Journal of Novel Applied Sciences
Available online at www.jnasci.org
©2013 JNAS Journal-2013-2-10/473-479
ISSN 2322-5149 ©2013 JNAS

Museum Site Selection

Kasra Rahbaripour

Department of Architecture, Tabriz branch, Islamic Azad University, Tabriz, Iran

***Corresponding author*:** Kasra Rahbaripour

ABSTRACT: The purpose for this paper is to identify and rank the criteria affecting museum site selection by utilisation of fuzzy technique for order preference by similarity to an ideal situation (TOPSIS) and analytical hierarchy process (AHP). The paper will develop an integrated analytical hierarchy process, and fuzzy TOPSIS process to upgrade the eminence in decision making for ranking alternative sites for museums. Selecting the best site from various possible posts involves the analysis of different technical, economic, social, and environmental factors. This study presents a multicriteria decision analysis technique based on fuzzy TOPSIS and Analytic Hierarchy Process (AHP). The paper accounts for the ranking of criteria, the incorporated weights of criteria with sub-criteria, and the performance values of the decision matrix. In this replica, the criteria attribute is categorised into the subjective criteria, and objective criteria. Three potential locations were selected based on subtractive summary technique criteria. The sites are ranked according to the view points of different stakeholders using multicriteria evaluation procedure. The results show that the ranking of alternative sites for museums resorts is different for promoters, tourists, and management. This is strongly influenced by the weighing of criteria. However, the recommended multicriteria approach helps stakeholders select the preeminent site according to their interests and objectives. They are also helped to examine the end results of their decision.

***Keywords*:** Fuzzy TOPSIS, AHP, Museum, Site Selection.

INTRODUCTION

This study is about the identifying and ranking the criteria used in site selecting a suitable site for Kodiak Maritime Museum. This is a non-profit corporation, established in 1996 with the aim of educating the public about Alaska's maritime heritage and commercial fishing industry and preserving this rich history on Kodiak's working waterfront. The museum to be would house artefacts and avail programmes that highlight the history of maritime deeds in the community. The prospective sites opted for were owned by the city of Kodiak. Kodiak Maritime Museum Board and the City of Kodiak choose them for the initial evaluation (Table 1).

Table 1. Settlement site and situation

#	Site	Location
1.	St. Paul Harbour Tract N18	This site is located on the southeast side of St. Paul Harbour and is currently used as harbour parking.
2.	St. Paul Harbour North	This site is located on the northeast corner of St. Paul Harbour at the intersection of Shelikof Street and Marine Way. There is a public restroom facility and a parking lot on the proposed site.
3.	Oscar's spit	This site is located on the south end of Oscar's Spit and is currently used as harbour parking.

Research Objectives and Focus Issues

Many ranking methods founded on the fuzzy concept have been recommended to solve the multicriteria decision-making process. The logic of the TOPSIS approach is to describe the ideal and anti-ideal solution. This research inculcates the evaluation of a number of locations to find the best location for a museum. For this, there is the need for a more complex technique, and that is AHP (Ataei, 2005). The decision makers use a tool, and in this study, the multicriteria evaluation process is suitable. The multicriteria evaluation process is meant to aid decision-

makers in incorporating objective measurements with value judgements that are based, not on personal opinions, but on collective group ideas.

In this case, the Kodiak Maritime Museum Board members know the set alternatives. Multicriteria evaluation is a design of such models because it provides a suitable framework for the integration of economic, social, and environmental factors that determine the best location for a museum (Malczewski, 2006; Anagnostopoulos et al., 2008).

Fuzzy TOPSIS and AHP procedure are an effective technique for the identification of trade-offs between criteria with the ultimate goal of achieving a compromise. For this reason, the solution provided by this technique is justified but not optimum (Cavallaro and Ciraolo, 2005).

It might be noted that the criteria are rules, measures, and standards which assists decision-making. There are certain issues needed to describe, that is classification, weights of the criteria, and the decision matrix, respectively.

Questionnaires are used to rank criteria. The Kodiak Maritime Museum Board members had to come up with suitable questions for them to choose a suitable site for the intended museum. These were:

1. Would the land be at least large enough to accommodate the estimated building square footages defined in the Feasibility Study and Business Plan for a Kodiak Maritime Heritage Centre (McDowell Group, 2010)?
2. How many driveways for ingress and egress are possible?
3. Are there existing utilities in proximity to the site or is it anticipated that utilities will be extended to the site within the planning horizon?
4. What are adjacent land uses that may be a potential source of contamination?
5.

Research Hypothesis

The multicriteria evaluation is used to find locations with minimum environmental impact in which the tourism, and thus the economy of the area, could benefit from the Kodiak Maritime Museum and locations that were most operational because of the accessibility and availability to all required natural resources.

Table 2. Research Review

Time	Writer(s)	Title of the research work	Resource (APA)	Research model	Results
2012	Liu P	Multi-attribute decision-making method research	APA	Interval vague set and TOPSIS	Positive results
2010	Geneletti, D	Combining stakeholder analysis and spatial multicriteria evaluation to select and rank inert landfill sites	APA	Multicriteria	The results were positive
2006	Berger, P.	Generating agricultural landscape for alternative future analysis	MLA	Multiple attribute.	positive
2008	Chang, B., Parvathinathan, G, and Breeden, J. B.	Environ Management	Combining GIS with fuzzy multicriteria decision-making	MLA	positive
2009	Charlie, R., & Chainux, M.	The healing sea	Multicriteria desion-making	MLA	Positive

Research Structure (Theoretical Framework & Structure)

The fieldwork involved a survey of the whole city of Alaska. Such a survey was aimed at the identification of all the sites potentially suited for a museum site. Every site should have buildings of considerable dimensions in the city, unused or with no productive use, and preferably with a heritage value that could be recovered. All sites that met the first two conditions were considered as potential sites such that a total of all the sites were identified (Figure1). For each potential site, figure 1 shows the location, accessibility, building characteristics, former and current use, and state of preservation of the facilities was collected. Data about the identified potential sites was complemented. Recordings and mapping of marine buildings suitable for tourism use in Alaska were presented. Table 3 shows the information layers, included in the map and the associated attributes. These layers formed the core information from which the evaluation criteria were derived and scored.

Figure 1. Site Situation

Table 3. Data layers and attributes stored in the GIS map

Layer	Information	Attributes
Environment		
Protected areas	Areas in which natural values require special protection	Name, Category, Date
Facility		
Airports and roads	Highways, main roads and regional Roads, Location of Galicia airports	Code, Ownership, Management, Road signs, Pavement, Condition, Width, Dimensions
Resources		
Intertidal	Intertidal zone	

Methodology

In this research, multicriteria evaluation techniques were applied for the selection and evaluation of the best sites for the Kodiak museum site. The suitability of the sites was determined based on environmental, functional, and tourism criteria. Multicriteria evaluation of potential sites comprised two steps:

Identification of Suitable Sites

In order to compare the scores of various criteria, the same unit of measurement must be used for all the criteria. To this end, a standardisation process is required. For quantitative criteria, two linear standardisation methods were used. That is:

1. The interval method, by applying Eq. 1 to Benefit criteria (positive) and Eq. 2 to Cost criteria (negative).
2. The maximum method, by applying Eq. 3 to Benefit criteria and Eq.4 to Cost criteria:

X"=(X-Xmin)/(Xmax-Xmin) (equation 1)

X"= (Xmin-X)/(Xmax-Xmin) (equation 2)

X"=X/Xmax (equation 3)

X"= (-X/Xmax) +1 (equation 4)

Where X" is the standardized score of criterion X, X is the raw score, and Xmax and Xmin are the maximum and minimum scores of criterion X. The interval method emphasizes small differences in criterion scores while the maximum method keeps the ratio between the original and the standardized scores (Geneletti, 2008). For qualitative criteria (Current use, building condition and use class), a ranking was established. For the Current use factor, the best value was abandoned, followed by warehouse-dwelling, whereas the worst values were dwelling, cloister, because the recovery of underused structures was given priority. For the building condition factor, the best value was good, followed by adequate and poor. For the use class factor, the best value was urban use, followed by land with special protection, because the constraints to building a museum in these types of land decrease with the decrease in the degree of protection (Table 4).

Table 4. Criteria for the evaluation of potential sites for Kodiak Maritime Museum

Group	Factor	Indicator	Unit of measurement	Benefit cost
Facilities	Infrastructure	Distance to nearest airport(km)	Quantitative	C
Environment	Wetlands	Distance to wetland (km)	Quantitative	C
Resources	Sunlight	Annual direct incident radiation(wh/m)	Quantitative	B
Legislation	Protected areas	Natural parks	Yes/No	
Impacts	Water treatment plants	Distance to water treatment plants	Quantitative	B

Ranking of Suitable Sites

The steps followed to rank suitable sites matched the steps of any fuzzy TOPSIS and AHP procedure:
Criteria represent the factors based on which the alternatives are compared and evaluated. Because criteria selection is essential to the results of the evaluation, a coherent and justified set of criteria must be defined. Kodiak Maritime Museum Board and the City of Kodiak, the promoters and the government set the following strategies to help in selecting the suitable site:

1. Location immediacy
2. Good air quality, and
3. Associated health-promoting measures.

Such standards were considered in the factors included in the following groups: natural resources, facilities, legislation, environment, and impacts. Natural resources for Kodiak Maritime Museum are raw materials that are essential for Kodiak Maritime Museum activities. The natural resources used in Kodiak Maritime Museum comprise of tidelands, or wetlands.

Facilities contribute to providing better accessibility to the location. Accessibility was measured by the factors; distance to roads and distance to the nearest airport. Factors such as distance to airports, distance to urban settlements, and accessibility by road have often been used in studies of hotel location (Chou et al., 2008) and the factor, existence of non-residents, has been added due to the characteristics of the evaluated activity, which is closely related to the city.

Legislation is not a constraint for Kodiak Maritime Museum, but it may affect the condition the characteristics of Kodiak Maritime Museum. Regional or zone regulations such as height limit of buildings is often considered in hotel location. In this sense, two factors were evaluated:

1. Protected areas: a site was evaluated positively if located within a protected area because Kodiak Maritime Museum is allowed in such areas, which are indicative of the environmental and landscape quality of the area.
2. Urban planning: each site was evaluated based on the requirements that the buildings of Kodiak Maritime Museum must satisfy according to each land use class.

Thus, the highest scores were assigned to sites located near the non-profit corporation Kodiak Maritime Museum's location, intermediate scores were assigned to sites located a bit far with standard protection, and the lowest scores were assigned to sites located far away with the city's protection. Moreover, the condition of the buildings and their current use affect the costs of building restoration or reconstruction; thus highest scores were assigned to buildings without a current use, intermediate scores were assigned to buildings used as warehouses, and the lowest scores were assigned to buildings with residential or religious current use (Table 5).

Table 5. Ranking of criteria according to promoters (E - economic scenario), clients (T– tourism scenario) and the Administration (S – social and environmental scenario)

Group	Rank	Factor	Rank	Weight
			E T S respectively.	E T S respectively.
Facility	4	Distance to nearest airport(km)	4	0.004
	4		4	0.006
	2		3	0.025
Environment	4	Distance to wetlands(km)	2	0.009
	1		4	0.016
	5		1	0.009
Legislation	4	Protected area	1	0.032
	5		1	0.033
	1		2	0.102
Resources	2	Annual direct incident radiation (wh/m)	1	0.060
	2		2	0.065
	5		1	0.011
Impacts	3	Distance to water treatment plants.(km)	1	0.040
	3		3	0.023
	4		1	0.026

The environmental quality and visual perception of the environment are common criteria for the evaluation of hotel location (Chou et al., 2008) and tourist attractiveness (Fyhri et al., 2009) and are related to the Kodiak Maritime Museum board suggestions according to which air quality in the area must ensure that long stays in the open air represent a relieving factor.

Research Tools

Multicriteria analysis is an idyllic tool used in this research.

Limits and Limitations

The technique fuzzy TOPSIS and AHP have its limits and limitations. These are: the ideal alternative has the best level while the negative ideal is the one with the worst attribute.

Findings

From the selected locations, three suitable sites were identified (Figure 1). For the ranking of these suitable sites, two evaluation matrices with the standardised scores of all alternative sites for the all the criteria were completed. Each matrix corresponds to a standardisation method. In these matrices, no dominated alternatives were found. Significant differences in criterion scores between both standardisation methods were found. For the remaining criteria, the differences between both methods were in the same range as for the distance to the nearest airport and landscape index, criteria, for which slightly higher differences were found. For criteria weighting, we calculated total score and average ranking in the four questionnaires for each group of factors and individual factor, as well as the quantitative weight of each factor that resulted from the expected value method.

The final ranking of sites according to the weights, derived from questionnaires and standardisation method using the EVAMIX method is presented. Three sites were ranked in the first position with both standardisation methods: two of them (site3 and site1) matched, whereas the third site varied according to the method used. Thus, site 3 was ranked in the first position with the interval method and site 2 was ranked in the first position with the maximum method. The reason behind this is the value of the “Annual direct radiation” criterion. With the interval method, annual direct radiation amounted to 0.79 for site 1 and 0.05 for site 2. With the maximum method, the difference in the value of this criterion for both sites was 0.06. The average variation in the ranking of the remaining sites was less than two positions. Such differences in the ranking of alternative sites according to standardisation method were due to the high weight (the second highest weight) allocated to the “Annual direct radiation” criterion. We have verified that when a weight below 0.02 is allocated to annual direct radiation, no differences are found in the resulting ranking of sites. Pictures of the two sites (site 3 and site 1) selected by both standardisation methods with the weights derived from questionnaires. Such a weighting of factors has led us to select two sites with very different characteristics. However, site 3 has better natural resources than site 1, while site 1 has better facilities, and both have similar environmental quality and impacts.

Table 6. Scores of sites resulting from the weights derived from questionnaires

Site	Dominance score		Ranking	
	Interval	Maximum	Interval	Maximum
Site 1	-0.01	0.01	5	4
Site 2	-0.01	0.01	5	4
Site 3	-0.01	-0.03	5	8

Table 7. Total score and average ranking in the 4 questionnaires for each group of factors and each factor and weights of each factor

Group/ Factor	Total Score	Average Ranking	Weight
Resources	35	1	
Annual direct incident radiation	41	2	0.111
Facility	66	5	
Distance to nearest airport (km).	46	3	0.009
Legislation	74	6	
Protected area	21	1	0.021
Environment Quality	52	2	
Distance to wetlands	69	5	0.010
Impacts	53	3	
Distance to water treatment plants	30	1	0.082

For this reason, a sensitivity analysis was performed in order to assess the influence of weighting on site selection. In this analysis, the interval method was used for standardisation because it emphasized the differences among annual radiation scores. Annual radiation scores were similar and high for all sites (because annual radiation is the radiation accumulated over the year), but small differences in the value of this criterion were significant. Sensitivity analysis was performed by designing scenarios that represented the point of view of the

promoters (economic scenario), the clients (tourism scenario), and the administration (social and environmental scenario).

The museum would be made up of many abandoned buildings –most of them (80%) with cultural heritage value– which amount to a total 4000 m2. Site 3 is made up of a number of buildings located next to each other immediately by the beach in an environment with high landscape quality, the landscape of this site are the second highest index, low incidence of impacts and convenient accessibility. All these factors are highly appreciated by the clients of Kodiak Maritime Museum. Site 3 is also composed of a single building with heritage value, located in an urban area with convenient accessibility to roads and urban settlements. Consequently, site 3 satisfies the main requirements of the Administration for this kind of resorts.

Table 8. Evaluation Criteria and Selection

Selection Criteria	Site #1	Site #2	Site #3
Environmental			
Stable subsurface and bearing capacity.	Unknown. Geotechnical investigations will need to be conducted to determine building foundation requirements. Existing buildings indicate bedrock in the vicinity as imported fill.	Unknown. Geotechnical investigations will need to be conducted to determine building requirements. Antidotal evidence indicates site is on imported fill placed after the 1964 earthquake.	Unknown. Geotechnical investigations will need to be conducted to determine building requirements. Antidotal evidence indicates site is on imported fill placed after the 1964 earthquake.
Accessibility			
Site access	Vehicular access is via Shelikof street and Marine way. Also accessible by boat or other watercraft.	Vehicular access is from Marine way through harbour driveways and parking lots. Also accessible by boat or other watercraft.	Vehicular access is from Marine way through harbour driveways and parking lots. Also accessible by boat or other watercraft.
Physical			
Location	Northeast corner of St. Paul harbour	St. Paul harbour spit, southeast corner, north of landing craft area	Southeast end of Oscar's pit
Land use			
Existing use	Would result in loss of harbour parking and public restrooms	Would result in loss of harbour parking	Would result in loss of harbour parking
Cost			
Cost consideration	Require demolition of existing building	May require sewer lift station	May require sewer lift station

RESULTS AND DISCUSSION

Discussion

By integrating multicriteria evaluation techniques and expert knowledge, several suitable sites have been identified and classified according to different points of view represented by different schemes of evaluation criteria eighting. The ranked classification of the sites obtained by combining the weightings of different stakeholders, with different points of view has not allowed us to identify a clear trend in site selection. However, sensitivity analysis has revealed that our strategy allows for the consideration of the different interests of decision-makers as represented by the different weights assigned to criteria, in the selection of the most suitable sites according to their interests.

Overall, analysis of results shows that multicriteria evaluation is strongly influenced by the weighting of criteria and that the selection of the final site is largely subjective, particularly when various stakeholders with different interests or objectives are involved.

CONCULSION

A strategy for ranking potential sites allows for sustainable planning of Kodiak maritime museum and contributes to the tourism promotion of the region, to the recovery of heritage and landscape values, and to minimizing the environmental impact of tourism. The strategy presented in this paper provides a reference framework to help decision-makers analyse location factors and select the most suitable sites according to objective criteria.In addition, the method described in the above sections allows decision-makers to consider all the criteria simultaneously and gain a deeper knowledge of the problem and the relationships between the criteria deemed. Therefore, methodology can be applied in other locations too. Further, research should be focused on capturing the preferences of local people, through social research techniques and on integrating the results of these techniques as new evaluation criteria in the multicriteria methodology.

REFERENCES

Anagnostopoulos K, Doukas H and Psarras J. 2008. A linguistic multicriteria analysis system combining fuzzy sets theory, ideal and anti-ideal points for location site analysis. Expert Syst. Appl. *35*, 2041-2048.

Berger P. 2006. Generating agricultural landscapes for alternative future analysis: A multiple attribute decision-making model. *Transactions in GIS*, *10*(1), 103-120.

Cavallaro F and Ciraolo L. 2005. A multicriteria approach to evaluate wind energy plants on an Italian island. *Energ. Policy, 33*, 235-244.

Chang B, Parvathinathan G and Breeden JB. 2008. Combining GIS with fuzzy multicriteria decision-making for landfill siting in a fast-growing urban region. *J. Environ.Manage*, *87*(1), 39-153.

Charlier R and Chaineux M. 2009. The healing sea: a sustainable coastal ocean resource: thalassotherapy. J*. Coastal Res*. *25*(4), 838-856.

Chou T, Hsu CL and Chen MC. 2008. A fuzzy multicriteria decision model for international tourist hotels location selection. *International Journal of Hospitality Management, 27*, 293-301.

De Montis A, Deplano G and Nijkamp P. 2007. Multicriteria evaluation and local environmental planning for sustainable tourism, in: Matias, A., Nijkamp, P., Neto, P. *(Eds.), Advances in Modern Tourism Research: Economic Perspectives*. Amsterdam: Physica-Verlag, 207-232.

Fyhri A, Jacobsen J and Tommervik H. 2009. Tourists' landscape perceptions and preferences in a Scandinavian coastal region. *Landscape Urban Plan*, *91*, 202-211.

Geneletti D. 2008. Impact assessment of proposed sky area: a GIS approach combining biological and physical indicators. *Environ. Impact Asses., 28*, 116-130.

Geneletti D. 2010. Combining stakeholder analysis and spatial multicriteria evaluation to select and rank inert landfill sites. *Waste Manage*, *30*, 328-337.

Geneletti D and van Duren I. 2008. Protected area zoning for conservation and use: A combination of spatial multicriteria and multiobjective evaluation. Landscape Urban Plan*, 85*(2), 97-110.

Hossain S and Chowdhury S, Das NG, Sharifuzzaman M and Sultana A. 2009. Integration of GIS and multicriteria decision analysis for urban aquaculture development in Bangladesh. Landscape Urban Plan*, 90*, 119-133.

Johnston K, Puczko L, Smith M and Ellis S. 2011. Global Spa Summit, Wellness Tourism and Medical Tourism*:* Where Do Spas Fit?*.* Global Spa Summit LLC, 123

Retrieved from: http://www.globalspasummit.org/images/stories/pdf/spas_wellness_medical_tourism_rep ort_final.pdf

Lane D, Michalowski W, Stephenson R and Page F. 2008. Integrated systems analysis for marine site evaluations and multicriteria decision support for coastal aquaculture. Aquaculture, Innovation and Social Transformation*, 17*, 255-264.

Lin ZK, Wang JJ and Qin YY. 2007. A decision model for selecting an offshore outsourcing location: using a multicriteria method*.* IEEE International Conference on Service Operations and Logistics, and Informatics*,* 27-29, 1-5.

Malczewski J. 2006. GIS-based multicriteria decision analysis: a survey of the literature*.* Int. J. Geogr. Inf. Sci*., 20*(7), 703-726.

Moeinaddini M, Khorasani N, Danehkar A, Darvishsefat A and Zienalyan M. 2010. Siting MSW landfill using weighted linear combination and analytical hierarchy process (AHP) methodology in GIS environment (case study: Karaj). *Waste Manage, 30*, 912-920.

Munda G. 2008*.* Social Multicriteria Evaluation for a Sustainable Economy. Berlin: Springer-Verlag.

Pan C. 2005. Market concentration ratio analysis of the international tourist hotel industry in Taipei area*. Tourism Manage, 2* (2), 57-66.

Proctor W and Drechsler M. 2006. Deliberative multicriteria evaluation. Environ. Plann. C*, 24*(2), 169-190.

Radiarta IN, Saitoh SI and Miyazono A. 2008. GIS-based multicriteria evaluation models for identifying suitable sites for Japanese scallop (Mizuhopecten yessoensis). aquaculture in Funka Bay, southwestern Hokkaido, Japan. Aquaculture, 284(1-4), 127-135.

Sener S, Sener E, Nas B and Karagüzel R. 2010. Combining AHP with GIS for landfill site selection: A case study in the Lake Baysehir catchment area (Konya, Turkey). Waste Manage, 30, 2037-2046

Wadhwa S, Madaan J and Chan FTS. 2009. Flexible decision modeling of reverse logistics system. *A value adding MCDM approach for alternative selection.* Robot. CIMInt.Manuf. 25(2), 460-469.

Wood CJ and Dragicevic S. 2007. GIS-based multicriteria evaluation and fuzzy sets to identify priority sites for marine protection*.* Biodivers. Conserv*., 16*, 2539-2558.