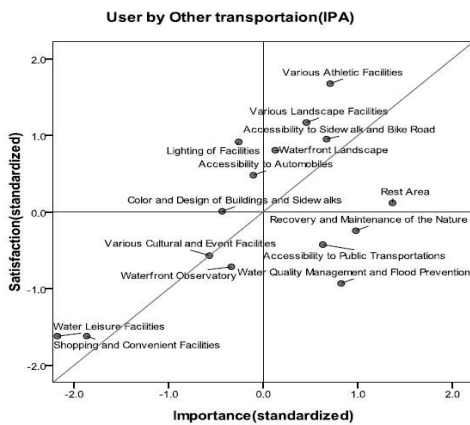


Fig. 12 Result of IPA, user of other Transportation

e. Analysis of Cognition Difference

1. Positioning Analysis of Four Parks

As present fifteen elements and the four park together, which park has the competitiveness about the elements are verified. As the vertical distance from the vector line is close, the elements mean the strength than other elements.

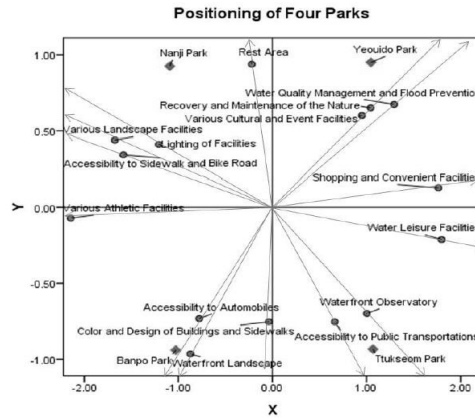


Fig. 13 Positioning Analysis of Four Parks using MDS

2. Analysis of Cognition Difference of User – High Frequency User (MDS of Importance)

To verify the cognition difference of High Frequency User, analysis of similarity was conducted from the MDS and presented in two dimensional space. Stress(the disparity of between the real data and value on space) is 0.09236 and RSQ is 0.96153, both are represent the data with confidence.

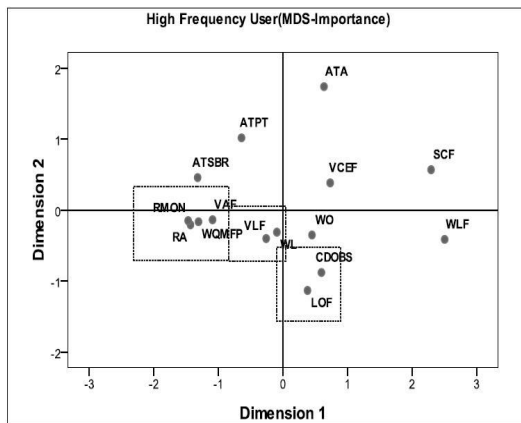


Fig. 14 MDS in Satisfaction of high frequency user

3. Analysis of Cognition Difference of User – Low Frequency User (MDS of Importance)

In the <figure 15>, the rectangle showed that the similarity between the elements than other as 4 groups. The elements of Recovery and Maintenance of the Nature, Rest Area, Water Quality Management and Flood Prevention showed the similarity in group1.

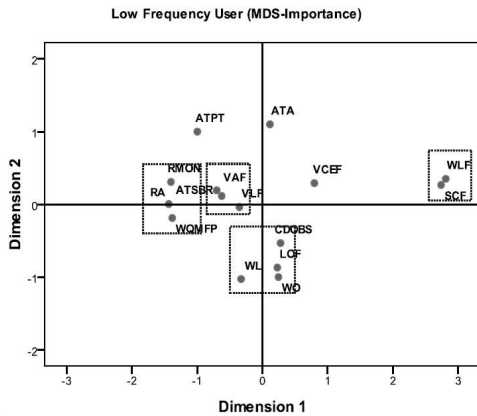


Fig. 15 MDS in Satisfaction of low frequency user

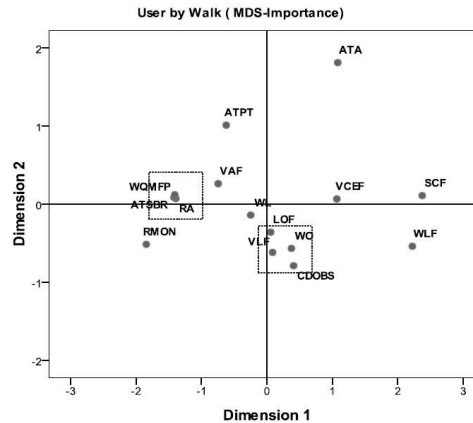


Fig. 17 MDS in Importance of user by walk

4. Analysis of Cognition Difference of User – Low Frequency User (MDS of Satisfaction)

In the <figure 16>, the rectangle showed that the similarity between the elements than other as 3 groups. The elements of Various Cultural and Event Facilities, Water Quality Management and Flood Prevention showed the similarity in group1. The elements of Lighting of Facilities, Waterfront Landscape showed the similarity in group2. The elements of Accessibility to Sidewalk and Bike Road, Various Landscape Facilities showed the similarity in group3.

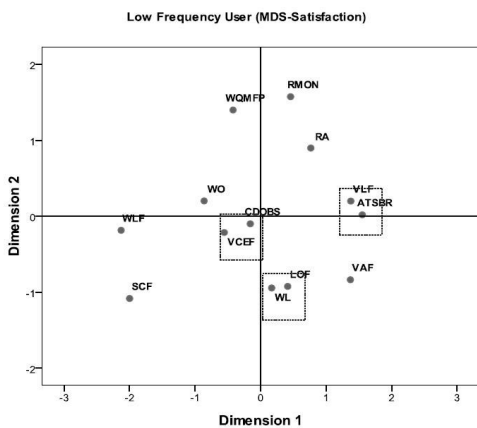


Fig. 16 MDS in Satisfaction of low frequency user

5. Analysis of Cognition Difference of User – User by Walk (MDS of Importance)

In the <figure 17>, the rectangle showed that the similarity between the elements than other as 2 groups. The elements of Rest Area, Accessibility to Sidewalk and Bike Road, Water Quality Management and Flood Prevention, Recovery and Maintenance showed the similarity in group1. The elements of Lighting of Facilities, Color and Design of Buildings and Sidewalks, Various Landscape Facilities Waterfront Observatory showed the similarity in group2.

6. Analysis of Cognition Difference of User – User by Walk (MDS of Satisfaction)

In the <figure 18>, the rectangle showed that the similarity between the elements than other. The elements of only Water Leisure Facilities and Various Cultural and Event Facilities showed the similarity in user by walk.

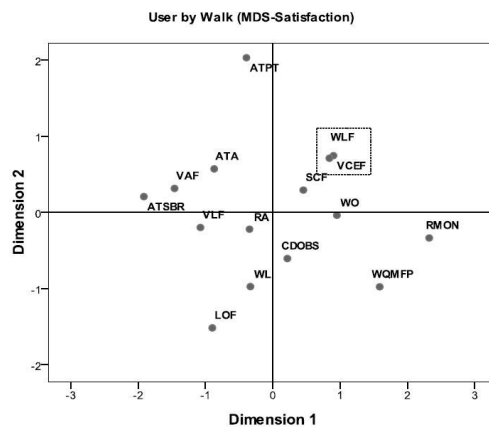


Fig. 18 MDS in Importance of user by walk

7. Analysis of Cognition Difference of User – User by other Transportation (MDS of Importance)

In the <figure 19>, the rectangle showed that the similarity between the elements than other. The elements of Water Leisure Facilities, Shopping and Convenient Facilities showed the similarity in group 1. The elements of Water Quality Management and Flood Prevention, Recovery and Maintenance of the Nature, Various Athletic Facilities, Rest Area showed the similarity in group 2.

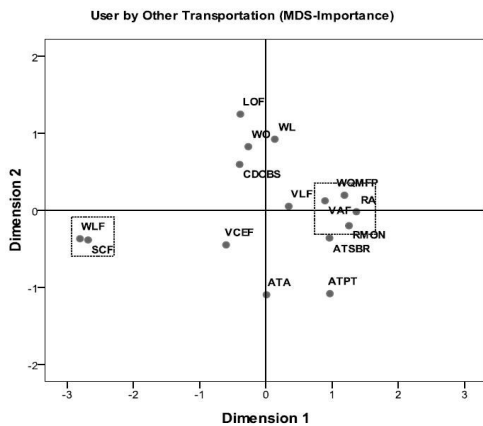


Fig. 19 MDS in Importance of user by other transportation

8. Analysis of Cognition Difference of User – User by other Transportation(MDS of Satisfaction)

In the <figure 20>, the rectangle showed that the similarity between the elements than other. The elements of Waterfront Observatory, Various Cultural and Event Facilities showed the similarity in group 1. The elements of Various Landscape Facilities, Rest Area showed the similarity in group 2.

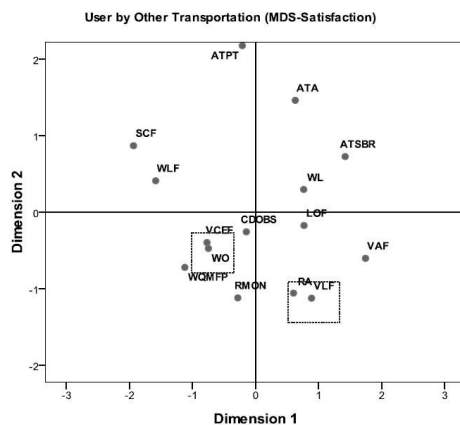


Fig. 20 MDS in Satisfaction of user by other transportation

IV. CONCLUSION

Due to the fact that there may be different perspectives from both ends of the spectrum—the users and the designers—in terms of the design elements to be used in urban waterfronts², there is a need to identify and consider the user's perspective, which should then be reflected in the new project. From this study when built up new waterfront we understand and consider how to satisfy user with the urban design elements on waterfront. And also Achieving balance of desire between the expert and user from cognition difference.

REFERENCES

- [1] Adalberto Vallega, 2001, Urban waterfront facing integrated coastal management, *Ocean & Coastal Management* 44 (2001) 379-410
- [2] Alexander Garvin, Gayle Berens, 1998, Urban parks and opens space, Urban land Institute.
- [3] B.S. Hoyle(1998), Revitalising the waterfront: International Dimensions of Dockland Redevelopment, Continuum intl Pub Group.
- [4] Bonita. M. Kolb, 2004, Tourism Marketing for Cities and Towns -Using Branding And Events to Attract Tourists
- [5] Chan, Ping-Cheung Patrick, Relevant attributes in assessment for design features of indoor games halls: The application of importance-performance analysis Indiana University, 2001
- [6] CABE(Commission for Architecture and the Built Environment), 2001, The value of urban design.
- [7] Isabel Cortes-Jimenez, 2008, Which Type of Tourism Matters to the Regional Economic Growth? The Cases of Spain and Italy, *International Journal of Tourism Research Int. J. Tourism Res.* 10, 127-139.
- [8] Jose A et al, 2005, Distrivuted weighted-multidimensional scalling for node localization in Sensor networks, *ACM Journal Name*, Vol. V, No. N, June 2005, Pages 1- 26.
- [9] Kim, 2009, An Analysis of Waterfront Urban Design Criteria for Urban Regeneration
- [10] Lee, 2010 The study on the Characteristics of Design for Waterfront in the Downtown Area : Focused on the BAN-PO District in the HAN River.
- [11] Lim, 2009, Analysis of the image of landscape and the preference factor at the waterfront of the city : a case study of the Han River Ichon waterfront.
- [12] Twan Huybers and Jeef Bennett, Environmental Management and the Competitiveness of Nature-Based Tourism, *Environmental and Resource Economics* 24:213-233, 2003

² CABE(Commission for Architecture and the Built Environment), 2001, The value of urban design

Kim, 2009, An Analysis of Waterfront Urban Design Criteria for Urban Regeneration