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CUSTOMER-BASED PORT SERVICE QUALITY MODEL

ABSTRACT

This port service quality study is an important precondition for an efficient development of port industry and traffic system as a whole. It is due to the complexity of any port, as a system consisting of a large number of stakeholders rendering services to customers with various requirements, that a unique set of port service quality indices has been still missing. For this reason, the paper explains the port service quality concept in compliance with stakeholders and their requirements within the context of port service quality.

The aim of the paper is to present a proposal for a customer-based port service quality model based on empirical study and its reliability testing on a selected sample. The proposed model is defined by five factors and fits satisfactorily into the obtained poll questionnaire results. The statistical data processing package SPSS 16.0 and the LISREL 8.54 programme were used in the study.

KEY WORDS

port service, customer, model, factor analysis

1. INTRODUCTION

Through the integration in the global traffic and logistic system, ports have acquired the function of accelerators of the global economic development. Being the initial and terminal points of the global flow of goods and inavoidable links in the traffic system chain (seaborne, land, and airborne ones), they render services to their customers thus contributing to the efficiency in the process of cargo movements from the point of origin to the point of destination.

Services facilitate economic growth and represent almost two thirds of the total global output with the continuously growing trend in the trade of services which represents one fifth of the global trade. Such dynamics exercised by the development of services has caused changes within service providers whose business strategies have been targeted toward fitting the market and meeting the highest standards posed by customer quality-based requirements.

Port service quality, in addition to the price, has thus become the key factor in the port terminal operation and maintenance of their position on the demanding and changeable market of port services. Through continued changes in quality, accompanied by service price, customers are offered a choice and service providers are required to meet customer requirements, thus making a dynamic quality system necessary.

For all the participants in traffic, the quality system represents the equilibrium between the efficiency, safety, risk, and environmental impact. The quality system requires adequate management, continuing polishing up and upgrading. Activities to be undertaken in this direction are time-consuming and very demanding; therefore, the aim posed to this study is the need for determining a port service quality model that will make it possible for the investigation of the present situation to be carried out and for any areas requiring modification and enhancement to be predicted according to customer requirements.

2. PORT SERVICE QUALITY CONCEPT THEORETICAL DETERMINANTS

Port service quality may be defined as a product or service that satisfies customer requirements and expectations. According to the Advances project, to secure a quality port service means to secure a service in a reliable, safe, competitive and environment-friendly manner in accordance with customer requirements and the lowest possible level of risks for life, environment, and property.

The enhancement of competitiveness, safety, and higher level of port environment protection calls for introduction of a port service quality concept, based on clearly defined term denoting quality, precisely determined requirements the port is required to meet on the market, port basic functions (operational areas), identification of stakeholders and their requirements,

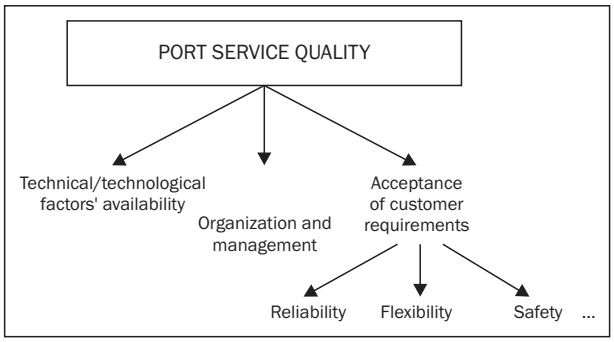
and bottle-necks and problems most frequently encountered in port operations.

The complexity of the port service quality concept ensues from principal features of services themselves (intangibility, heterogeneity, and inseparability of production from consumption), from the complexity of the port service process of production, as well as from the large number of stakeholders taking part in service production and subjective approach to the understanding of quality.

Service quality may be defined from two aspects: the organization-based aspect and the customer-based aspect. Whereas from the organization-based aspect service quality is the basic requirement characterized by the price, from the customer-based aspect quality is a set of attributes (dimensions are the most important service quality parameters measurable by a set of attributes) for the evaluation of service meeting customer requirements. From the organization-based aspect, the provided service must be in compliance with customer requirements, provided however that the cost of quality be taken into account (warranties, service production adverse consequences). Where service quality is analysed from the customer-based aspect, it is widely related with the level of customer's satisfaction achieved by the service provided, which represents a subjective understanding of quality (perceived quality) with regard to the quality expected. From the customer-based aspect (buyer's or customer's), quality represents the achieved level of the built-in usable value of the product or service.

Port service quality may also be considered:

- from the technical-technological aspect including: development level of the infrastructure and suprastructure, quality of access by sea, availability of port equipment, development level and fitness of technological loading/discharging and warehousing procedures, organization of transport within the terminal, standardization of transport units and vehicles, implementation of information and communication technologies, development level of the intermodal system, land connections with the port hinterland, and, where the European Union ports are considered, the integration in the trans-European traffic network as well...
- from the aspect of port organization and management, which is considered most responsible for stakeholders' coordination, port integration in the traffic of goods flows, investments in the area of infrastructure and new technologies, and for the quality management system and enhancement of the port service quality in accordance with customer requirements...
- from the aspect of customers, referring to service reliability, time required, frequency, flexibility, availability, competitiveness, safety, relations with port management... (*Scheme 1*).



Scheme 1 - Port service quality aspects

Service quality acts as a prerequisite in attracting new customers and holding on the existing ones, hence the need for the service quality to be made commercially attractive to all stakeholders in the transport and logistic chain, thus to foster investments aimed at providing good quality services and developing good relationship with customers.

3. PORT SYSTEM STAKEHOLDERS AND THEIR PORT SERVICE QUALITY-BASED REQUIREMENTS

Port is a complex system consisting of a large number of internal and external port community stakeholders, and their participation in service providing is benchmarked by specific requirements, or targets. The stakeholder concept has become a key term in all port management strategies. The term stakeholder denotes any individual or group having interest in the port or being affected by the port operation [4]. Looking from the technological and economic aspect, any port is the place where stakeholders get into contact with each other and deals are made between them, any of "stakeholders" acting in accordance with their interests and priorities.

Each particular port has a specific stakeholder structure, which is at the same time changeable with regard to market conditions and requirements, thus making it necessary for their relationship within the system to be continuously undergoing redefinition. The following groups of stakeholders performing on the complex shipping trade and port service market may be subject to analysis:

- Internal stakeholders making part of the complex port administration organizational structure (port managers, employees, board members, and shareholders);
- External stakeholders performing within the port area (port organizations and related industry) and those performing outside the port area (hinterland-based industry, stakeholders involved in companies' physical transport operations – port operators, agents, stevedores). External stakeholders

are interested in monitoring continuously port development activities, the performance of port activities and procedures producing immediate effect upon their own business efficiency;
- Customers as stakeholders posing port standards for services they pay - forwarders, logistic operators, importers/exporters, shippers;
- Government bodies including public administration for transport, economy, ecology, and planning at the national, regional, and local levels.

In compliance with the Advances programme, there are four different groups of port stakeholders:

1. Service paying stakeholders: owners, consignees, cargo owners.
2. Organizing stakeholders: dispatchers, agents, logistic operators, multimodal transport operators. This group of stakeholders represents port service customers.
3. Executive stakeholders: transport operators, loading/discharging operators.
4. Authorities: customs, port authority.

The variety of function features, specific problems and bottlenecks in ports make it necessary for numerous customer requirements posed to ports to be subject to analysis. The requirement represents customer's specific need or desire for qualitative standards to be based on. Considering the fact that service quality is defined by the market and/or customers, it is important for their requirements to be predicted because it is the level of satisfaction achieved in respect of such requirements that brings the service quality and customer requirements to convergence. The requirements may be outlined on the basis of ten general (common) indicators researchers have identified as most frequently used customer-based quality assessment criteria in a large number of service providing companies. The most frequently applied set of requirements known in literature as "Service Quality Determinants" includes[5]:

1. *reliability* in service providing – capacity to fulfil what has been promised to the customer, accuracy, precision, and consistency in service providing at first attempt;
2. *availability* (accessibility) of service – suitable business hours, location, queuing time, easy contact making;
3. *tangible elements* – physical suitability, equipment, personnel appearance, promotion materials;
4. *business-like manners and responsibility* – readiness, disposability and availability of personnel for providing timely assistance and prompt service as required;
5. *competence* – the level of knowledge and service providing skills, qualified contact personnel;
6. *kindness* - obligingness, respect, understanding, disposition of contact personnel;
7. *communication* – providing information in the appropriate language and customer-friendly procedures, acceptance of customers' points of objection and/or proposal;
8. *credibility* – company's fairness, professionalism, reputation and confidence;
9. *understanding* – making effort to understand customers' individual needs and requirements;
10. *safety* – prevention of possible dangerous situations and risks, financial safety, guaranties.

These ten indicators are the backbone of the port service quality model and the basis for the quality assessment to be based upon, and they are in interactive relationship with some additional indicators such as the past experience and verbal and external communication between actual and potential customers.

4. PROPOSAL FOR A CUSTOMER-BASED PORT SERVICE QUALITY MODEL

With a view to determining the port service quality model, an empirical study was carried out by the authors in 2009. The necessary data were collected by means of a poll questionnaire. The questionnaire consisted of 25 attributes (*Table 1*) which were considered suitable by the authors for defining the port service quality. The importance of attributes was rated by respondents between 1 and 5 on the Likert Scale. Rate 1 means that the attribute involved has no importance at all, and rate 5 denotes a very important port service quality attribute.

Having in mind that the customer requirements are defined as a group of attributes offering best customer-based illustration of the port service quality, authors were aware of the complexity of their empirical study and found it necessary for an adequate method to be used which would enable them to reach a scientific explanation of connections between the variety of attributes and to identify the group of attributes influencing the definition of the port service quality model. With this aim, the collected data were subject to the principal components analysis method and to the factor analysis using the SPSS 16.0 programme. The principal components analysis was applied as the factor extracting method, and the Oblimin rotation as the rotation method.

The suitable sample of respondents consisted of forwarders and agents operating in the area of Rijeka. The specific feature of the study was a relatively small number of respondents or port service customers in the area, whereby the factor analysis minimum criterion of 100 respondents required could not have been satisfied, so that the sample that had formerly consisted of forwarders and agents had to be extended by students in the final year of study in Transport Technology, Transport Technology and Organization, and

Table 1 - Port service quality attributes

Mark	Attribute
01	Berth availability immediately upon vessel's arrival at port
02	Vessel's loading/discharging operations in compliance with contracts
03	Adequate number of berths at port
04	Tugboat availability at port upon request
05	Port service availability 24/365
06	Container railway delivery with no delays attributable to unforeseen queuing at terminal
07	Container loading/discharge on/from train according to plan, with no time sheet deviations
08	Vessel's total stay at port with no unforeseen time deviations
09	Clearly elaborated port operation procedures
010	Pilot service availability at port 24 hours/day
011	On-line port services availability for customers on web site
012	Accurate and complete container/vessel documents
013	Complete and correct container information availability at port at any time
014	Container follow-up system in operation at port
015	Intermodal transport system in operation at port
016	Clear and simple customs and other inspection procedures
017	High level of information integration between stakeholders
018	Port information availability on the internet
019	Container damage low frequency rate
020	Lost container low frequency rate
021	Employees' high qualification/skill level
022	Port's good connections to the main road
023	Port's good railway connections to the main line
024	Port's good connections with hinterland
025	Dangerous cargo handling availability at port

Shipping and Traffic Logistics and Management with the Faculty of Maritime Studies of Rijeka. Out of 195 questionnaires distributed in total, 142 (72.8%) got responded, and hence the number of 142 respondents representing the sample of the study.

In order for the method to be applied, it was stated that variables were numerical and it was concluded on the basis of the determined correlation matrix that the data concerning the selected variables were suitable for the factor analysis to be carried out.

Using the principal components factor analysis after having the variables transformed in orthogonal axes, factors were extracted on the basis of their innate values (*Table 2*). Using the most commonly applied Kaiser criterion (using only those principal components of innate value above 1) would result in seven factors in this study.

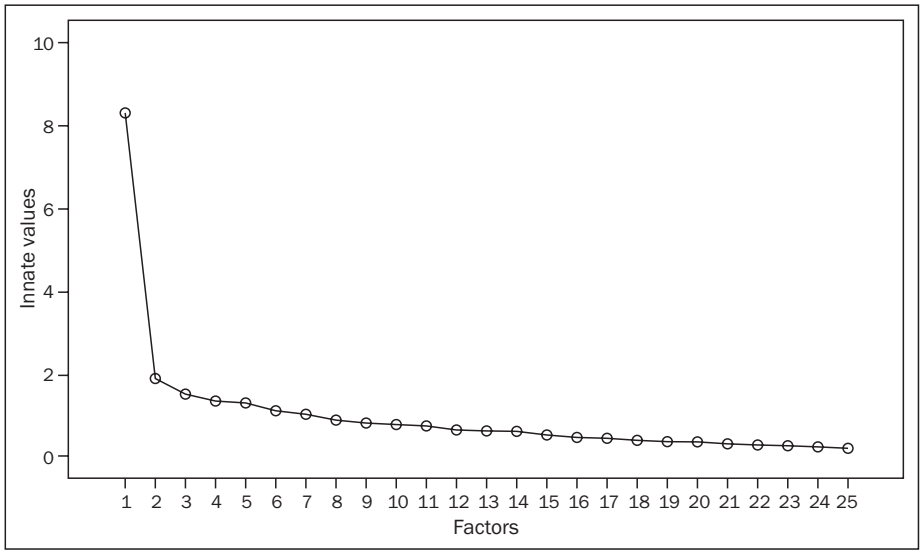
It is evident from the results displayed in *Table 2* that the percentage of total variance illustrated by seven extracted factors amounts to 65.55%. However, the Scree plot criterion based on Cattel's graph shows the interruption between factors five and six, thus confirming the extraction of five factors (*Graph 1*).

Table 2 - Matrix of factor structure, Innate values, and variance explanation

Factor	Innate values		
	Total	% Variance	Cumulatively %
1	8.311	33.244	33.244
2	1.871	7.483	40.727
3	1.494	5.975	46.702
4	1.328	5.310	52.012
5	1.287	5.149	57.161
6	1.092	4.367	61.529
7	1.005	4.019	65.547

Source: Authors - based on SPSS 16.0 data analysis

The number of factors having been once determined, made it possible to determine the extracted factors structure matrix containing factor loadings. Factor loadings represent correlation coefficients between factors and variables, i.e. they point to the importance of each variable for each particular factor. The Oblimin rotation, as the oblique rotation method, was then applied to the obtained factor structure matrix which resulted in the factor matrix



Graph 1 - Cattel's (Scree plot) graph

Source: Authors - based on SPSS 16.0 data analysis

Table 3 - Factor matrix after the Oblimin factor rotation

Attributes	Factors					Communalities
	1	2	3	4	5	
022	**0.799**	0.056	-0.372	0.196	-0.348	0.664
023	**0.757**	0.398	-0.455	0.102	-0.430	0.674
021	**0.738**	-0.088	-0.213	0.118	-0.251	0.598
024	**0.702**	0.430	-0.557	0.083	-0.426	0.664
016	**0.684**	0.194	-0.559	0.208	-0.397	0.582
019	**0.663**	0.303	-0.268	0.211	-0.296	0.492
02	0.175	**0.795**	-0.252	0.098	-0.187	0.645
01	0.113	**0.740**	-0.060	0.208	-0.182	0.605
020	0.494	**0.507**	-0.396	-0.099	-0.363	0.492
013	0.218	0.029	**-0.752**	0.066	-0.364	0.606
015	0.550	0.264	**-0.687**	0.236	-0.194	0.620
05	0.381	0.386	**-0.676**	-0.032	-0.390	0.546
06	0.364	0.167	**-0.656**	0.245	-0.309	0.468
07	0.288	0.376	**-0.655**	0.040	-0.341	0.487
014	0.282	-0.188	**-0.649**	0.364	-0.279	0.626
08	0.403	0.348	**-0.526**	-0.061	-0.398	0.410
018	0.343	0.246	-0.322	**0.706**	-0.242	0.609
017	0.556	0.160	-0.377	**0.636**	-0.296	0.643
04	0.107	0.371	-0.255	**0.560**	-0.437	0.552
010	0.195	0.326	-0.423	-0.010	**-0.724**	0.585
09	0.472	0.113	-0.262	0.006	**-0.706**	0.586
011	0.273	0.161	-0.411	0.268	**-0.694**	0.536
03	0.281	0.064	-0.212	0.316	**-0.685**	0.545
012	0.214	0.537	-0.508	-0.228	**-0.595**	0.680
025	0.363	0.180	-0.319	0.032	**-0.580**	0.374

Source: Authors - based on SPSS 16.0 data analysis

Table 4 - Display of fit index values obtained from the model goodness-of-fit testing

Index	Index value	Goodness-of-fit	
		Good	Acceptable
Chi-Square	570.4	√	
Degree of freedom (df)	286		
Chi-Square/df	2.02	√	
Root Mean Square Error of Approximation (RMSEA)	0.084		√
Goodness of Fit Index (GFI)	0.76		√
Adjusted Goodness of Fit Index (AGFI)	0.72		√
Normed Fit Index (NFI)	0.86		√
Non-Normed Fit Index (NNFI)	0.92	√	
Comparative Fit Index (CFI)	0.93	√	

Source: Authors - aided by LISREL 8.54 programme

upon which the factor interpretation has been based (*Table 3*).

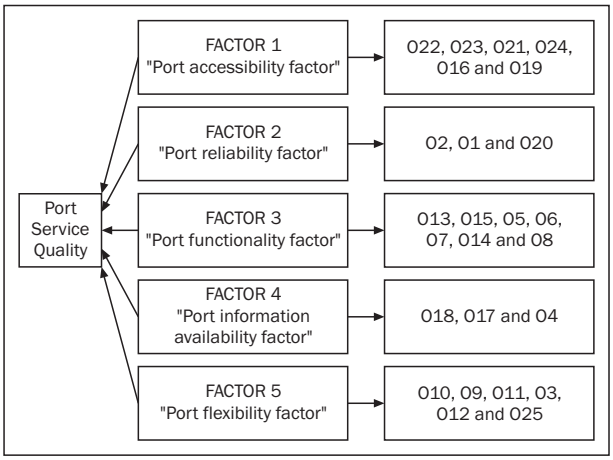
The factor interpretation has been based upon the displayed factor matrix obtained after rotation and identification of attributes with significant loadings related to the same factor. The amount of factor loading represents the general principle used in the factor matrix testing.

It can be seen in *Table 3* that there were 5 factors extracted, which represents port service quality dimensions measurable by the set of 25 attributes.

Once the port service quality factors have been determined and explained, the reliability of the questionnaire was analysed using the Cronbach α Coefficient for each factor separately and the total coefficient value. The total coefficient value obtained amounts to 0.913 whereby the questionnaire reliability has been confirmed as well as its suitability for use as a measuring instrument in the repeated study.

The established model testing was performed by the Confirmatory Factor Analysis (CFA). The testing was aimed at evaluating fitness of the model to results obtained through the poll questionnaire, or the level of consistency of the hypothetic and empirical models. The level of model fitness is determined by the fit index. There is a number of indices used in practice, there being no unambiguously determined group in application by researchers, and this fact points to various model fitness evaluation possibilities. The confirmatory factor analysis was performed using the LISREL 8.54 programme. The testing comprised the five-factor measuring model obtained by the factor analysis. The results obtained are presented in *Table 4*.

It was confirmed by the results obtained that the measuring scale used for the purpose of defining the port service quality model, with the initial group of arguments divided into five measuring scales, did represent the appropriate measuring instrument for the port service quality study. The index values of the measuring model fitness to the data showed that the defined model fitness to data was satisfactory and the model was acceptable for further analysis [11].



Scheme 2 - Factor analysis results

5. RESEARCH RESULTS

This empirical study has resulted in a proposed customer-based port service quality model. The method of principal components analysis and factor analysis, based on the collected data was used to obtain the model indicated by five factors which represents port service quality dimensions measurable by a set of 25 attributes. The result obtained is shown in *Scheme 2*.

The first factor is defined by attributes 022, 023, 021, 024, 016, and 019, and therefore it may be called "*port accessibility factor*". Port connections to the main roads are assigned the most significant factor loading value related to this factor.

The second factor indicates attributes 02, 01, and 020 and therefore, it may be called "*port reliability factor*". This factor bears the greatest factor loading

on the attribute denoting the time required for vessel loading/discharging operations in compliance with the contract.

The third factor consists of seven attributes: 013, 015, 05, 06, 07, 014, and 08, and thus it may be called "*port functionality factor*" with regard to the fact that it represents the attribute with the highest factor loading, enabling the port to have complete and correct information on the containers available at any time.

The fourth factor has a significant factor loading for three attributes: 018, 017, and 04, and so it may be called "*port information availability factor*", because the attribute of availability of information in respect of the port on the internet bears the highest factor loading.

The fifth factor refers to six attributes: 010, 09, 011, 03, 012, and 025, which may be called "*port flexibility factor*" with regard to its highest load-bearing attributes.

Some attributes within the results (024, 016, 020, 015, 017 and 012) bear high factor loadings upon two factors, so that we can say that they are distributed along the bi-polar dimension.

It may be thus concluded for the customer-based port service quality that it is determined by five dimensions: "*accessibility*", "*reliability*", "*functionality*", "*information availability*", and "*flexibility*".

The research on quality should be broad but contextually specific to ensure a set of port service quality attributes. Subjectivity and the nature of quality contribute to the importance of scientific research, therefore in this research a port service quality model is proposed. This model is defined by the set of attributes based on the analysis of literature and experience of surveyed port service users.

Numerous definitions of the terms "service" and "service quality", found in the national and foreign literature [12], as well as the port complexity in terms of service provision, point out the different perceptions of the port service quality. With regard to the fact mentioned above, and the fact that port service quality attributes are indicators of user requirements, it can be concluded that there is no unique concept of dimensions and attributes that could define customer-based port service quality model. Also, the content analysis of the quality attributes is not fully scientifically established because, due to specific conditions, the interpretation of each attribute may differ.

6. CONCLUSION

The study has defined the port service quality model on the basis of empirical research. To this aim, the port service quality concept has been explained through the complexity ensuing from principal features of services themselves (intangibility, heterogeneity, and production and consumption inseparability), from the complexity of the port service process of production, as well as from the large number of stakeholders taking part in the service production and their subjective approach to the understanding of quality.

Changes affecting the port service market along with technological enhancements have initiated competition between ports, whereby ports have confronted by new challenges and the need for continuing adjustment to customer requirements, since it is through meeting such requirements that the service quality is brought closer to customer expectations.

To determine the principal attributes of the port service quality as the universal and at the same time specific feature of the service provided is considered useful both in respect of enhancement of actual services and better understanding of customers and of predicting trends on the port service market.

The study based on the collected data has stated that port service attributes are indicated by five groups of attributes combined in factors. The five factors extracted with regard to the port service quality pertaining attributes are called: "*accessibility factor*", "*reliability factor*", "*functionality factor*", "*information availability factor*", and "*flexibility factor*".

The Cronbach Coefficient was used to determine the reliability of the questionnaire. The established model testing confirmed that the measuring scale with the initial group of arguments divided into five measuring scales did represent the appropriate measuring instrument for the port service quality study, and the measuring model fitness-to-data index values showed that the defined model fitness to data was satisfactory and the model was acceptable for further analysis.

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SAŽETAK

MODEL KVALITETE LUČKE USLUGE SA STAJALIŠTA KORISNIKA

Istraživanje kvalitete lučke usluge važna je pretpostavka uspješnog razvitka lučke industrije i prometnog sustava u cjelini. Složenost luke kao sustava kojeg čini veliki broj subjekata koji pružaju usluge korisnicima s različitim zahtjevima, razlog je nepostojanja jedinstvenog seta pokazatelja kvalitete lučke usluge. Stoga je u radu objašnjen koncept kvalitete lučke usluge u skladu sa subjektima i njihovim zahtjevima u kontekstu kvalitete lučke usluge.

Cilj je ovog rada predložiti model kvalitete lučke usluge sa stajališta korisnika na temelju provedenog empirijskog istraživanja i testirati njegovu pouzdanost na izabranom uzorku. Predloženi model definiran je s pet faktora i zadovoljavajuće je prilagođen rezultatima provedene ankete. Pritom je korišten statistički paket za obradu podataka SPSS 16.0 i program LISREL 8.54.

KLJUČNE RIJEČI

lučka usluga, korisnik, model, faktorska analiza

LITERATURE

[1] Project ADVANCES – Added Value Network Concerning European Shipping, Final publishable report, EU, 2004.

[2] **Juran, J. M.**, **Gryna, F.M.**: *Planiranje i analiza kvalitete*, 3. izd., Zagreb, MATE, 1999

[3] **Cuadrado, M.**, **Frasquet, M.**, **Cervera, A.**: *Benchmarking the port services, a customer oriented proposal*. Benchmarking, 11 (2004), 3, pp. 320-330.

[4] **Henesey, L.E.**, **Notteboom, T.E.**, **Davidsson, P.**: *Agent-based simulation of stakeholder relations, an approach to sustainable port terminal management*. IAME. 2003, p. 5.

[5] **Zeithaml, V.A.**, **Berry, L.L.**, **Parasuraman, A.**: *The nature and determinants of customer expectations of service*, Journal of the Academy of Marketing Science. 21 (1993), p. 4.

[6] **Parasuraman, A.**, **Zeithaml, V.**, **Berry, L.L.**: *A conceptual model of service quality and its application for service quality research*, Journal of Marketing, 49 (1985), pp. 41-50.

[7] **Myung-Shin, Ha.**: *A comparation of service quality at major container ports: implications for Korean ports*, Journal of Transport Geography 11 (2003), pp. 131-137.

[8] **Ugboma, C.**, **Callistus, I.**, **Ogwude, C.I.**: *Service quality measurement in ports of developing economy: Nigerian ports survey*, Managing service quality, 14 (2004), 6. pp. 487-495.

[9] **Kolanović, I.**, **Zenzerović, Z.**, **Skenderović, J.**: *Metodološki pristup empirijskom istraživanju kvalitete lučke usluge*, Pomorstvo, 23 (2009), 1, pp. 275-297.

[10] **Fulgosi, A.**: *Faktorska analiza*, Zagreb, Školska knjiga, 1988.

[11] **Hu**; **Bentler**: *Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives*, Structural Equation Modeling. 6(1999), 1. pp. 1-55.

[12] **Kolanović, I.**: *Temeljne dimenzije kvalitete lučke usluge*. Pomorstvo, 21 (2007), 2. pp. 207-224