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CRITERIA FOR SELECTING A LOCATION FOR A PORT OF NAUTICAL TOURISM

The paper clearly and systematically presents the results of the study "Criteria for Selecting a Location for a Port of Nautical Tourism" conducted throughout 2006 and 2007. The purpose of the research was to define spatial possibilities and constraints, and to propose criteria to ensure the optimum selection of a location and facilities for a port of nautical tourism. With regard to the research problem, the general and special goals set called for the application of multiple criteria analysis in selecting the criteria critical to determining the location and facilities for a port of nautical tourism.

Modern decision-making in the commercial exploitation of the marine domain calls for the integrated management of the marine and coastal environment to ensure that natural resources are preserved. Because this is a complex problem that has a number of dominating criteria, the systems approach to its resolution entails the application of multiple criteria analysis in optimising solutions.

Based on the research conducted and the results obtained from analysing the opinions of experts, the authors have identified the crucial criteria and ranked them in accordance to their importance. The weighting coefficient has been calculated for each criterion, and the preference level of the model for optimising the selection of the location and facilities of a nautical tourism port, determined. This research points to the importance of the systematic understanding and acceptance of the integrated management of the marine and coastal environment as a factor of sustainable development.

Key words: *research, criteria, location of a port of nautical tourism, group weighting methods, multiple criteria analysis*

1. INTRODUCTION

Maritime activities can be located and evolve solely in coastal regions, the structure and position of which impact heavily on the selection and performance of business operations. The area in which maritime activities develop is a naturally vulnerable area, subjected to a multitude of constraints in using natural resources. Each new form of economic activity in the coastal area calls for this area to be re-evaluated and re-organised.

Planning and selecting an optimum location and the best facilities and services for a port of nautical tourism are vital in improving the way nautical tourism is managed. This can be done by applying the appropriate decision-solving procedures. In problem-solving, it is considered that the best progress can be achieved by improving the way solutions are selected. The procedure involves setting out basic goals, criteria and measures, and assessing the solutions identified. The complexity of the problem that needs to be resolved in planning a system of nautical-tourism ports – marinas, in particular, as the highest range in the construction of nautical ports – is due to the complexity of goals and diversely dimensioned criteria in assessing solutions.

2. DEFINING THE RESEARCH PROBLEM

Space has always played a crucial role in any human activity. It can be considered a non-renewable natural source, because once it has been used for one activity, the legal, social and economic reasons make it unavailable to other activities [3]. This fact underlines the importance of the criteria of determining priorities in spatial use in the early phases of planning. Planning identifies criteria that can be defined as guidelines for the practical realisation of adopted planning and development goals, making the selection and contents of criteria dependent upon the goals set. [1].

Nautical tourism is a major user of the marine water area and the coastline, and efforts should be made to avoid a heavy concentration of nautical-tourism ports in a narrow coastal area, as this makes it harder to keep marine pollution in check. The development of nautical tourism in Croatia is linked to the construction of new nautical ports and the modernisation and reorganisation of the existing ones. In this, every further increase in the number of vessels or berths and new nautical ports raises the chances of polluting the sea and the coastal area. The research on the needs and opportunities for the further construction of nautical-tourism ports along the Croatian coast and on the islands points to:

- A growing demand for berths, that is, a lack of berths
- The considerable effects, in terms of revenue lost and harm to the environment, caused by vessels that are unable to dock in nautical ports due to this lack of berths.

In comparison with some Mediterranean countries, Croatia's marine water area has the capacity to absorb an increase in the number of vessels, without this having an adverse effect on the level of saturation (carrying capacity) of the marine and coastal area.

In the future, construction in tourism and nautical tourism will seek to expand into new areas in the most diverse forms, resulting in mounting pressure to the coast and the sea. Therefore, great attention must be directed at overall planning, the complex issue of construction in tourism and nautical tourism, the development of broader zones, and spatial protection. Ways should be developed that will enable the involvement of tourist resorts and nautical ports in modern courses of development. This development must be compatible, complex and sustainable (fostering a culture of the environment, burdening areas to an extent that is reasonable, successfully overseeing the natural system).

3. RESEARCH CONTENTS, GOALS AND METHODS

In addition to researching the factors impacting on the selection of a location for nautical-tourism ports, a comprehensive study was conducted in 2006/2007 regarding the criteria for building a universal model for selecting the location of ports of nautical tourism. A targeted questionnaire was compiled in 2007 to survey a number of experts in various fields linked to the issue at hand. Addressing the specific issues pertaining to nautical-tourism ports, the questions were posed in a way that enabled the experts to give ratings through their responses and suggestions.

3.1. Research contents, goals and methods

The questionnaire consisted of a section on general information and three appendixes, which can be classified as:

- personal data
- MCA input parameters
- rating individual criteria
- rating sets of criteria.

Written in the English and the Croatian language, the questionnaire was used to survey experts from Croatia and other European countries, who possess experience and knowledge in the research subject. The questionnaire was sent either to the e-mail addresses of the experts or to the address of the institution in which they work. The experts filled out the questionnaire only if they wished to do so. The data gathered in the study made it possible to define the criteria and subcriteria of selecting locations for nautical-tourism ports and to construct a universal model using the chosen MCA methodology. The aim of the research

can be summarised in several guidelines: identify the criteria and subcriteria pertinent for selecting the locations of nautical-tourism ports; assess the criteria and subcriteria identified; rank the proposed, individual criteria by their importance; rank the proposed sets of criteria by importance; and, propose other criteria and subcriteria pursuant to personal knowledge and experience.

The research contents (Table 1) can be divided into subject units [2]:

- MCA input parameters – proposal of criteria and subcriteria grouped in six basic sets
- individual criteria – proposal of concrete criteria to be ranked and weighted
- sets of criteria – proposal of six sets of criteria to rated and weighted

The research conducted is presented in the following section.

Table 1. *Research parameters, respondent profiles*

RESEARCH PARAMETERS	
AIM OF RESEARCH	Identify the criteria and subcriteria pertinent for selecting the locations of nautical-tourism ports; assess the criteria and subcriteria identified; rank the proposed, individual criteria by their importance; rank the proposed sets of criteria by importance; and propose other criteria and subcriteria pursuant to personal judgement.
TIMESCALE	2007
SAMPLE – SCOPE	Experts from Croatia and Europe
SAMPLE – SIZE	55 respondents
RESEARCH INSTRUMENT	Questionnaire written in two languages. Doc. version for e-mailing, and version to be filled out by hand
METHOD	Self-administered questionnaire

RESPONDENT PROFILE	
COUNTRY OF ORIGIN	Croatia 10, European countries 9
EDUCATIONAL LEVEL	8 experts or 42 % having a PhD or M.Sc., 10 experts or 53 % having university qualifications, the remainder having two-year college qualifications

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

Research methods

- The experts were contacted personally, by telephone, e-mail and by post.
- Attempts to collaborate with American and Spanish experts were met with no reply.
- In analysing responses, it was noted that a total of 19 responses were received, that is, 34.55 percent of the total of 55 questionnaires sent out. Ten responses were from Croatian and nine from other European countries: Slovenia, Italy, France, England and Norway.
- In gathering data, only the method of self-administered questionnaire was used. The respondents filled out the questionnaire by themselves and at their own initiative.

Survey timescale

The survey was conducted throughout 2007.

Methodological notes regarding response analysis

- Prior to making a statistical analysis, all responses were translated into the Croatian language.
- All characteristics of the experts are presented for the entire set.
- When checking and analysing responses, it was noticed that the ratings and rankings of some experts deviate from the sample as a whole; such deviations are presented separately.
- All results are presented in a graphic form.

3.2. Methodology for assessing the importance of criteria

Any multiple criteria problem contains a number of different and, usually, conflicting criteria that can be of differing importance to decision makers. Most methods of selecting the best alternative, that is, multiple criteria decision-making (MCDM), in general require information on the relative importance of each criterion [7]. A number of methods can be applied in assessing the level of importance of criteria, each of which relies completely upon human judgement. The techniques in this category may pertain to individuals or to groups of people. An individual decision-maker may be asked to assess the importance of criteria, or the opinion of a group of experts (referees) on this matter may be obtained. Such a group should comprise experts in the area under consideration, including, if possible, one of the responsible decision-makers.

Measuring opinions consists of a series of methods used to obtain information from an individual or to gather information from a certain number of pe-

ople, mostly experts in a field relating to the given problem. The advantage of group opinion over individual opinion is that it provides a broader spectrum of information and brings expertise and experience to the analysis. However, there are certain problems related to the use of expert groups. For example, it may be more time-consuming, individuals of authority may seek to dominate the group, or a group member may have great persuasiveness that can take discussions in a completely irrelevant direction. An important aspect of assessing criteria importance is the fact that the involvement of a number of people will generally result in a varied ranking based on an individual judgement. So, methods are required that serve to synthesize these differing assessments.

Relative criteria importance can be expressed in terms of priority or weight. Priority relates to cases in which criteria are listed in order of importance. In this, until a higher level (more important) criterion is taken under consideration, the next (less important) criterion may not be considered [4]. On the other hand, weighting is used to numerically express (usually in percentages) the importance of a criterion or to distinguish between the relative importances of several criteria within the same priority.

For the purpose of this research, group weighting methods have been used. These are: [6]:

- **Ranking** – It is assumed that n criteria A_j ($j = 1, 2, ..., n$) need to be assessed and that l experts E_k ($k = 1, 2, ..., l$) are involved in this task. Each referee (expert) is required to rank all criteria according to their importance, by assigning the number *n-1* to the most important criterion, the number *n-2* to the second most important criterion and so on, down to the least important criterion that is assigned the number *0*. This is a fairly simple method and requires little time to obtain the judgements of experts. Because only a set of whole numbers is obtained from each referee, there is no need for weighting the assessments of each individual referee. Instead, only the rankings of all experts are weighted.
- **Rating** – Each referee is presented with the criteria and asked to give a numerical rating to each criterion. Ratings are usually made on a given scale of, for example, 0 – 10 or 0 – 100. Each criterion is weighted separately as the sum of elements in a given line in the table. If these weights need to be normalised, this is done by dividing each criteria with the sum of all weights, which is equal to the number of referees.

4. RESEARCH RESULTS

The review of research results is divided into three subchapters, each of which relates to a particular part of the questionnaire. They refer to:

1. personal data and preference
2. MCA input parameters – proposal of criteria and subcriteria grouped in six basic sets
3. individual criteria – proposal of concrete criteria to be ranked and weighted – and sets of criteria – proposal of six sets of criteria to be rated and weighted.

All results are presented in a graphic form for the entire set of respondents.

4.1. Analysis of responses pertaining to personal data and preferences

Out of the 55 experts contacted, 19 responded to the survey, giving a response rate of 34.55 per cent, which is above the average response rate for written surveys, making this a representative sample. Ten experts are from the Republic of Croatia and nine from the European countries of Slovenia, Italy, France, England and Norway. Chart 1 illustrates the educational level and the country of origin of the experts.

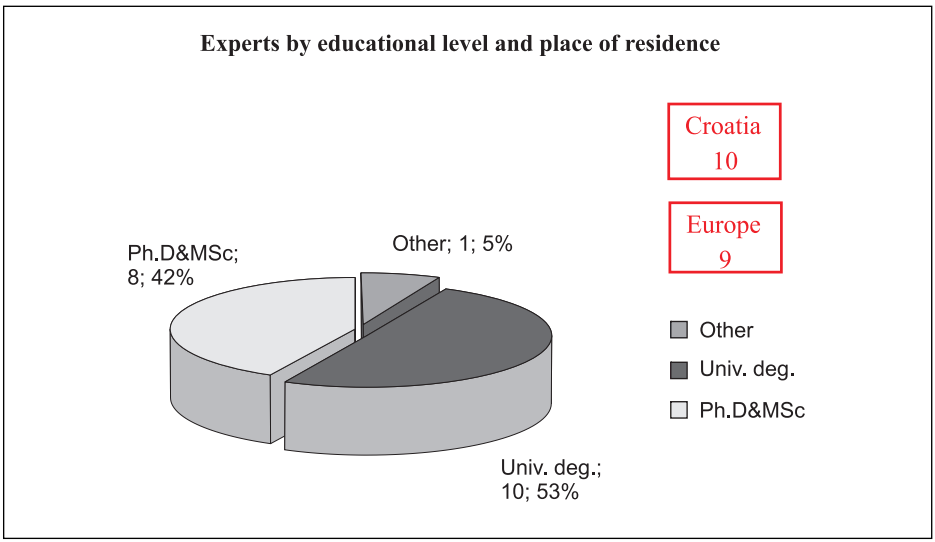

Chart 1. *Educational level and country of origin of experts*

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis Faculty of Maritime Studies of Rijeka, 2008.

4.2. Analysis of MCA input parameters – criteria and subcriteria

For some (or all) criteria, a corresponding qualitative score can be assigned that is translated into a quantitative value using an appropriate linear scale from 0 – 10 and the ratings *poor*, *average* and *good*. The criteria have two attributes [6]:

- They can be either maximisation criteria or minimisation criteria,
- Most often, they do not have the same importance and are typically assigned corresponding weighting coefficients.

In Appendix 1, the experts were asked to rate the importance of individual criteria on a scale of 0 to 100, as well as the importance of subcriteria within a specific criterion. It should be noted that subcriteria have global weights, that is, the sum of subcriterion weights within a criterion is the global weight of that criterion. Furthermore,, in the process of expert rating, criterion weights were normalised by the total possible sum (100), considerably facilitating further analysis. Table 2 presents the results of the scores determined in this way.

Table 2. *MCA input parameters*

LOCATION FACTOR	Criteria/ subcriteria	min/ max	EXP 1	EXP 2	EXP 3	EXP 4	EXP 5	EXP 6	EXP 7	EXP 8	EXP 9	EXP 10	EXP 11	EXP 12	EXP 13	EXP 14	EXP 15	EXP 16	EXP 17	EXP 18	EXP 19
Institutional and political factors	**A**		**15**	**10**	**10**	**10**	**10**	**10**	**0**	**-**	**5**	**5**	**4**	**6**	**10**	**3**	**4**	**7**	**-**	**-**	**5**
Spatial plan of micro location	A1	max	8	6	4	4	6	4			2.5	2.5	2	2.5	4	1	1.5	1.5			2
Regional taxation system	A2	max	5	1.5	2.5	2.5	3	2.5			1	1	1	2	2.5	1	1	3			2
Regional development policies	A3	max	2	2.5	3.5	3.5	1	3.5			1.5	1.5	1	1.5	3.5	1	1.5	2.5			1
Natural and site factors	**B**		**15**	**20**	**25**	**25**	**20**	**25**	**35**	**-**	**30**	**25**	**30**	**25**	**25**	**25**	**25**	**30**	**-**	**-**	**30**
Geo-morphological & oceanographic features	B1	max	5	5	7	7	7	7			8	7	10.5	8	7	9	10	10			5
Locality hydrographic features	B2	max	5	8	10	10	7	10			13	10	10	9	10	8	8	10			15
Micro climate features	B3	max	5	7	8	8	6	8			9	8	9.5	8	8	8	7	10			10
Environmental factors	**C**		**25**	**35**	**25**	**30**	**25**	**25**	**20**	**-**	**20**	**25**	**25**	**25**	**25**	**20**	**20**	**20**	**-**	**-**	**30**
Environmental value of micro location	C1	min	8	10	7	6	7	6			5	7	6	7	7	4	5	4.5			10
Vulnerability to human activity	C2	min	4	8	3.5	9.5	6	4			4	3	4	3.5	3.5	3	4	3.5			5
Assessment of adverse environmental impact	C3	min	5	7	4.5	5	6	5			5	4	5	4.5	4.5	4	3	4			7
Monitoring the micro location sea area	C4	max	3	4	4	4	3	4.5			2.5	5	4.5	4	4	4	3	4.5			4
Investments in environmental protection (5-30 %)	C5	max	5	6	6	5.5	3	5.5			3.5	6	5.5	6	6	5	5	3.5			4

LOCATION FACTOR	Criteria/ subcriteria	min/ max	EXP 1	EXP 2	EXP 3	EXP 4	EXP 5	EXP 6	EXP 7	EXP 8	EXP 9	EXP 10	EXP 11	EXP 12	EXP 13	EXP 14	EXP 15	EXP 16	EXP 17	EXP 18	EXP 19
Technological factors	**D**		15	**15**	**15**	**10**	**15**	**15**	**12**	**-**	**20**	**20**	**15**	**15**	**15**	**20**	**15**	**15**	**-**	**-**	**10**
Physical and geographical features of the micro location (prospects for a protective jetty, connectedness of sea area and nearby coastal zones, easy access for vessels, and fairly smooth sea)	D1	max	3	3	3	2	3	3			4	4	3	3	3	6	4	3.5			2
Micro location carrying capacity – size of vessels (yachts) – assumed, installed fleet	D2	max	2	2	2	1	2	2			3	2.5	2	2	2	4	3	3			2
Categorisation and minimum standards, general and special conditions	D3	max	2	2	2	1	2	2			3	2.5	1.5	2	2	0.5	1	1			1
Development level of transport and other infrastructure	D4	max	2.5	2.5	3	2	2.5	3			3.5	4	3	3	3	2	2	2.5			2
Distance from town centres	D5	min	2.5	2.5	2.5	2	2.5	2.5			2.5	3.5	2.5	2	2.5	2.5	1.5	1.5			1
Safety and navigation conditions	D6	max	3	3	2.5	2	3	2.5			4	3.5	3	3	2.5	5	3.5	3.5			2
Economic factors	**E**		**20**	**10**	**15**	**15**	**20**	**15**	**25**	**-**	**15**	**20**	**20**	**20**	**15**	**30**	**30**	**25**	**-**	**-**	**10**
Regional nautical services offered (potential scope of market activity)	E1	min	5	2	3	3	3	3			3	4	4	4	3	6	6	4.5			1
Offering in the milieu	E2	max	5	1	2.5	2.5	5	2.5			2.5	3.5	3	3.5	2.5	5	5	4			1
Concession fee	E3	min	1	2	2	2	2	2			2	2.5	2.5	2.5	2	4	4	3.5			2

LOCATION FACTOR	Criteria/ subcriteria	min/ max	EXP 1	EXP 2	EXP 3	EXP 4	EXP 5	EXP 6	EXP 7	EXP 8	EXP 9	EXP 10	EXP 11	EXP 12	EXP 13	EXP 14	EXP 15	EXP 16	EXP 17	EXP 18	EXP 19
Investment costs (to build new or remake the existing nautical ports)	E4	min	3	2	3	3	3	3			3	4	4.5	4	3	7	7.5	5.5			2
Milieu ICS development level	E5	max	3	1	1.5	1.5	2	1.5			1.5	2	2	2	1.5	2.5	2.5	2.5			1
Available staff (professional abilities)	E6	max	1.5	1	1.5	1.5	2	1.5			1.5	2	2	2	1.5	2	2	2			1
Potential for development (capacity increase)	E7	max	1.5	1	1.5	1.5	3	1.5			1.5	2	2	2	1.5	3.5	3	3			2
Socio-cultural factors	**F**		**10**	**10**	**10**	**10**	**10**	**10**	**8**	**-**	**10**	**5**	**6**	**9**	**10**	**2**	**6**	**3**	**-**	**-**	**15**
Direct and indirect benefits	F1	max	2	4	4	4	2	4			4	2	2	3	4	1	3	1.5			3
Urban development level and distinctiveness	F2	max	5	3	3	3	5	3			3	1	1	2.5	3	0.3	1.5	0.5			3
Greater QOL of the local community	F3	max	2	2	2	2	2	2			2	1	2	2	2	0.5	1	0.5			4
Regional (micro location) socio-cultural conditions	F4	max	1	1	1	1	1	1			1	1	1	1.5	1	0.2	0.5	0.5			5

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

According to Table 2 and in alignment with the equation for weighting criteria [6] using the group score, it follows that [2]:

$$w_j = \frac{\sum_{k=1}^{n} w_{jk}}{\sum_{j=1}^{m}\sum_{k=1}^{n} w_{jk}} ;$$

and that:

$$w_{jk} = \frac{\rho_{jk}}{\sum_{j=1}^{m} \rho_{jk}} ,$$

whereby:

n – total number of experts,
m – total number of criteria,
ρ_{jk} – k^{th} expert's rating of j^{th} criterion,
w_{jk} – weight calculated for j^{th} criterion of k^{th} expert,
w_j – weight calculated for j^{th} criterion.

By applying the derived equations, the weights of each criterion and subcriterion were calculated. Table 3 and Chart 2 show the values of each individual criteria, and Table 4 and Chart 3, the values of the subcriteria. It should be noted that 16 experts rated criteria, and 15, subcriteria.

Table 3. *Weights of individual criteria*

Location factors /criteria	**Criterion *j***	**Weight w_j**
Institutional and political factors	A	0.07125
Natural and site factors	B	0.25625
Environmental factors	C	0.246875
Technical and technological factors	D	0.15125
Economic factors	E	0.190625
Socio-cultural factors	F	0.08375
Total:	m = 6	1.00000

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

The logical conclusion drawn by looking at Table 3 is that natural and site factors stand out as the most important criterion in selecting a location for nautical ports. This criterion is followed by the environmental criterion that is also very significant, indicating the importance that the experts attach to protecting marine and coastal environments. Economic factors, as a criterion, are prominent in the third place.

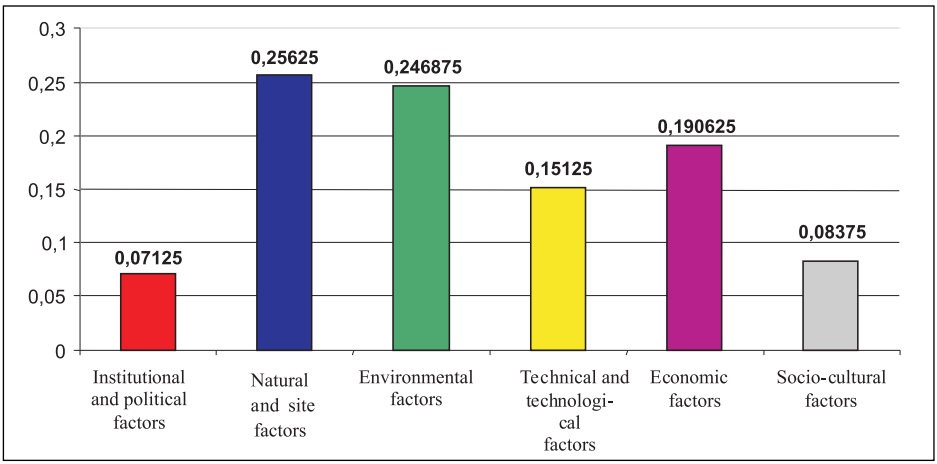

Chart 2. *Criterion weights according to ratings given by experts (n=16)*

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

Chart 2 presents the order of criterion weights according to the opinions of the experts. A slight deviation is observed for environmental factors, and somewhat larger ones, for economic factors and technological factors. It is also necessary to bring out the importance of socio-cultural factors that could outweigh even economic factors in cases where the decision-maker has a preference for development in less-developed regions.

The table and chart in the following section illustrate the weights of all subcriteria as rated by the experts according to the questionnaire. Weights are given individually and summarily.

Table 4. *Subcriterion weights according to ratings given by experts*

Subcriteria	*EXP 1*	*EXP 2*	*EXP 3*	*EXP 4*	*EXP 5*	*EXP 6*	*EXP 9*	*EXP 10*	*EXP 11*	*EXP 12*	*EXP 13*	*EXP 14*	*EXP 15*	EXP 16	EXP 19	$\sum_{j=1}^{n} w_{jk}$	w_j
A1	0.0800	0.0600	0.0400	0.0400	0.0600	0.0400	0.0250	0.0250	0.0200	0.0250	0.0400	0.0100	0.0150	0.0150	0.0200	0.5150	0.0343
A2	0.0500	0.0150	0.0250	0.0250	0.0300	0.0250	0.0100	0.0100	0.0100	0.0200	0.0250	0.0100	0.0100	0.0300	0.0200	0.3150	0.0210
A3	0.0200	0.0250	0.0350	0.0350	0.0100	0.0350	0.0150	0.0150	0.0100	0.0150	0.0350	0.0100	0.0150	0.0250	0.0100	0.3100	0.0207
B1	0.0500	0.0500	0.0700	0.0700	0.0700	0.0700	0.0800	0.0700	0.1050	0.0800	0.0700	0.0900	0.1000	0.1000	0.0500	1.1250	0.0750
B2	0.0500	0.0800	0.1000	0.1000	0.0700	0.1000	0.1300	0.1000	0.1000	0.0900	0.1000	0.0800	0.0800	0.1000	0.1500	1.4300	0.0953
B3	0.0500	0.0700	0.0800	0.0800	0.0600	0.0800	0.0900	0.0800	0.0950	0.0800	0.0800	0.0800	0.0700	0.1000	0.1000	1.1950	0.0797
C1	0.0800	0.1000	0.0700	0.0600	0.0700	0.0600	0.0500	0.0700	0.0600	0.0700	0.0700	0.0400	0.0500	0.0450	0.1000	0.9950	0.0663
C2	0.0400	0.0800	0.0350	0.0950	0.0600	0.0400	0.0400	0.0300	0.0400	0.0350	0.0350	0.0300	0.0400	0.0350	0.0500	0.6850	0.0457
C3	0.0500	0.0700	0.0450	0.0500	0.0600	0.0500	0.0500	0.0400	0.0500	0.0450	0.0450	0.0400	0.0300	0.0400	0.0700	0.7350	0.0490
C4	0.0300	0.0400	0.0400	0.0400	0.0300	0.0450	0.0250	0.0500	0.0450	0.0400	0.0400	0.0400	0.0300	0.0450	0.0400	0.5800	0.0387
C5	0.0500	0.0600	0.0600	0.0550	0.0300	0.0550	0.0350	0.0600	0.0550	0.0600	0.0600	0.0500	0.0500	0.0350	0.0400	0.7550	0.0503
D1	0.0300	0.0300	0.0300	0.0200	0.0300	0.0300	0.0400	0.0400	0.0300	0.0300	0.0300	0.0600	0.0400	0.0350	0.0200	0.4950	0.0330
D2	0.0200	0.0200	0.0200	0.0100	0.0200	0.0200	0.0300	0.0250	0.0200	0.0200	0.0200	0.0400	0.0300	0.0300	0.0200	0.3450	0.0230
D3	0.0200	0.0200	0.0200	0.0100	0.0200	0.0200	0.0300	0.0250	0.0150	0.0200	0.0200	0.0050	0.0100	0.0100	0.0100	0.2550	0.0170
D4	0.0250	0.0250	0.0300	0.0200	0.0250	0.0300	0.0350	0.0400	0.0300	0.0300	0.0300	0.0200	0.0200	0.0250	0.0200	0.4050	0.0270
D5	0.0250	0.0250	0.0250	0.0200	0.0250	0.0250	0.0250	0.0350	0.0250	0.0200	0.0250	0.0250	0.0150	0.0150	0.0100	0.3400	0.0227
D6	0.0300	0.0300	0.0250	0.0200	0.0300	0.0250	0.0400	0.0350	0.0300	0.0300	0.0250	0.0500	0.0350	0.0350	0.0200	0.4600	0.0307
E1	0.0500	0.0200	0.0300	0.0300	0.0300	0.0300	0.0300	0.0400	0.0400	0.0400	0.0300	0.0600	0.0600	0.0450	0.0100	0.5450	0.0363
E2	0.0500	0.0100	0.0250	0.0250	0.0500	0.0250	0.0250	0.0350	0.0300	0.0350	0.0250	0.0500	0.0500	0.0400	0.0100	0.4850	0.0323
E3	0.0100	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0250	0.0250	0.0250	0.0200	0.0400	0.0400	0.0350	0.0200	0.3600	0.0240
E4	0.0300	0.0200	0.0300	0.0300	0.0300	0.0300	0.0300	0.0400	0.0450	0.0400	0.0300	0.0700	0.0750	0.0550	0.0200	0.5750	0.0383
E5	0.0300	0.0100	0.0150	0.0150	0.0200	0.0150	0.0150	0.0200	0.0200	0.0200	0.0150	0.0250	0.0250	0.0250	0.0100	0.2800	0.0187
E6	0.0150	0.0100	0.0150	0.0150	0.0200	0.0150	0.0150	0.0200	0.0200	0.0200	0.0150	0.0200	0.0200	0.0200	0.0100	0.2500	0.0167
E7	0.0150	0.0100	0.0150	0.0150	0.0300	0.0150	0.0150	0.0200	0.0200	0.0200	0.0150	0.0350	0.0300	0.0300	0.0200	0.3050	0.0203
F1	0.0200	0.0400	0.0400	0.0400	0.0200	0.0400	0.0400	0.0200	0.0200	0.0300	0.0400	0.0100	0.0300	0.0150	0.0300	0.4350	0.0290
F2	0.0500	0.0300	0.0300	0.0300	0.0500	0.0300	0.0300	0.0100	0.0100	0.0250	0.0300	0.0030	0.0150	0.0050	0.0300	0.3780	0.0252
F3	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0200	0.0100	0.0200	0.0200	0.0200	0.0050	0.0100	0.0050	0.0400	0.2700	0.0180
F4	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100	0.0150	0.0100	0.0020	0.0050	0.0050	0.0500	0.1770	0.0118
$\sum_{j=1}^{m} w_{jk}$	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	15.000	1.0000

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

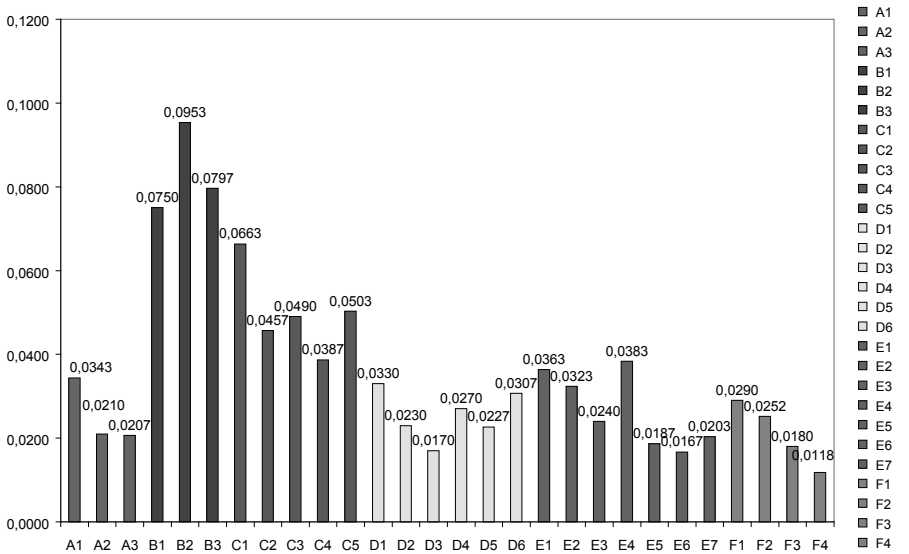

Chart 3. *Chart presentation of subcriteria according to ratings given by experts*

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral Thesis, Faculty of Maritime Studies of Rijeka, 2008.

The above tables and charts lead to the conclusion that the experts have attributed the greatest weight to natural and site criteria and subcriteria and to environmental criteria and subcriteria. Institutional and political, as well as socio-cultural criteria are of relatively minor importance. Such criterion weights were to be expected, given the set of experts (their knowledge, experience, vocation and professional activities) that made the assessment. When analysing subcriteria at the second level, it is observed that some subcriteria have a greater weight than can be gathered from the individual criteria. For example, all three subcriteria of the natural and site criteria have a distinctly greater weight than the subcriteria of the environmental criteria. Understandably, this can be explained by the number of subcriteria, given that the environmental factor has five subcriteria, while the natural and site factor has three. Interestingly, subcriterion Al – the micro location spatial plan – has a greater importance than most of the subcriteria on the technological or economic criteria. This results from the fact that this subcriteria may act as a constraining factor in cases when a spatial plan has not been adopted or does not foresee a site for a nautical-tourism port in a given micro location. In this case, preliminary research needs to be carried out, and all advantages and benefits that nautical ports could bring to the micro location, identified.

4.3. Analysis of scores for individual criteria and sets of criteria

In the appendixes to the questionnaire, the experts were asked to rank the listed criteria by giving them a score from 1 to 6, with score 1 being the most important criterion and score 6, the least important. Tables 5 and 6 show how the experts ranked the criteria [2].

Surface area not less than 10,000 m^2 (surface of the sea area approximately equal to the surface ashore),

A. Moderately inclined terrain above the tide line,
B. Sea depth not less than 2 metres but not more than 6 metres,
C. Full protection against waves from the open sea and at least partial protection against the wind,
D. The vicinity of at least one larger town and the immediate vicinity of the municipal infrastructure,
E. Water flow that is sufficient for a full exchange of water in one day.

Table 5. *Ranking criteria according to expert opinions*

Criteria/ Experts	A	B	C	D	E	F
EXP 1	3	2	5	1	6	4
EXP 2	4	3	5	1	6	2
EXP 3	3-4	5	3-4	2	6	1
EXP 4	2	1	3	5	6	4
EXP 5	2	5	6	1	3	4
EXP 6	3	3	1	1	2	3
EXP 7	-	-	-	-	-	-
EXP 8	6	5	3	4	1	2
EXP 9	5	4	1	2	6	3
EXP 10	4	5	3	2	6	1
EXP 11	4	6	3	1	5	2
EXP 12	4	5	3	2	6	1
EXP 13	3	6	2	1	5	4
EXP 14	2	4	3	1	5	6
EXP 15	4	3	2	1	6	5
EXP 16	3	4	5	1	6	2
EXP 17	3	6	2	1	5	4
EXP 18	4	6	2	1	5	3
EXP 19	4	2	3	1	6	5

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

Table 5 shows that expert no. 7 did not rank the criteria provided. This, however, has no special effect on the total score and the calculated weights. Notably, criterion D (Full protection against waves from the open sea and at least partial protection against the wind) has been given the highest score as many as 12 times. This points to the importance of safety and navigation conditions in selecting a location, which the experts have judged to be a criterion vital to the safety of boaters and their crafts.

Table 6. *Ranking criteria according to expert's opinions*

Criteria/ Experts	A. Institutional and political	B. Site and natural	C. Technological	D. Economic	E. Socio-cultural	F. Environmental
EXP 1	6	4	2	3	5	1
EXP 2	6	2	3	5	3	1
EXP 3	4	1	5-6	5-6	3	2
EXP 4	6	2	5	4	3	1
EXP 5	6	4	1	3	5	2
EXP 6	3	1	2	2	3	1
EXP 7	6	1	4	2	5	3
EXP 8	5	4	6	3	2	1
EXP 9	6	1	3	4	5	2
EXP 10	6	1	4	3	5	2
EXP 11	6	1	4	3	5	2
EXP 12	6	1	4	3	5	2
EXP 13	6	3	4	5	2	1
EXP 14	5	2	3-4	1	6	3-4
EXP 15	6	2	4	1	5	3
EXP 16	5	1	4	2	6	3
EXP 17	6	1	4	2	6	5
EXP 18	5	1	4	3	6	2
EXP 19	6	1	4	5	3	2

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

Criterion C (Sea depth not less than 2 metres but not more than 6 metres) and criterion F (Water flow that is sufficient for a full exchange of water in one day) are ranked second. Each of these criteria was ranked second by four experts. Sea depth is a crucial criterion as it determines the size of crafts that will be docked in the nautical port. As there is a trend in the Mediterranean, as well as

worldwide, towards crafts exceeding 10 metres in length, sea depth plays a vital role in selecting the location for a nautical port. Understandably, the defined standards are likely to shift upwards, as underscored by one of the experts. Most experts, 10 in all, gave the criterion E (The vicinity of at least one larger town and the immediate vicinity of municipal infrastructure) a score of 6.

Based on Table 6, it can be concluded that criterion B (site and nature-related factors) has the greatest importance in selecting a location for a nautical-tourism port. As many as 11 experts consider this criterion to be the most important in selecting a location for a nautical port. This confirms the previous ranking procedure in which this criterion was ranked first by the 12 experts.

The equation for calculating the weight of criteria based on their inter-ranking is [2]:

$$w_j = \frac{\sum_{k=1}^{n} R_{jk}}{\sum_{j=1}^{m}\left(\sum_{k=1}^{n} R_{jk}\right)} \; ; \; R_{jk} \in \{m-i : i \in (1,..,m)\} \; ;$$

whereby $\mathbf{R_{jk}}$ is the rank of criterion j according to the ranking of the k^{th} expert and for which:

$R_{jk} = m - 1$ for the most important criterion

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.

.

$R_{jk} = 0$ for the least important criterion

***n* – total number of experts,**
***m* – total number of criteria,**
w_j – weight calculated for the j^{th} criterion.

When the above equation is applied to the data in Tables 5 and 6, and providing that the arithmetical mean of the rank of criterion $\mathbf{R_{jk}}$ is used where the same criterion and the same expert have a double ranking (e.g. ranks 3-4), the following table of criteria ranking is obtained.

Table 7. *Criteria ranking*

Criteria/ Experts	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
A. Area 10.000 m^2	3	2	2.5	4	4	3		0	1	2	2	2	3	4	2	3	3	2	2
B. Moderately sloped terrain	4	3	1	5	1	3		1	2	1	0	1	0	2	3	2	0	0	4
C. Sea depth 2-6 m	1	1	2.5	3	0	5		3	5	3	3	3	4	3	4	1	4	4	3
D. Protection against waves	5	5	4	1	5	5		2	4	4	5	4	5	5	5	5	5	5	5
E. Vicinity of a town	0	0	0	0	3	4		5	0	0	1	0	1	1	0	0	1	1	0
F. Water flow	2	4	5	2	2	3		4	3	5	4	5	2	0	1	4	2	3	1

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

According to the above table, criterion E (vicinity of a town centre) has the lowest ranking, followed by criterion B (moderately sloped terrain). This is reasonable, considering that the ranking refers to the individual criteria. The experts deem criterion D to be the most important, because of the safety of boaters and their crafts. Criteria C and F are ranked at the second and third place, respectively, indicating the importance they have due to a trend of increasingly larger crafts and because of environmental standards. Referring to the surface area of a nautical port, criterion A is ranked fourth, implying the importance that the size of the sea and shore area has in accommodating crafts and the supporting facilities and services. This criterion is not crucial in making a decision regarding the selection of a location.

Table 8. *Criteria ranking*

Criteria/Experts	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
A. Institutional and political	0	0	2	0	0	3	0	0	0	0	0	0	0	1	0	1	0	1	0
B. Site and natural	2	4	5	5	2	5	5	2	5	5	5	5	3	4	4	5	5	5	5
C. Technological	4	3	0.5	1	5	4	2	1	3	2	2	2	2	2.5	2	2	2	2	2
D. Economic	3	1	0.5	2	3	4	4	3	2	3	3	3	1	5	5	4	4	3	1
E. Socio-cultural	1	3	3	3	1	3	1	4	1	1	1	1	4	0	1	0	0	0	3
F. Environmental	5	5	4	4	4	5	3	5	4	4	4	4	5	2.5	3	3	1	4	4

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

It follows from Table 8 that criterion A has the lowest ranking and the socio-cultural criterion is the second lowest. Criterion B is ranked the highest and is followed by the economic and the technological criterion.

The below given tables 9 and 10 present the weights of criteria according to how they were rated by experts.

Table 9. *Criterion weights according to the ratings given by experts*

Criteria/ Weight	$\mathbf{w_j}$
A. Area not less than 10.000 m^2 …	0.160072
B. Moderately sloped terrain …	0.118705
C. Sea depth 2-6 m…	0.188849
D. Protection against waves…	0.284173
E. Vicinity of a town…	0.061151
F. Water flow…	0.18705

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral Thesis, Faculty of Maritime Studies of Rijeka, 2008.

Table 10. *Criterion weights according to the ratings given by experts*

Criteria/ Weight	$\mathbf{w_j}$
A. Institutional and political	0.027397
B. Site and natural	0.277397
C. Technical and technological	0.150685
D. Economic	0.186644
E. Socio-cultural	0.106164
F. Environmental	0.251712

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

In analysing the data, the first task was to determine how many experts gave a specific criterion the same ranking (for example, criterion D – protection against waves, 12 experts have ranked it as most important). Then, by applying the criterion weighting equations the following weights were obtained:

Table 11. *Ranking of criterion weights*

Criteria / Rank	**1**	**2**	**3**	**4**	**5**	**6**	$\mathbf{w_j}$
A. Area not less than 10.000 m^2 …	0	3	6	8	1	1	0.167857
B. Moderately sloped terrain …	1	2	3	3	5	4	0.117857
C. Sea depth 2-6 m…	2	4	7	1	3	1	0.185714
D. Protection against waves…	12	4	0	1	1	0	0.282143
E. Vicinity of a town…	1	1	1	0	5	10	0.060714
F. Water flow…	3	4	3	5	2	1	0.185714

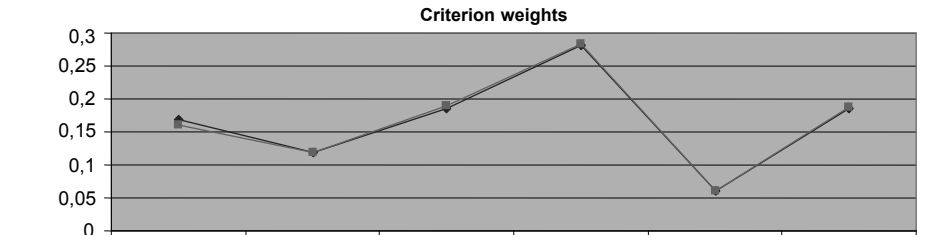
Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

Table 12. *Ranking of criterion weights*

Criteria / Rank	**1**	**2**	**3**	**4**	**5**	**6**	$\mathbf{w_j}$
A. Institutional.and political	0	0	1	1	4	13	0.030201
B. Site and natural	11	4	1	3	0	0	0.268456
C. Technological	1	2	3	11	2	2	0.154362
D. Economic	2	4	7	2	4	1	0.184564
E. Socio-cultural	0	2	5	0	8	4	0.104027
F. Environmental	6	8	4	1	1	0	0.258389

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

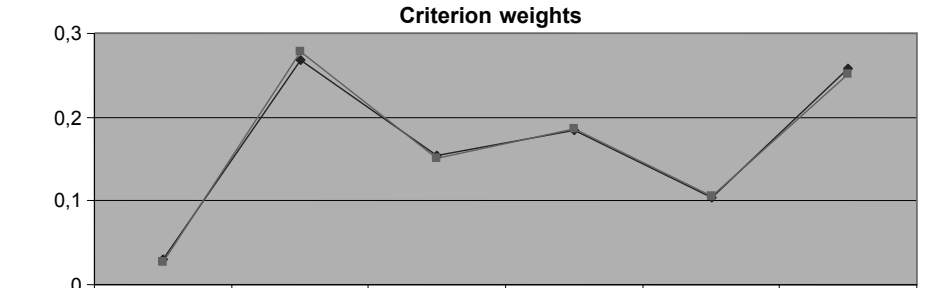
The results presented in Tables 11 and 12 indicate that the weighting coefficients go hand in hand with the rankings the experts have assigned them. As both procedures are correct and equal, there are minimum differences in criterion weights (Graphs 1 and 2).



	A. Area 10000 m^2...	B Moderately sloped terrain	C. Sea depth 2-6 m...	D. Protection against waves	E. Vicinity of a town...	F. Water flow...
težine	0,167857143	0,117857143	0,185714286	0,282142857	0,060714286	0,185714286
težine	0,160071942	0,118705036	0,188848921	0,284172662	0,061151079	0,18705036

Graph 1. *Comparative presentation of criterion weights*

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.



	A. Institutional and political	B. Site and natural	C. Technical & technological	D. Economic	E. Socio-cultural	F. Environmental
težine	0,030201342	0,268456376	0,154362416	0,184563758	0,104026846	0,258389262
težine	0,02739726	0,27739726	0,150684932	0,186643836	0,106164384	0,251712329

Graph 2. *Comparative presentation of criterion weights*

Source: Kovačić, M.: Optimisation of selection of the location and facilities of a nautical tourism port, Doctoral thesis, Faculty of Maritime Studies of Rijeka, 2008.

A comparison of the ranking and weighting procedures shows there are but very small deviations in the results obtained. This confirms that the procedures have been correctly chosen in seeking to prevent irregularities from occurring in making judgements and final conclusions.

It can be concluded that the applied methodology of multiple criteria analysis makes it possible to obtain results that point to almost identical conclusions on the importance of individual criteria. This confirms the premise that it is justified to apply MCA in selecting the optimum location for a port of nautical tourism. Given that this is a poorly structured problem, it is important to

point out that the decision-maker (for example, the state, local government or investor) is given the opportunity to influence criteria assessment based on his own judgements that do not necessarily have to coincide with the results of this research or the ratings of experts.

5. CONCLUSION

Up to now, there has been no systematic research conducted for the purpose of optimising the selection of the location and facilities of ports of nautical tourism by using various methods (survey, ranking, rating, MCA). Hence, to help optimise the selection of a location and facilities for a nautical port consistent with sustainable development, the research carried out by the authors has focused on the issues, complexity and importance of the maritime domain, its valorisation and protection.

The aim of the research was to identify the criteria and subcriteria pertaining to the selection of a location for a nautical port, assess the criteria and subcriteria identified, rank the proposed individual criteria, rank the proposed sets of criteria, and to have experts put forward other criteria and subcriteria in accordance with their knowledge and experience.

The research was conducted in the Croatian and English languages. Out of the 55 experts to whom the questionnaire with a commentary was sent, a total of 19 experts from Croatia and other European countries responded. This gives a response rate of 34.55 per cent, which is above the average response rate for written surveys, making this a representative sample. Ten experts were from Croatia, and nine from the European countries of Slovenia, Italy, France, England and Norway.

To summarize, it can be concluded that the research conducted has resulted in accomplishing the goals set out. Stress is placed on the correct selection of the methodologies using the group weighting method and MCA, which can be applied in the decision process of selecting the optimum location and facilities for a port of nautical tourism.

Based on these insights, further progress can be made in research pertaining to the valuation and management of the marine domain and nautical ports.

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Sažetak

KRITERIJI ZA ODABIR LOKACIJE LUKE NAUTIČKOG TURIZMA

Pregledno i sustavno u radu su izneseni rezultati istraživanja "Kriteriji za odabir lokacije luke nautičkog turizma", koje je provedeno tijekom 2006/2007 godinu. Svrha istraživanja bila je, definirati prostorne mogućnosti i ograničenja te predložiti kriterije radi optimalnog odabira lokacije i sadržaja luke nautičkog turizma. Postavljeni su opći i poseban cilj istraživanja koji obzirom na problem istraživanja zahtijevaju primjenu višekriterijske analize za izbor bitnih kriterija pri utvrđivanju lokacije i sadržaja luke nautičkog turizma.

Suvremeno odlučivanje u svezi gospodarskog korištenja pomorskog dobra, zahtijeva integralno upravljanje morskim i obalnim okolišem radi očuvanja prirodnih resursa. Kako se radi o složenom problemu s više dominantnih kriterija, sustavni pristup njegova rješavanja zahtijeva primjenu metoda višekriterijske analize u cilju optimiziranja rješenja.

Temeljem provedenog istraživanja i rezultata analize ekspertnih mišljenja, autori definiraju bitne kriterije i rangiraju ih po njihovoj važnosti. Utvrđen je težinski koeficijent za svaki pojedini kriterij te definiran stupanj preferencije modela optimizacije izbora lokacije i sadržaja luke nautičkog turizma. Provedeno istraživanje ukazuje na važnost sustavnog poimanja i prihvaćanja integralnog upravljanja morskim i obalnim okolišem kao čimbenikom održivog razvoja.

Ključne riječi: *istraživanje, kriteriji, lokacija luke nautičkog turizma, metode za grupno procjenjivanje težina, višekriterijska analiza.*

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