VOLUME 6, ISSUE 3, (2018)

UCTEA - The Chamber of Marine Engineers

JEMS

JOURNAL OF ETA MARITIME SCIENCE

URUNDUL F. (2007) Fog on the Mississippi, New Orleans, USA.

ISSN:2147-2955

Volume : 6
Issue : 3
Year : 2018

JEMS - JOURNAL OF ETA MARITIME SCIENCE - ISSN: 2147-2955

JEMS JOURNAL

Journal of ETA Maritime Science

JOURNAL INFO

Publisher : **Feramuz AŞKIN**
The Chamber of Marine Engineers Chairman of the Board

Engagement Manager : Alper KILIÇ

Typesetting : Remzi FIŞKIN
Emin Deniz ÖZKAN
Burak KUNDAKÇI
Ömer ARSLAN

Layout : Remzi FIŞKIN

Cover Design : Selçuk NAS
Remzi FIŞKIN

Cover Photo : Faruk ÜRÜNDÜL

Publication Place and Date :

The Chamber of Marine Engineers

Address : *Caferağa Mah. Damga Sk. İffet Gülhan İş Merkezi No: 9/7 Kadıköy/İstanbul - Türkiye*

Tel : *+90 216 348 81 44*

Fax : *+90 216 348 81 06*

Online Publication : www.jemsjournal.org / 30.09.2018

ISSN : 2147-2955

e-ISSN : 2148-9386

Type of Publication: JEMS is a peer-reviewed journal and is published quarterly (March/June/September/December) period.

Responsibility in terms of language and content of articles published in the journal belongs to the authors.

JEMS JOURNAL

EDITORIAL BOARD

JEMS JOURNAL

EDITORIAL BOARD

JEMS JOURNAL

MEMBERS OF ADVISORY BOARD:

JEMS SUBMISSION POLICY:

1. Submission of an article implies that the manuscript described has not been published previously in any journals or as a conference paper with DOI number.

2. Submissions should be original research papers about any maritime applications.

3. It will not be published elsewhere including electronic in the same form, in English, in Turkish or in any other language, without the written consent of the copyright-holder.

4. Articles must be written in proper English language or Turkish language.

5. It is important that the submission file to be saved in the native format of the template of word processor used.

6. References of information must be provided.

7. Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text.

8. To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

9. JEMS operates the article evaluation process with "double blind" peer review policy. This means that the reviewers of the paper will not get to know the identity of the author(s), and the author(s) will not get to know the identity of the reviewer.

10. According to reviewers' reports, editor(s) will decide whether the submissions are eligible for publication.

11. Authors are liable for obeying the JEMS Submission Policy.

12. JEMS is published quarterly period (March, June, September, December).

13. JEMS does not charge any article submission or processing charges.

JEMS JOURNAL

CONTENTS

JEMS JOURNAL

İÇİNDEKİLER

DOI ID: 10.5505/jems.2018.30306

Journal of ETA Maritime Science

JEMS JOURNAL

Editorial (ED)

We are pleased to introduce JEMS 6(3) to our valuable followers. There are valuable and endeavored studies in this issue of the journal. We hope that these studies will contribute to the maritime industry. I would like to mention my gratitude to authors who sent their valuable studies for this issue, to our reviewers, to our editorial board, to our section editors, to our foreign language editors who provide quality publications by following our publication policies diligently and also to layout editors who spent great efforts in the preparation of this issue.

Your Sincerely.

Editor
Prof. Dr. Selçuk NAS

Journal of ETA Maritime Science

JEMS JOURNAL

Editörden (ED)

JEMS 6(3)'ü siz değerli takipçilerimizin ilgisine sunmaktan mutluluk duyuyoruz. Dergimizin bu sayısında birbirinden değerli çalışmalar yer almaktadır. Dergimizde yer alan bu çalışmaların denizcilik endüstrisine katkı sağlamasını ümit ediyoruz. Bu sayı için değerli çalışmalarını gönderen yazarlarımıza, yayın politikalarımızı titiz bir şekilde takip ederek kaliteli yayınlar çıkmasına katkıda bulunan başta hakemlerimiz olmak üzere, bölüm editörlerimize, yabancı dil editörlerimize ve yayın kurulumuza, sayımızın yayına hazırlanmasında büyük emekleri olan mizanpaj editörlerimize teşekkürlerimi sunuyorum.

Saygılarımla.

Editör
Prof. Dr. Selçuk NAS

Received: 25 February 2018 Accepted: 30 April 2018 *DOI ID: 10.5505/jems.2018.95914*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Theophilus Chinyerem NWOKEDI

Sustainability Planning and Benchmarking of Post Concession Performance of Nigerian Seaports: The Case of Onne Seaport

Theophilus Chinyerem NWOKEDI[1], Gladys Chineze EMENIKE[2]

[1]Department of Maritime Management Technology, Federal University of Technology, Nigeria
[2]Center for Transport and Logistics Studies, University of Port-Harcourt, Nigeria
nwokeditc@gmail.com; ORCID ID: https://orcid.org/0000-0002-9441-7311
chiemenike@gmail.com; ORCID ID: https://orcid.org/0000-0002-8570-8627

Abstract

The study appraised the sustainability of the improvement in post concession cargo throughput, revenue, ship traffic statistics and ship traffic volume performance of Onne seaport and developed benchmarks and planning models for sustainability of Onne seaport performance. Time series data of 10 years was gathered from the Nigerian ports authority on post concession cargo throughput, port revenue, ship traffic statistic and ship traffic volume performances of the seaport. The Arithmetic progression and series mathematical tool were used to analyze the data. It was found that; the post concession performance benchmark for each performance parameter of cargo throughput, port revenue, ship traffic volume and ship traffic statistics are C_1 *= 2,554,795 metric tons,* R_1 *= 103.76 Million USD,* S_1 *= 256,831,040 NRT, and* V_1 *= 443 vessels respectively. The conditions for sustainability of the post concession cargo throughput, port revenue, ship traffic volume and ship traffic statistics performance of the port are:* $C_1 + (n-1)d \geq 2{,}554{,}795$ *metric tons,* $R_1 + (n-1)d \geq 103.76$ *Million USD,* $S_1 + (n-1)d \geq 256{,}831{,}040$ *Net Registered Tonnage and* $V_1 + (n-1)d \geq 443$ *respectively. Recommendations were proffered on the basis of the research findings.*

Keywords: *Sustainability-planning, Benchmarking, Post-concession, Seaport, Performance.*

Nijerya Limanlarının İmtiyaz Sonrası Performansının Sürdürülebilirlik Planlaması ve Karşılaştırması: Onne Limanı Örneği

Öz

Çalışmada; Onne Limanı'nın imtiyaz sonrası yük hacmi, geliri, gemi trafik istatistiği ve gemi trafik hacmi performanslarındaki iyileşmenin sürdürülebilirliği değerlendirilmiş ve Onne Limanı performansının sürdürülebilirliği için karşılaştırmalar ve planlama modelleri geliştirilmiştir. Nijerya Limanlar Otoritesi'nden limanın imtiyaz sonrası yük hacmi, liman geliri, gemi trafik istatistiği ve gemi trafik hacmi performansları ile ilgili 10 yıllık zaman serisi verileri toplanmıştır. Verilerin analizinde aritmetik dizi ve seriler kullanılmıştır. Yük hacmi, liman geliri, gemi trafik hacmi ve gemi trafik istatistiği ile ilgili her bir performans parametresi için imtiyaz sonrası performans ölçütü sırasıyla; C_1 *= 2,554,795 metrik ton,* R_1 *= 103.76 milyon dolar,* S_1 *= 256,831,040 NRT ve* V_1 *= 443 gemi bulunmuştur. Limanın imtiyaz sonrası yük hacmi, geliri, gemi trafik hacmi ve gemi trafik istatistiği performanslarının sürdürülebilirliğine yönelik koşulları sırasıyla;* $C_1 + (n-1)d \geq 2{,}554{,}795$ *metrik ton,* $R_1 + (n-1)d \geq 103.76$ *milyon dolar,* $S_1 + (n-1)d \geq 256{,}831{,}040$ *NRT ve* $V_1 + (n-1)d \geq 443$ *gemidir. Araştırma bulgularına dayanarak tavsiyeler sunulmuştur.*

Anahtar Kelimeler: *Sürdürülebilirlik planlaması, Karşılaştırma, İmtiyaz sonrası, Liman, Performans.*

To cite this article: Nwokedi, T. C. and Emenike, G. C. (2018). Sustainability Planning and Benchmarking of Post Concession Performance of Nigerian Seaports: The Case of Onne Seaport. *Journal of ETA Maritime Science*, 6(3), 181-197.
To link to this article: https://dx.doi.org/10.5505/jems.2018.95914

1. Introduction

Reference [1] defines sustainability as a concept which encompasses the ability of a system or process to meet the objectives and needs of today without compromising its ability to meet the needs and/ or objectives of the future. Thus, the concept of sustainability requires that the system meets the demand of today, with capacity to certainly meet the demand of future generations. Maritime transport and seaports have basic functions of trade facilitation, employment generation, and revenue objectives which all gears towards economic growth and development of coastal states. Thus, when a seaport system and /or maritime transport system achieves these basic objectives, we may regard such seaport or maritime transport system as productive. The ability to say with certainty that a seaport is productive with regards to the objectives of trade facilitation, employment and revenue generation etc. depends on the level of achievement of productivity/performance targets, which must be quantified prior to performance assessment. Seaport performance appraisal must, therefore, quantify the minimum target and benchmark as the basis for performance assessment decisions. Appraisal of performance sustainability can equally be based on this minimum performance benchmark. To sustain this acceptable level of performance target generationally and causing it to diverge from the basic benchmark/target into higher performance levels without diminishing to lower performance levels than the target benchmark, one may assert with accuracy that such a seaport or maritime transport system is a sustainable system; since it has the basic ability to fulfill present performance demand while guaranteeing future demand requirements. The implication of this is that a quantified without basis (acceptable performance or productivity benchmark or target), it is impossible to determine whether the performance of a seaport for instance is sustained and /or is sustainable within a reference period; provided that there is the availability of input resources in adequate and/ or right level [1]. Sustainability of performance and/or productivity can therefore only be successfully appraised with reference to a target benchmark over any given period. Just as performance can be appraised by reference to a given benchmark, so may input resources with which productivity was achieved and sustained be assessed by reference to a basic input resource benchmark.

[2] notes that in order to improve the productivity and or Performance of Nigerian seaports, the Federal Government of Nigeria embarked on port reform initiatives to reverse the continuously declining and poor performance of the Nigerian ports witnessed in the pre-concession era between 1956 and 2004.

A study report by [3] concluded that the administra¬tion of the Nigerian ports between 1956 when the Nigerian Ports Authority (NPA) was created by the ports Act as the public administrator of ports to 2002 when the Haskoning study was concluded and winds of port reforms began to blow in Nigeria; was characterized by an unusually high degree of centralization, with the NPA working as a public regulator of ports and port service provider. Reference [3] notes that although the sector was supposed to be controlled by the state-owned Nigerian Ports Authority (NPA), approval by either the President or the Minister of Trans¬port was needed for almost all major decisions. Following the aforementioned, a major decision that affects productivity, policy, and operations in the seaport sector was slowed almost to a standstill such that the performance of the ports with regards to key port productivity indices was poor. Furthermore, NPA was in charge of both regulation of port operations and the day-

to-day operational decisions and service provision. Because it had the authority to set its own tariffs, NPA was inclined to raise its prices to deal with internal budget deficits, instead of working to improve efficiency and productivity [3, 2]. By the end of the 1990s, repeated tariff increases, along with unchecked inefficiencies and poor governance, had made Nigerian ports among the slowest, least productive and most expensive, in the world such that even Nigerian port users and merchants reroute Nigerian destined cargoes to the neighboring ports of Cotonuo in Benin Republic from where such cargoes were smuggled into the Nigeria markets by land routes [4, 5, 2].

The Haskoning study recommended the adoption of the government's port management model referred to as "landlord" approach, whereby the NPA (public sector) is responsible for port planning and regulatory tasks as it relates to safety, security and environment, while also maintaining ownership of port-related land and basic infrastructure. The private sector in the landlord model would be responsible for marine and terminal operations, construction, purchase, and ownership of superstructure and equipment. With the recommendation of the Haskoning study, the Nigerian Government began the process of reforming and privatizing the port terminals in the year 2004 and by 2006, the majority of the seaports were privatized by the concession of the port terminals to private terminal operators [6] [7]. Port concession, therefore, is Nigeria's response to the imperatives of reforming and modernizing the port sector in order to increase port productivity and performance and reduce the cost of services to port users. Concession, which transfers port operational obligations to private sectors while retaining public ownership of port infrastructure, was preferred over all other options and it is expected that with concession, performance of the ports with regards to key port performance indicators such as cargo throughput performance, ship traffic volume/ship traffic performance, port revenue as well as such variables as ship turnaround time, cargo dwell time and berth occupancy which affects productivity will improve and end the pre-concession problems and challenges which impinged port performance in that era.

The concession of the Federal Ocean Terminal (FOT) and the Federal Lighter Terminal (FLT) which constitute the Onne seaport concluded in the year 2006. Table 1 below is a summary of post concession terminal operators in Onne port complex showing the available number of berth and port infrastructure on which productivity depends.

Table 1. *Terminal Operator in Onne Port and Lease Agreement*

Company name	Terminal	Berths	Lease terms (years)	Handover date
Intels Nigeria Ltd	FOT A	1 - 6	25	21st June 2006
Brawal Oil Services Ltd	FLT A	1	25	21st June 2006
Intels Nigeria Ltd	FLT A	2, 3, 4	25	21st June 2006
Atlas Cement Co. Ltd	Jetty FOT A	Jetty	25	21st June 2006
West African Container Terminal (WACT)	FOT B	7 – 8	25	2007

Source: *NPA Bran Manual, 2006*

Table 2. *Berth Characteristics of Onne Port*

Berths		Quay Length (m)	Draught (m)	Terminal Operator
Federal Lighter Terminal (FLT)				
A	1	340	7.5	Brawal
B	2	930	8.5	Intels
	3	376	10.0	„
	4	376	10.0	„
Federal Ocean Terminal (FOT)				
A	1	250	10.0	Intels
	2	250	10.0	„
	3	250	10.0	„
	4	250	12	Intels
	5	250	12	„
	6	320	12	„
B	7	285	12	WACT
	8	285	12	WACT
	9	250	12	Intels
	10	250	12	„
	11	250	12	„

Source: *NPA bulletin*

The table above, which indicates the berth characteristics of Onne port, the quay size, draught levels, and the number of berths, is indicative of the level of investment in port infrastructure and input resources upon which port productivity depends. The expectation is that to sustain the present level of Onne port performance or surpass it, the present level of investment in port infrastructure must be continuously maintained and/ or improved upon. That is a key condition necessary to ensure the sustainability of port productivity as a decline in present level of investment in port infrastructure as evidenced in the table by allowing its decay may not at the long run guarantee sustainable port and maritime transport system.

As aforementioned, the concession exercise was aimed to correct the inadequacies of the pre-concession era and put the seaport facility on the roadmap of high performance and productivity. Many studies have been carried out in the past to analyze and/or compare the post and pre concession performance of the seaports. For example, the works of references [8, 9] both found that the post concession performance of Onne port complex with regards to performance indicators as cargo throughput, ship traffic volume, port revenue has improved tremendously, showing significant differences from the pre-concession performances. References [7] did an aggregate study of pre and post concession performance of all the Nigerian ports and also found significant improvement in seaport performances in the post concession era. Studies by references [10, 11] also found significant improvement in the productivity of the Calabar seaport in the post-concession era. The implications of the findings of these studies is that port privatization and

concession have to a fair extent meet some basic objectives that motivated its adoption particularly; improving the performance and productivity of the port terminals. The motivation for this current study, however, is the challenge to sustain the trend of improvement in the post-concession performance of the seaports particularly that of Onne which is our case study. It is only the sustenance of this improvement in post-concession performance of ports that can guarantee sustainable port operations, maritime transport, economic growth and development. This will ensure the intergenerational maintenance of equity levels in productivity of the ports without allowing it to diminish into the poor and declining performance trend of the pre-concession era.

To achieve sustainability in the post-concession performance of the seaport, there is a need for informed application of strategic port facility management and port performance planning tools such as port performance forecasting and benchmarking. Port performance forecasting and benchmarking as productivity planning tools enable deliberate, conscious, strategic and informed programming of pattern and levels of performance expectation and input resources; so that performance (productivity and output) are achieved at programmed set point or within range of set points predetermined as acceptable. This will ensure that productivity is guarded away from unacceptable productivity and performance regions as long as the variables that influence performance are properly monitored to remain at programmed ranges. Thus, the basic principles of performance forecasting and benchmarking as planning tools can be used to ensure the sustainability of the improved post concession performance of the Onne seaport.

1.1. Forecasting and Benchmarking As Tools for Planning the Sustenance of Seaport Performances

Reference [11] notes that forecasting connotes an act of planning which entails futuristic postulations (programming of the future) based on indices of past and present variables. It involves pragmatic decision making that seeks to determine by modeling or programming future targets and expectations based on past and present occurrences. It is therefore true of forecasting that the future exists only in the present [11]. Thus , future performance of seaports with regards to performance variables as cargo throughput, port revenue, ship traffic etc. can be forecasted using appropriate forecasting methods and past and present values of the performance indices so that such future performances can strategically be planned and sustained significantly to remain within the forecasted limits without deviation to unacceptable limits. The forecasts aid port performance planners to determine acceptable performance benchmarks.

Benchmarking as a productivity planning tool is the process of determining a performance benchmark for each performance variable or an aggregate performance benchmark for all performance variables. A benchmark is looked at as the minimum acceptable performance set point (or range of set points) which forms a reference point or basis for comparison of subsequent performances for the decision on whether subsequent performance levels are acceptable to the organization based on their extent of agreement with the benchmark. Performance benchmarking is, therefore, a strategic performance planning tool employed by organizations to determine performance benchmarks which represent minimum acceptable performance and/ or productivity levels as targets which the organization must strive to achieve with regards to each performance parameter

for which benchmark was set using her input resources. While it is important that performance benchmarks are met; performances below benchmarks represent poor performances and are unacceptable. Thus, benchmarks reveal deficiencies in performance as current performance levels are compared with already determined levels of performance benchmarks. In so doing, shortcomings which negatively influenced performance to decline below benchmarks can be corrected in order that productivity may improve.

As aforementioned, previous studies indicate improvement in the post concession performance of Onne seaport terminals starting from the 2006 base year when the seaport terminals were handed over to the private terminal operators. As a result, the appropriate quantified benchmarks can be determined for key performance indicators as port revenue, cargo throughput, ship traffic volume, and etc. starting from the 2006 base year in order that subsequent performances can have quantified common basis for projection and comparison of post concession port performances and subsequent sustenance based on the benchmarks.

1.2. Objectives of the Study

The main aim of the study is to appraise the sustainability of the improvement in post concession performance of Onne seaport and determine performance benchmarks for key port performance indicators of cargo throughput, port revenue and ship traffic volume of the seaport as the basis for port productivity projection and assessment. The specific objectives of the study are:

(i) To appraise the sustainability of post concession cargo throughput, port revenue ship traffic statistics, and ship traffic volume performance of Onne seaport.
(ii) To raise performance benchmarks and progression models for sustainability planning and projection of future performance targets for post concession cargo throughput, port revenue ship traffic statistics and ship traffic volume performances of Onne seaport.
(iii) To make recommendations on the basis of research findings.

1.3. Research Questions

(i) Was the post concession cargo throughput, port revenue, ship traffic size and ship traffic volume of Onne seaport sustained beyond the respective 2006 base year performance values?
(ii) Can performance benchmarks and progression models be developed for sustainability planning and projection of future cargo throughput, port revenue, ship traffic size and ship traffic volume performances of Onne seaport?

2. Methodology

The study employed statistical forecasting and arithmetic progression tools with secondary data to appraise the sustainability of the post concession performance of Onne seaport and determined performance benchmarks for major performance indicators. Ten years (2006 – 2015) time series data was obtained from Nigerian Ports Authority covering performance indicators such as port revenue, cargo throughput and ship traffic volume. It is important to state that the data used for the study was obtained from the Nigerian Ports Authority (NPA) annual statistical bulletin (2015) edition which was made publicly available to the public in both print and online version. Therefore no further authorization is required from the NPA to use the data. The study employed basic mathematical tools of arithmetic differences to unravel deviating in cargo throughput, ship traffic and port revenue performances from the 2006 base year to determine how improvement

in Onne seaport performances has been sustained at or beyond the level of the base year performance over the period. Thus this enables the researcher to achieve objective 1. Using the symbols X_1, X_2, -- X_5 ----- X_n to represent the post concession performance of the seaport for each performance indicator (parameter) from the base year 2006 to 2015 representing a 10 year period (that is n = 10). A measure of differences between the base year performance values for each parameter and the subsequent year performance is used to determine levels of deviation from base year performance values and sustainability of the improvement in post concession performance of the Onne seaport starting with the base year values for each performance indicator. When n = 10 years, the 10th year difference in revenue performance with the base year, for instance, can be measured by the difference operator $X_n - X_1$; and similarly for the other parameters.

To develop a sequence that models the progression in performance and that forms the basis for sustainability planning and projection of future performance targets and benchmarks for each performance indicator; we note that the performance data for each indicator from 2006 base year to 2015 form a sequence of 10 terms each. Using *C*, *R*, and *S* to symbolize cargo throughput, port revenue and ship traffic volume performances respectively; we write the performance sequence for each parameter as:

$C = C_1, C_2, C_3, C_4, \text{----- } C_n$
$R = R_1, R_2, R_3, R_4, \text{----- } R_n$
$S = S_1, S_2, S_3, S_4, \text{----- } S_n$

Where C_1, R_1, S_1 = base year (1st term) cargo throughput, revenue and ship traffic volume performances of the seaport; C_n, R_n and S_n = 10th term (year) cargo throughput, revenue and ship traffic volume performances of the seaport.

Assuming that the performance sequence progressed by arithmetic progression (AP); such that performance is to be sustained without falling below the 1st term (improved base year performance level) for each indicator by an arithmetic progression. We have:

$U = a, a + d, a + 2d, \text{---------- } a + n - 1(d)$ ---------- (i) as the general form of an AP.

Where U = sequence, a = 1st term of the sequence, d = common difference. The difference is however found not to be common for the performance values from the 1st term to the 10th term as shown by the data collected but for purposes of planning, forecasting and projection; a common difference will be found using the sum of the first 10 terms of the sequence as used in this study.

With particular reference to the performance indicators and/or parameters used namely cargo throughput, port revenue and ship traffic volume; we have:

$U_c = C_1 + C_1 + d + C_1 + 2d + \text{------ } + C_1 + (n - 1)d$ ----------(ii)

Where C_1 = 1st term of the sequence = base year (2006) post concession cargo throughput performance level of the port.

d = common difference
n = number of terms = 10

Similar for revenue we have:

$U_r = R_1 + R_1 + d + R_1 + 2d + \text{------ } + R_1 + (n - i)d$ ---------- (iii)

For ship traffic volume we have:

$U_s = S_1 + S_1 + d + S_1 + 2d + \text{------ } + S_1 + (n - i)d$ ---------- (iv)

As aforementioned, the difference in performance levels of each parameter for purposes performance projection and sustainability planning using Arithmetic Progression must be common (ie; Common Difference 'd'). To make the difference common for projection and sustainability planning purposes, we recall that the sum of an Arithmetic sequence (AP) is given by:

$S_n = n/2\ [(2a + (n - 1)\ d]$ ---------- (v)

In particular, the sums for cargo throughput, revenue and ship traffic performances will thus be given respectively as:

$S_{cn} = n/2\ [(2C_1 + (n - I)d]$ ---------- (vi)

$S_{rn} = n/2\ [(2R_1 + (n\text{-}1)d]$ ----------(vii)

$S_{sn} = n/2\ [(2S_1 + (n - 1)d]$ ----------(viii)

Thus the common difference for each performance parameter can be determined for purposes of projecting and port performance sustainability planning using equations (vi), (vii) and (viii) and making d the subject of the equations.

Having obtained the common differences for each performance indicator, the n^{th} term for each performance parameter can be projected using the formula:

n^{th} *term* $= C_1 + (n\text{-}1)d$ ---------- *(ix)*; for cargo throughout performance

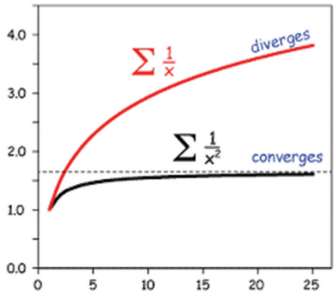
n^{th} *term* $= R_1 + (n - 1)d$ ---------- *(x)*; for revenue performance

n^{th} *term* $= S_1 + (n - 1)d$ ---------- *(xi)*; for ship traffic volume

Using the above equations can project and model the basis for progression and sustenance of Onne seaport post concession performance which objective 2 sort to achieve.

To development benchmark as target and basis for port performance assessment; we recall that benchmarks are best developed using AP at points from where or which the sequence diverges farther and farther away to positive infinity provided such points are at acceptable performance levels. From infinity, sequence equally converges (comes closer and closer) to the benchmark term (ie fixed point). See figure 1 below.

Figure 1. *Divergence and Convergence of Post Concession Performances from and to Performance Benchmarks*



Source: *www.xakly.com/images/pseries*

The 1st term (2006 base year) performance of the seaport in each performance parameter reveal higher/ improved post concession performance than the pre concession years and since this year marks the 1st year of the post concession era which recorded improved performance of the port productivity indicators, we assume that the 2006 base year (1st term) performance levels is within acceptable performance region/level; thus the AP builds a benchmark around it such that n^{th} term for each parameter;

n^{th} *term* $= C_1 + (n\text{-}1)d$; for cargo through.

n^{th} *term* $= R_1 = (n\text{-}1)d$; for Port revenue.

n^{th} *term* = $S_1 = (n-1)d$; for ship traffic volume.

Thus benchmarks are developed at C_1, R_1, and S_1 levels of performances. Sustainability planning is thus based on these and subsequent performances compared with these benchmarks such that subsequent performances are proactively caused to diverge from the benchmark levels/values to positive infinity and in adverse economic conditions; performances are monitored to converge on the benchmarks (1st terms) and not allowed to fall below it. Performances below these benchmarks are indications of relapsing of performances into the poor performance regions of the pre concession era. This is unacceptable because it does not meet the performance objectives of privatization and concession. Performance comparisons in subsequent years can then be made based on the benchmarks.

Also subtracting the base year (2006) performance value of each parameter from the subsequent years' performance enables us to determine if performance was progressively sustained beyond, at or retrogressively below the base year performance values.

Using 'MATLAB' software and adopting the methods discussed above, the study was carried out in other to achieve the research objectives.

3. Limitation of the Study

The data used for the study was sourced from the NPA annual statistical bulletin covering the period from 2006 to 2015. As a result, the accuracy of the results and findings to a large extent will be dependent of the accuracy of the data used.

4. Results and Findings

The result of the analysis indicates that the subsequent ship traffic performance of the port for the periods (years) after 2006 base year was not consistently sustained at or progressively beyond that of the 2006 base year performance value of 443. Ship traffic performance of the port was only progressively sustained beyond the 2006 base year value (increased) in 2010, 2011, and 2013 by 29, 22 and 1 respectively. The years 2007, 2008, 2009, 2012, 2014 and 2015 which shows

Table 3. *Sustainability Appraisal of Post Concession Ship Traffic Performance of Onne Port (2006 -2015)*

S/no.	Year	Vessel traffic stat	N^{th} term – a
1	2006	443	-
2	2007	407	-36
3	2008	348	-95
4	2009	435	-8
5	2010	414	29
6	2011	465	22
7	2012	435	-8
8	2013	444	1
9	2014	438	-5
10	2015	415	-28
Sum		4,244	

Source: *Authors Computation based on Data Collected*

Table 4. *Determining the Common Differenced based on S_n and a for Ship Traffic Performance Sustainability Planning based on -----(1)*

$S_n = n/2\ (2a + (n-1)d$	$a = V_1$	d
4244	443	-21

Source: *Authors Calculation*

negative N^{th} term – a values witnessed lower ship traffic performance than the base year; an indication that the high ship traffic performance of the port in 2006 post concession base year could not be surpassed and/ or sustained in those. Since ship traffic performance of the port is a measure of the aggregate sum of vessels that called or berthed at the port over the period, it is an important factor which influences port revenue generation and cargo (customs) charges since both revenue and cargo charges are dependent variables on ship traffic of the port. The implication is that, decreasing trend of ship traffic performance as witnessed in the post concession performances of Onne port may at the long run induce revenue and cargo charges among other variables dependent on it to take decreasing trend. Planning is therefore needed to ensure that ship traffic performance of the port is progressively sustained to achieve values beyond or at the base year value as benchmark to curb performance from relapsing into the poor performance trend of the pre concession era. The studies of references [6] and [7] also found similar inconsistently declining trend in the post concession ship traffic performances of the Nigerian seaports.

The tables indicate that the aggregate sum of 4244 vessels called at the port over the period, for sustainability planning a common difference 'd' -21 vessels. For sustainability planning, we assume a positive common difference since a negative common difference indicate a decreasing performance trend against a desired positively increasing/progressive performance trend which is always the target of sustainability planning. Using the common difference of 21, the post concession vessel traffic performance of Onne port is projected/extrapolated and panned for performance sustainability for the next 10 years starting with 2016 as shown in the table below.

Table 5. *10 Years Progression Model for Benchmarking and Sustainability Planning/Projection of Post Concession Ship Traffic Performance of Onne Port (2016 -2025)*

S/n	Year	No. of Term	Progression and Sustainability Planning Model	Projected Forecast Value
1	2016	11^{th} term	$V_1 + (n-1)d = V_1 + 10d$	653
2	2017	12^{th} term	$V_1 + (n-1)d = V_1 + 11d$	674
3	2018	13^{th} term	$V_1 + (n-1)d = V_1 + 12d$	695
4	2019	14^{th} term	$V_1 + (n-1)d = V_1 + 13d$	716
5	2020	15^{th} term	$V_1 + (n-1)d = V_1 + 14d$	737
6	2021	16^{th} term	$V_1 + (n-1)d = V_1 + 15d$	758
7	2022	17^{th} term	$V_1 + (n-1)d = V_1 + 16d$	779
8	2023	18^{th} term	$V_1 + (n-1)d = V_1 + 17d$	800
9	2024	19^{th} term	$V_1 + (n-1)d = V_1 + 18d$	821
10	2025	20^{th} term	$V_1 + (n-1)d = V_1 + 19d$	842

Source: *Author's Calculation*

The table shows the progression models determined based on the result of the analysis for sustainability planning to ensure that ship traffic performance of the seaport does not fall below the performance target. Thus the port authority and terminal operators should, for example, target to achieve a ship traffic performance of 842 vessels in the year 2025, following the previous performance sequence. Thus, ship traffic performance figure below 842 in the year 2025 is an indication that the performance target was not met. Comparison with performance benchmark will thus indicate if post concession performance was sustained at, above or below benchmark value. From the result on Table 4, the post concession performance benchmark for ship traffic statistics of Onne port is a = V_1 = 443 vessels. From this improved post concession ship traffic performance value/point, performances can progressive diverge to infinity or converge to benchmark. Performance below 443 vessels is indicative of diminishing performance into poor performance trend of the pre concession era. Thus, for the continuous progression of post concession ship traffic performance of Onne port, $V_1 + (n-1)d \geq V_1$. ie; $V_1 + (n-1)d \geq 443$ is a condition that must be met.

Table 6 below shows the post concession ship traffic volume of Onne port. Since ship traffic volume measured in Gross registered tonnage (GRT) is a measure of the total internal space (both cargo space and engine/ lightship space) that entered the port over a time period, it influences port revenue generation and cargo charges since ports tend to have higher charges for bigger size vessels. The N^{th} term – a values of post concession ship traffic volume performance in each subsequent year after the 2006 base year value is positive. This indicates that subsequent post concession ship traffic volume performance of the port is greater in each year than in the based. We thus infer that the port has consistently and progressively sustained its post concession ship traffic volume beyond/above the base year value. The implication is that even when the trend of vessel calls at the port is decreasing as indicated in Table 5, ship traffic volume is increasing and thus cargo throughput may increase since vessels with bigger cargo carrying capacity called

Table 6. *Sustainability Appraisal of Post Concession Ship Traffic Volume Performance of Onne Port (2006 -2015)*

S/no.	Year	Vessel volume	N^{th} term – a
1	2006	25,683,104	-
2	2007	34,302,177	8,619,073
3	2008	27,901,126	2,218,022
4	2009	27,171,664	1488560
5	2010	37,423,926	117440822
6	2011	42,735,452	17052340
7	2012	42,062,351	16379247
8	2013	38,967,131	13284027
9	2014	26,879,605	1196501
10	2015	26,572,745	889641
Sum		276,246,931	

Source: *Authors Computation based on Data Collected*

at the port in subsequent years than in 2006. Port authorities thus may take into consideration dredging to deepen already existing berth or building deeper berth and increasing draught levels in order to attract higher capacity vessel to maintain and or sustain the post concession ship traffic volume performance of the port.

The table indicates the post concession ship traffic volume performance progression and sustainability planning models developed for Onne port for each year from 2016 to 2025. For example, the ship traffic volume performance of Onne port in 2025 which marks the 20th year (2 decades) of privatization of Onne port

Table 7. *Sustainability Planning of Onne Ship Traffic Volume Performance Using a Common Difference*

$S_n = n/2\ (2S_1 + (n-1)d$	$a = S_1$	d
276,246,931	256,831,040	431,464.24

Source: *Authors Calculation*

The result of the analysis determined the sum S_n of ship traffic volume performance of the port as 276,246,931 upon which a common difference of 431,464.24 was determined for sustainability planning and projection of the targeted post concession ship traffic volume performance of the seaport. Based on 'd' and the first term, a 10 years post concession ship traffic volume sustainable performance plan was developed for Onne as shown in the table below starting from 2016.

based on the post concession performance sequence is forecasted to progress to 284444749 Net Registered Tonnage (NRT). The post concession ship traffic volume performance benchmark from which performance can diverge to infinity is at a = S_1 =256,831,040 NRT. Thus the condition that ensures the sustenance of the post concession ship traffic volume performance of Onne port is: $S_1 + (n-1)d \geq S_1 = S_1 + (n-1)d \geq$ 256,831,040 Net Registered Tonnage. This same condition ensures that performance

Table 8. *10 years Progression Model for Benchmarking and Sustainability Planning/Projection of Post Concession Ship Traffic Volume Performance of Onne Port (2016 -2025)*

S/n	Year	No. of Terms	Progression and Sustainability Planning Model	Projected Forecast Value (NRT)
1	2016	11th term	$S_1 + (n-1)d = S_1 + 10d$	280561573
2	2017	12th term	$S_1 + (n-1)d = S_1 + 11d$	280993037
3	2018	13th term	$S_1 + (n-1)d = S_1 + 12d$	281424501
4	2019	14th term	$S_1 + (n-1)d = S_1 + 13d$	281855965
5	2020	15th term	$S_1 + (n-1)d = S_1 + 14d$	282287429
6	2021	16th term	$S_1 + (n-1)d = S_1 + 15d$	282718893
7	2022	17th term	$S_1 + (n-1)d = S_1 + 16d$	283150357
8	2023	18th term	$S_1 + (n-1)d = S_1 + 17d$	283581821
9	2024	19th term	$S_1 + (n-1)d = S_1 + 18d$	284013285
10	2025	20th term	$S_1 + (n-1)d = S_1 + 19d$	284444749

Source: *Authors Calculation*

Table 9. *Sustainability Appraisal of Post Concession Revenue Performance of Onne Port (2006 -2015)*

S/no.	Year	Revenue Generated Million(USD)	N^{th} term - a
1	2006	103.76	-
2	2007	128.24	24.48
3	2008	139.27	35.51
4	2009	117.96	14.2
5	2010	150.34	46.58
6	2011	255.56	151.8
7	2012	245.84	142.08
8	2013	251.43	147.67
9	2014	267.58	163.67
10	2015	243.22	139.46
Sum		1659.46	

Source: *Authors computation based on data collected*

progressively diverges to infinity from S_1 in normal time and converges at s_1 in time of economic recession affecting the port.

The result of the analysis shown in Table 9 above indicates that the revenue performance of the port in the subsequent years (terms) after 2006 in the post concession era was far beyond the based year (2006) value of R_1 = 103.76 million USD. Thus the revenue performance of the

Table 10. *Sustainability Planning of Onne Port Post Concession Revenue Performance Using a Common Difference*

$S_n = n/2\ (2R_1 + (n-1)d$	$a = R_1$	d
1659.46	103.76	13.82

Source: *Authors Computation*

Table 11. *10 years Progression Model for Benchmarking and Sustainability Planning/Projection of Post Concession Revenue Performance of Onne Port (2016 -2025)*

S/n	Year	No. of Term	Projection/Planning Model	Planned Sustainability /Projected Forecast Value in Million USD
1	2016	11^{th} term	$R_1 + (n-1)d = R_1 + 10d$	241.96
2	2017	12^{th} term	$R_1 + (n-1)d = R_1 + 11d$	255.78
3	2018	13^{th} term	$R_1 + (n-1)d = R_1 + 12d$	269.6
4	2019	14^{th} term	$R_1 + (n-1)d = R_1 + 13d$	283.42
5	2020	15^{th} term	$R_1 + (n-1)d = R_1 + 14d$	297.24
6	2021	16^{th} term	$R_1 + (n-1)d = R_1 + 15d$	311.06
7	2022	17^{th} term	$R_1 + (n-1)d = R_1 + 16d$	324.88
8	2023	18^{th} term	$R_1 + (n-1)d = R_1 + 17d$	338.7
9	2024	19^{th} term	$R_1 + (n-1)d = R_1 + 18d$	352.52
10	2025	20^{th} term	$R_1 + (n-1)d = R_1 + 19d$	366.34

Source: *Author's Calculation*

port in each year between 2006 and 2015 was progressively sustained above the base year improved performance value. This is an indication of fair and sustained revenue performance. This supports the findings of references [7] and [10] who found improvements in the post concession revenue performances of Nigerian seaports.

The result shows that the sum total of 1659460000 USD was generated as the aggregate post concession revenue performance of the port by the Nigerian ports Authority NPA over the 10 years period covered in the study, starting with a post concession base year revenue performance of 103.76 in 2006. Based on this, the post concession revenue performance sequence, a common difference 'd' of 13.82 USD was determined for purposes of developing a progression model for sustainability planning of port revenue.

Table 11 above indicates the post concession revenue performance progression and sustainability planning models developed for Onne port for each year from 2016 to 2025. For example, the revenue performance of Onne port in 2025, which marks the 20th year (2 decades) of privatization of Onne port based on the post concession performance sequence, is forecasted to progress to 366.34 MillionUSD. The post concession revenue performance benchmark from which performance can diverge to infinity is at a = R_1 = 103.76 MillionUSD. Thus the condition that ensures the sustenance of the post concession revenue performance of Onne port is: $R_1 + (n-1)d \geq R_1 = R_1 + (n-1)d \geq 103.76$ MillionUSD. This same condition ensures that performance progressively diverges to infinity from R_1 all things being equal; and converges at R_1 in time of economic recession affecting the port. Below R_1 is an indication that revenue performance is relapsing into the poor performance trend of the pre concession/ privatization era.

In 2007, the port failed to sustain her post concession cargo throughput performance above or at the 2006 post concession base year value. The N^{th} Terms – a values for the other years between 2008 and 2015 show positive values greater than zero; this indicates that the post concession

Table 12. *Sustainability Appraisal of Post Concession Cargo Throughput Performance of Onne Port (2006 -2015)*

S/no.	Year	Cargo Throughput (MT)	N^{th} term - a
1	2006	2,554,759	-
2	2007	2,482,177	-72582
3	2008	3,222,663	667904
4	2009	3,385,455	830,696
5	2010	2,921,727	366,968
6	2011	3,309,815	755,056
7	2012	3,877,024	1,322,265
8	2013	3,872,495	1,317,736
9	2014	4,556,390	2,001,631
10	2015	4,621,110	2,066,351
Sum		34,803,615	

Source: *Authors Computation based on Data Collected from NPA Onne*

cargo throughput performance of the seaport in the subsequent years between 2008 and 2015 were sustained above that of the base year. This is in agreement with the findings of references [6] and [11].

The table indicates the post concession revenue performance progression and sustainability planning models developed for Onne port for each year from 2016 to the table above starting from the year 2016.

Table 13. *Sustainability Planning of Post Concession Cargo Throughput Performance of Onne Port Using a Common Difference Operator*

$S_n = n/2\ (2C_1 + (n-1)d$	$A = C_1$	D
34,803,615	2,554,795	205689.44

Source: *Author's Calculation*

The Table 13 above indicates that the sum total cargo throughput over the period covered in the study is 34,803,615 based on which a common difference 'd' of 205689.44 was determined. Based on the common difference and the first term 'a' = 2554795, sustainability plan can be projected for the post concession cargo throughput performance of Onne. Performance benchmark can equally be determined. The table below shows the post concession cargo throughput performance sustainability plan based on the first term 'a' and common difference 'd' as shown in 2025. For example, the cargo throughput performance of Onne port in 2025, which marks the 20th year (2 decades) of privatization of Onne port based on the post concession performance sequence, is forecasted to progress to 6,462,894 metric tons. The post concession cargo throughput performance benchmark from which performance can diverge to infinity is at a = C_1 = 2,554,795 metric tons.. Thus the condition that ensures the sustenance of the post concession cargo throughput performance of Onne port is: $C_1 + (n-1)d \geq C_1$. Ie; $C_1 + (n-1)d \geq$ 2,554,795 metric tons.

Table 14. *10 years Progression Model for Benchmarking and Sustainability Planning/Projection of Post Concession Cargo Throughput Performance of Onne Port (2016 -2025)*

S/n	Year	No. of Terms	Progression and Sustainability Planning Model	Projected Forecast Value (MT)
1	2016	11th term	$C_1 + (n-1)d = C_1 + 10d$	4611689.4
2	2017	12th term	$C_1 + (n-1)d = C_1 + 11d$	4817378.8
3	2018	13th term	$C_1 + (n-1)d = C_1 + 12d$	5023068.2
4	2019	14th term	$C_1 + (n-1)d = C_1 + 13d$	5228757.6
5	2020	15th term	$C_1 + (n-1)d = C_1 + 14d$	5434447
6	2021	16th term	$C_1 + (n-1)d = C_1 + 15d$	5640136.4
7	2022	17th term	$C_1 + (n-1)d = C_1 + 16d$	5845825.8
8	2023	18th term	$C_1 + (n-1)d = C_1 + 17d$	6051515.2
9	2024	19th term	$C_1 + (n-1)d = C_1 + 18d$	6257204.6
10	2025	20th term	$C_1 + (n-1)d = C_1 + 19d$	6462894

Source: *Author's Calculation*

5. Managerial Implications

It is in the interest of port managers and terminal operators to maintain acceptable levels of productivity as well as ensuring that this high level of productivity, once achieved, is sustained continually. The implication is that quantitative models must be determined and proactively used to grow and sustain seaport performances. The study therefore has produced empirical guides for performance benchmarking and performance targets for port performance variables of vessel traffic, ship traffic volume, cargo throughput, and port revenue which port managers and terminal operators may adopt in projecting, comparing, and sustaining seaport and terminal performances. The benefits are that port managers and terminal operators may thus proactively improve and sustain the post concession port revenue, ship traffic volume, vessel traffic size, and cargo throughput of the seaports without giving room for its decline below benchmarks in the poor productivity regions of pre concession era. This will consequently improve and sustain the overall productivity of the maritime transport system.

6. Conclusion

It is evident from the result that while the post concession cargo throughput, port revenue, and ship traffic volume performance of the Onne seaport showed sustained progression from the 2006 base year values, the ship traffic statistics of the port illustrating the number of vessels that called at the port per annum shows an overall decline from the base year value, indicating that the port was unable to progressively sustain her ship traffic performance within the period. The post concession performance benchmark for each performance parameter of cargo throughput, port revenue, ship traffic volume, and ship traffic statistics are C_1 = 2,554,795 metric tons, R_1 = 103.76 MillionUSD, S_1 = 256,831,040 NRT, and V_1 = 443 vessels respectively. The conditions for sustenance of the post concession cargo throughput, port revenue, ship traffic volume, and ship traffic statistics performance of the port are: $C_1 + (n-1)d \geq$ 2,554,795 metric tonnes, $R_1 + (n-1)d \geq$ 103.76 MillionUSD, $S_1 + (n-1)d \geq$ 256,831,040 Net Registered Tonnage and $V_1 + (n-1)d \geq 443$ respectively.

7. Recommendation

The performance sequence of the port should be the basis for planning the sustenance of port productivity. As a result, it is recommended that the performance benchmarks and sustainable productivity conditions determined for port performance indicators of cargo throughput, port revenue, ship traffic volume and ship traffic statistics based on post concession performance sequence of the port, should be the basis for sustainability planning and benchmarking of the post concession performance of Onne seaport.

8. Suggestions for Further Studies

Further studies should be carried out to determine benchmarks for sustainability planning and productivity improvement in other major seaports in Nigeria. A comparison of performance benchmarks determined for all the major seaports in Nigerian should equally be carried to develop empirical guide for port managers and terminal operators in their drive for performance improvement and sustenance. The actual post concession performances of the seaports from 2016 to 2025 with respect to the various performance indicators will be compared after 2025 with the forecasted/projected performances and benchmarks to determine if significant differences exist.

References

[1] Tatyana, P. S. (2004) Beyond economic growth: An introduction to sustainable development. International Bank for Reconciliation (World Bank), Washington.

[2] Ndikom O.B., (2006) Kernel concept of shipping operations, policies and strategies: the industry overview. Bunmico publishers, Lagos.

[3] World Bank and PPIAF (2007) "How the Haskoning Study Shaped Nigerian Port Reform." Draft report. Washington, DC. Washington, DC.

[4] Mohiuddin, Arif. Royal Haskoning (2002) "Technical and Financial Assessment of the Nigerian Port Sector: Recommendations for Port Reform." Report to the Nigerian Federal Ministry of Transport.

[5] James Leigland and Gylfi Palsson (2007) port reform in Nigeria Upstream policy reforms kick-start one of the world's largest concession programs. Gridelines publication.

[6] Okeudo G.N. (2013) Effect of Port Reform on Cargo Throughput Level at Onne Seaport Nigeria. A Comparative Study Before and After Reform Policy Implementation. IOSR Journal of Business and Management, Volume 12, (1) PP 71-78.

[7] Olaogbebikan Jimoh Eniola* Ikpechukwu Njoku Faniran Akin Oluwatosin and Enosko Okoko(2014) Performance Evaluation of Nigerian Ports: Pre and Post Concession Eras. Civil and Environmental Research Vol.6.(2).

[8] Victor O, Ikechukwu A., Obioma R, Callistus C., and David A. (2015): Infrastructure Financing and Management: The Impact of Concession on the Operations and Performance of Nigerian Seaports. Journal of Behavioural Economics, Finance, Entrepreneurship, Accounting and Transport, 2015, Vol. 3, No. 2, 65-70.

[9] Nwokedi T.C., Emeghara G.C., Ikeogu C. (2015) Trend Analysis Of Impacts Of Cargo Pilferage Risk On Post Concession Cargo Throughput Performance Of Nigerian Seaport Terminals. International Journal of Research Commercial and Management. Vol. 5 (7) 11- 15.

[10] Bassey j. Bassey & David d. Emi (2014) the impact of Concessioning on Performance of Calabar Seaport. Multidisplinary Jouraial of Research on Developmental Perspectives. Vol. 3(1).

[11] Ndikom, O.B, (2006), The Essentials of Port Reforms: The Nigerian Experience. Lagos: Bunmico Publishers, Lagos.

This Page Intentionally Left Blank

Received: 9 February 2018 Accepted: 30 April 2018 *DOI ID: 10.5505/jems.2018.71676*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Burak ZİNCİR

Assessment of Alternative Fuels from the Aspect of Shipboard Safety

Burak ZİNCİR, Cengiz DENİZ

İstanbul Technical University, Maritime Faculty, Turkey
bzincir@itu.edu.tr; ORCID ID: https://orcid.org/0000-0002-6719-4730
denizc@itu.edu.tr; ORCID ID: https://orcid.org/0000-0001-9702-4583

Abstract

Global regulations about shipboard emissions become stricter day by day. There are various ways to reduce shipboard emissions, and using alternative fuels on main engine and auxiliary engines is one of these ways. The alternative fuels can have different physicochemical properties than conventional fuels, which needs special procedures and safety precautions while using onboard. Safety is important term for sustainable shipping. This study aimed to determine the safety ranking of the trend alternative fuels and possible ones in the future. A safety evaluation method was formed to assess fourteen alternative fuels by considering handling, storage and crew health. Flashpoint, auto-ignition, explosion limits, flame speed, density, and exposure limit are criteria for the safety evaluation. Analytic Hierarchy Process was used while finding the weighing of the alternative fuels at these criteria. Scale of relative importance was used to find the pair-wise comparison of the fuels. The criteria weighing were determined by taking expert opinions. Seven experts gave points to the criteria at the asked questionnaire. The questionairre was about; which fuel property is more important at the storage, handling, and operation with the fuels. According to the final safety assessment results, liquefied petroleum gas had the highest weighing of 0,130. Ethanol and ammonia followed it with 0,120 and 0,116, respectively. Liquefied natural gas and methanol, as trend alternative fuels with liquefied natural gas for shipping industry, got 0,084 and 0,053, respectively.

Keywords: *Alternative fuels, Shipboard safety, Safety assessment.*

Alternatif Yakıtların Gemi Emniyeti Açısından Değerlendirilmesi

Öz

Gemi kaynaklı emisyonları ilgilendiren uluslar arası denizcilik sözleşmeleri gün geçtikçe katılaşmaktadır. Gemi kaynaklı emisyonları azaltmaya yönelik çeşitli yöntemler bulunmaktadır ve alternatif yakıt kullanımı da bunlardan biridir. Alternatif yakıtların, gemilerde kullanılan konvansiyonel yakıtlardan farklı fiziko-kimyasal özellikleri olabilir. Bu farklı özellikler, gemi üzerinde özel prosedürler ve emniyet tedbirleri alınmasını gerektirebilir. Emniyet, sürdürülebilir deniz ticareti için önemli bir kavramdır. Bu çalışma günümüzde revaçta olan alternatif yakıtların ve ileride kullanılabilecek olanların emniyet puanını belirlemeyi amaçlamaktadır. Emniyet değerlendirme yöntemi oluşturularak, seçilen 14 alternatif yakıt, depolama, elleçleme ve mürettebat sağlığı temel alınarak değerlendirilmiştir. Emniyet değerlendirmesinde kullanılan değerlendirme kriterleri, parlama noktası, kendiliğinden tutuşma sıcaklığı, patlama limitleri, alev hızı, yoğunluk ve etkileme derecesidir. Analitik Hiyerarşi Prosesi

To cite this article: Zincir, B. and Deniz, C. (2018). Assessment of Alternative Fuels from the Aspect of Shipboard Safety. *Journal of ETA Maritime Science*, 6(3), 199-214.
To link to this article: https://dx.doi.org/10.5505/jems.2018.71676

kullanılarak bu değerlendirme yapılmıştır. Nispi önem derecesi puanları kullanılarak yakıtların çiftsel karşılaştırması yapılmıştır. Kriterlerin ağırlıkları da yedi ekspere sorulan anket sonucunda görüşleri alınarak belirlenmiştir. Anket, hangi yakıt özelliğinin, yakıtların depolanması, elleçlenmesi ve operasyonunda daha önemli olduğunu sormaktadır. Çalışma sonuçlarına göre sıvılaştırılmış petrol gazı 0,130 ile en yüksek emniyet puanını almıştır. Etanol ve amonyak, 0,120 ve 0,116 ile takip etmiştir. Günümüzün revaçta alternatif yakılarından sıvılaştırılmış doğalgaz ve metanol, 0,084 ve 0,053 emniyet puanı almıştır.

Anahtar Kelimeler: *Alternatif yakıtlar, Gemi emniyeti, Emniyet değerlendirmesi.*

1. Introduction

Because of strict emission regulations and reduction at shipboard emission limits, alternative fuel usage on ships increases. Nowadays, liquefied natural gas (LNG), methanol and liquefied petroleum gas (LPG) are used as alternative fuels as sole fuel or dual-fuel with conventional fuels. While using these fuels on ships, special procedures and safety precautions have to be taken, because they have different fuel properties than the conventional fuels.

The safety term is important for the shipping industry, and is considered as one of the pathways for sustainable shipping. The safety is defined as 'The absence of unacceptable levels of risk to life, limb, and health (from non-willful acts)' by International Maritime Organization [1]. All shipboard operations are done by taking the safety into consideration according to International Convention for Safety of Life at Sea (SOLAS) which was entered into force on 25 May 1980. The SOLAS includes minimum standards for construction, equipment of ship, and shipboard operations to provide safe voyage of ships [2]. It is sure that the safety is the most important issue at the alternative fuel use on ships. The International Code of Safety for Ships using Gases or other Low-flashpoint Fuels was entered into force on 1 January 2017, which aims to provide minimum safety standards for ships using alternative fuels to reduce risk to the ship, crew, and environment, by the amendments to the SOLAS [3].

Researchers also focus on the safety of various alternative fuels. A previous research was done about the assessment of methanol, ethanol, LNG, and hydrogen at various criteria, which the safety was one of the criteria [4]. The study briefly mentioned about the safety aspects of these fuels, and compared them by using Analytic Hierarchy Process (AHP). Density, flammability limits and combustion characteristics of the alternative fuels were used to give point to each fuel. Another study was done by Gu and Zhang [5]. They compared LNG, nuclear power, wind energy, solar energy, and bio-fuel by the AHP at various criteria, one of them was again the safety. Mansson [6], conducted a study about the comparison of LNG, two types of methanol and hydrogen produced from electrolysis by wind power at the safety and other 9 criteria by using the AHP. He used fire & explosion characteristics, flashpoint and health effect of the alternative fuels at his safety assessment. Although there are some studies about the safety assessment of the alternative fuels, it takes small place at the whole assessment study. It does not directly focus on the safety aspect of the alternative fuels in detail, and the studies assess few numbers of alternative fuels.

This study aims to focus on the safety aspect of higher number of alternative fuels in detail by focusing on shipboard handling, storage and crew health. The study showed that, LPG had the highest final safety weighing of 0,130. Ethanol, ammonia, LNG, and methanol had 0,120, 0,116, 0,084, and 0,053, respectively, as final safety weighing. Remaining alternative fuels had lower final

safety weighing than above-mentioned fuels. The lower final safety weighing points out the higher safety precaution demand while storage and operation onboard of these alternative fuels.

2. Alternative Fuels

Using alternative fuel on diesel engines is one of the emission abatement methods. Sulfur free or lower sulfured alternative fuels reduce sulfur oxide (SO_X) emissions. Combustion specifications of these fuels can mitigate nitrogen oxide (NO_X), and CO_2 emissions. The alternative fuels were started to be used at shore-based facilities for many years before. Rudolf Diesel tested his first engines with peanut oil over 100 years ago [7]. On the contrary, it is in development at the shipping industry, and it starts to increase in recent years.

The alternative fuels, which were used at this study, had to be determined. For this purpose, the literature search is done both at Web of Science and Google Scholar with the keywords, diesel engine and alternative fuels. Since Web of Science gave a limited number of studies, the Google Scholar results were selected in this study. There are many studies examining various alternative fuels on the diesel engines, but the significant study number is important. Found alternative fuels were again searched at the Google Scholar with the same keywords, and the exact study numbers were detected.

The alternative fuel number was 37, and the total paper number at the Google Scholar about the alternative fuel use on diesel engines was 581.414 [8]. As a significant study number, 15000, which was equal about to 2,5% of the total researches, was determined. As a result, the number of 14 alternative fuels was selected, because they were above the significant study number. Hydrogen (78.400), ethanol (47.200), methanol (43.300), waste cooking oil (32.700), palm oil (28.200), corn oil (27.300), ammonia (24.700), pyrolysis oil (22.600), kerosene (22.000), rapeseed oil (20.600), soybean oil (20.500), LPG (19.600), LNG (19.500) and jatropha oil (16.000) had the research numbers above from 15000.

3. Comparison Criteria for Safety Assessment

The previous studies in the literature used flammability, toxicity, fire & explosion risks, density, auto-ignition temperature, stoichiometric air-fuel ratio, octane and cetane numbers of the alternative fuels as the comparison criteria for the safety assessment [4 – 6]. In this study, flashpoint, auto-ignition temperature, flammability limits, flame speed, density, and exposure limit of each alternative fuel were taken into consideration when forming the safety assessment method for mentioned alternative fuels. Table 1 shows specifications of the alternative fuels.

The flashpoint is the lowest temperature which vapor of the material will ignite by the support of an ignition source [47]. The flashpoint of a fuel is important at the storage and handling because lower flashpoint temperature means fuel is more dangerous. The intention of fuel to ignite by outside sources such as sparks, arc etc. is higher if the flashpoint temperature is lower.

The auto-ignition temperature is a limit, which a material will ignite without the support of an ignition source [48]. If the auto-ignition temperature of a fuel is high, its resistance to spontaneous ignition is higher. It means it is easier to store and handle these kinds of fuels in the tanks.

Combustible materials are able to burn within the lower and upper fuel limits which are determined experimentally. These limits are considered as the flammability limits or explosive limits. There is a lower explosive limit (LEL), which is the lowest limit of fuel concentration in the combustible mixture

Table 1. *Specifications of the Alternative Fuels*

Alternative Fuels	Flashpoint (°C)	Auto-ignition (°C)	Density (kg/m^3)	Flammability Limits (%)	Flame Speed (cm/s)	Exposure Limit (mg/m^3 – 8h)
Ammonia	132 [9]	650 [10, 11]	682 [10, 11]	15 – 25 [9]	14 [12]	17 [11]
Corn Oil	277 [13, 14]	393 [15, 16]	916 [14, 15]	Unknown	Unknown	10 [16]
Ethanol	13 [4, 17, 18]	363 [4, 18]	794 [4, 17]	3,3 – 19 [4]	41 [4]	1900 [19]
Hydrogen	-150 [4]	585 [4, 20]	83,8 [4, 20]	4 – 75 [4]	270 [4, 20]	336 [21]
Jatropha Oil	240 [13, 14]	274 [22]	920 [13, 14]	Unknown	Unknown	10
Kerosene	38 [23, 24, 25]	210 [23, 25]	775 [23]	0,7 – 7 [23]	60 [26]	200 [25]
LNG	-188 [27]	537 [4, 28]	450 [4]	5 – 15 [28]	38 [4]	650 [28]
LPG	-105 [29, 30]	450 [29]	540 [31]	2 – 10 [29, 30]	40 [32]	1900 [29, 30]
Methanol	12 [33]	470 [4]	682 [4]	6 – 36,5 [4, 33]	50 [4]	196 [33]
Palm Oil	280 [14]	316 [34]	952 [34]	Unknown	83 [35]	10
Pyrolysis Oil	104 [36]	348 [36]	1.200 [37]	0,9 – 5,9 [38]	Unknown	52 [36]
Rapeseed Oil	317 [14, 39]	360 [40]	910 [14]	Unknown	Unknown	10 [39]
Soybean Oil	282 [41]	445 [41]	920 [14]	Unknown	94 [42]	10 [43, 44]
Waste Cooking Oil	278 [45]	300 [40, 46]	910 [45]	Unknown	Unknown	10

to be burn, and upper explosive limit (UEL), which is the highest limit of fuel concentration in the combustible mixture to be burn [49]. If the flammability limit of a fuel is wide, it means it can be burned at more variety of proportion of mixture, and it needs more precautions at the storage and handling operations.

The flame speed is the rate of spreading of the flame during the combustion process [50]. If the flame speed is high, it is more difficult to extinguish the flames, and it spreads quickly. The flame speed is another important factor in storage and handling operations.

The density is the mass per unit volume of a fuel. The fuels with higher density remain one part of the room while tank leakage, in contrary the fuels with low density expand more quickly, and ventilation of a room is easier.

The exposure limit is the highest permissible limit to airborne concentrations of chemical substances which workers are exposed daily. Threshold Limit Values (TLV) are taken into consideration at this safety evaluation method. These values are developed as guidelines to assist in preventing health hazards at work places, and they are not legal standards [51]. The

exposure rate of jatropha oil, palm oil and waste cooking oil (WCO) could not be found in the literature, thus it is assumed that they have same exposure rate with other vegetable oils.

4. Safety Assessment Method

The safety assessment was done with the assist of the Analytic Hierarchy Process (AHP), which was found by Saaty [52]. The AHP is a powerful decision-making tool for complex, multi-criteria problems. It is useful if data are both quantitative and qualitative or criteria weights are given referred to expert opinions [53]. More detailed information can be found in Saaty's study.

In this study, flashpoint, auto-ignition temperature, flammability limits, flame speed, density, and exposure limit of fuels were compared. To determine the importance of criteria at the storage and handling operations, expert opinions were taken. The experts were experienced academicians who worked at the ships for many years.

Data in Table 1 were used at the AHP to find weighing of the alternative fuels. Value difference between each alternative fuel forms intervals for scale of relative importance points, which were used at the AHP [4]. To form a single pair-wise comparison matrix, scale of relative importance was used to determine which item is more important than the other. Table 2 shows the alternative fuel notations, Table 3 shows the scale of relative importance for AHP, and Figure 1 illustrates the safety evaluation diagram.

Table 2. *Alternative Fuel Notations for Assessment*

Alternative Fuels	Alternative Notation
Ammonia	A1
Con Oil	A2
Ethanol	A3
Hydrogen	A4
Jatropha Oil	A5
Kerosene	A6
LNG	A7
LPG	A8
Methanol	A9
Palm Oil	A10
Pyrolysis Oil	A11
Rapeseed Oil	A12
Soybean Oil	A13
WCO	A14

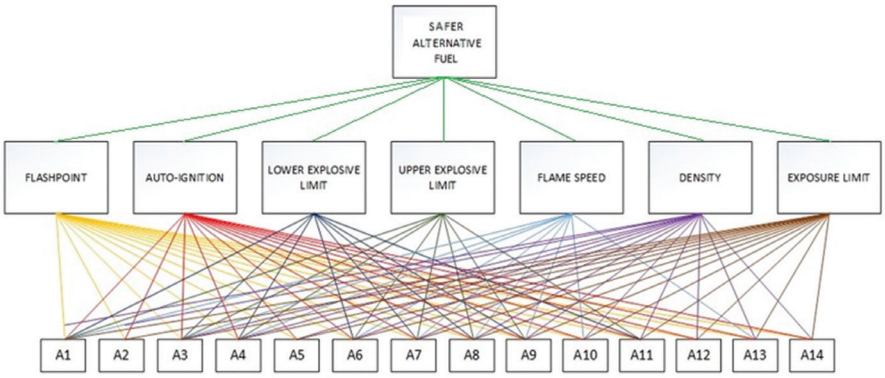


Figure 1. *Safety Evaluation Diagram*

Table 3. *Scale of Relative Importance [54]*

Scales	Definition	Note
1	Equal importance	i is equally important to j
3	Moderate importance	i is moderately important to j
5	Essential importance	i is essentially important to j
7	Very strong importance	i is very strongly important to j
9	Absolute importance	i is very absolutely important to j
2, 4, 6, 8	Intermediate value	The relative importance of i is between to adjacent judgment

Table 4. *Random Index Values [56]*

Order	2	3	4	5	6	7	8	9	10	11	12	13	14
Random Index (RI)	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45	1,49	1,52	1,54	1,56	1,58

To calculate the consistency of the AHP table, Formulas 4.1, 4.2, and 4.3 were used [55]. λ_{max} is maximum eigen value, W_i is weighing of i type of criterion or alternative. a_i is sum of row of i type of criterion or alternative. CI is consistency index, RI is random index, and CR is consistency ratio. The random index table, which was developed by Saaty [56], was used while doing CR calculation.

$$\lambda_{max} = \sum_{i=1}^{n}(W_i \cdot \sum_{i=1}^{n} a_i) \quad (4.1)$$

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (4.2)$$

$$CR = \frac{CI}{RI} \quad (4.3)$$

5. Assessment Results

This section of the study includes the expert opinions about the fuel properties (criteria) used at the assessment of the alternative fuels and the assessment results of the alternative fuels at previously mentioned criteria.

Expert Opinions about the Fuel Properties

Seven academicians of a university in Istanbul, who have sea experience, indicated their opinions about the importance of fuel properties at the storage and operation of fuels on a ship. Three of the seven academicians were chief engineer, one of them was first engineer, and the remaining three were second engineers. A short questionairre was formed and asked to the experts. The questionairre was about which fuel property is more important at the storage, handling, and operation with the fuels. They gave points from 1 to 5, to the fuel properties which are shown in Table 5 with their notations. 1 is less important while 5 is most important at the evaluation of fuel properties. All given points by the experts were summed, and the difference between each fuel property was found to determine points from 1 to 9 for AHP table. This method was also used in a previous study [4].

The expert opinion weighings are shown in Table 6. It can be seen at the table that the flashpoint and exposure rate are the most important fuel properties. The flashpoint and exposure rate get weighing of 0,315, the auto-ignition temperature follows it with 0,207. The flammability limits and flame speed have equal importance with 0,071, and the density has the lowest importance with the weighing of 0,021.

Table 5. Fuel Property Notations for Assessment

Criterion Notation	Fuel Properties
C1	Flashpoint
C2	Auto-ignition temperature
C3	Flammability limits
C4	Flame speed
C5	Density
C6	Exposure Rate

Table 6. Expert Opinion Weighing

	C1	C6	C2	C3	C4	C5	W
C1	1,00	1,00	2,00	5,00	5,00	9,00	0,315
C6	1,00	1,00	2,00	5,00	5,00	9,00	0,315
C2	0,50	0,50	1,00	4,00	4,00	9,00	0,207
C3	0,20	0,20	0,25	1,00	1,00	6,00	0,071
C4	0,20	0,20	0,25	1,00	1,00	6,00	0,071
C5	0,11	0,11	0,11	0,17	0,17	1,00	0,021
λ_{max} = 6,194, CI = 0,039, CR = 0,031 < 0,1							

Comparison Criterion Results

Alternative fuels were compared with the previously mentioned criteria. The alternative fuel specifications in Table 1 were used to compare and evaluate the alternative fuels at each criterion. Same method which was used at the previous section was applied to find the relative importance between the alternative fuels, and to form AHP tables.

The flashpoint evaluation weighing of the alternative fuels are shown at Table 7. One can see from the table that the rapeseed oil is the safest alternative fuel which is followed by the soybean oil and palm oil with the weighings of 0,178, 0,151, and 0,137, respectively. It is also seen that gaseous alternative fuels like LNG, hydrogen, and LPG are less safer than the other alternative fuels at the flashpoint evaluation.

Table 8 shows the auto-ignition temperature evaluation weighing of the alternative fuels. Ammonia, hydrogen and LNG are the top three safest alternative

Table 7. Flashpoint Evaluation Weighing of Alternative Fuels

	A12	A13	A10	A14	A2	A5	A1	A11	A6	A3	A9	A8	A4	A7	W
A12	1,00	2,00	2,00	2,00	2,00	3,00	4,00	5,00	6,00	6,00	6,00	8,00	9,00	9,00	0,178
A13	0,50	1,00	2,00	2,00	2,00	2,00	4,00	4,00	5,00	6,00	6,00	8,00	8,00	9,00	0,151
A10	0,50	0,50	1,00	2,00	2,00	2,00	4,00	4,00	5,00	6,00	6,00	8,00	8,00	9,00	0,137
A14	0,50	0,50	0,50	1,00	2,00	2,00	4,00	4,00	5,00	6,00	6,00	8,00	8,00	9,00	0,124
A2	0,50	0,50	0,50	0,50	1,00	2,00	4,00	4,00	5,00	6,00	6,00	8,00	8,00	9,00	0,112
A5	0,33	0,50	0,50	0,50	0,50	1,00	3,00	4,00	5,00	5,00	5,00	7,00	8,00	8,00	0,092
A1	0,25	0,25	0,25	0,25	0,25	0,33	1,00	2,00	3,00	3,00	3,00	5,00	6,00	7,00	0,051
A11	0,20	0,25	0,25	0,25	0,25	0,25	0,50	1,00	3,00	3,00	3,00	5,00	6,00	6,00	0,044
A6	0,17	0,20	0,20	0,20	0,20	0,20	0,33	0,33	1,00	2,00	2,00	4,00	4,00	5,00	0,030
A3	0,17	0,17	0,17	0,17	0,17	0,20	0,33	0,33	0,50	1,00	2,00	3,00	4,00	5,00	0,025
A9	0,17	0,17	0,17	0,17	0,17	0,20	0,33	0,33	0,50	0,50	1,00	3,00	4,00	5,00	0,023
A8	0,13	0,13	0,13	0,13	0,13	0,14	0,20	0,20	0,25	0,33	0,33	1,00	2,00	3,00	0,014
A4	0,11	0,13	0,13	0,13	0,13	0,13	0,17	0,17	0,25	0,25	0,25	0,50	1,00	2,00	0,011
A7	0,11	0,11	0,11	0,11	0,11	0,13	0,14	0,17	0,20	0,20	0,20	0,33	0,50	1,00	0,009
λ_{max} = 15,046, CI = 0,080, CR = 0,051 < 0,1															

fuels at the auto-ignition temperature evaluation with the weighing of 0,251, 0,177, and 0,135, respectively. On the other hand, kerosene, jatropha oil, and waste cooking oil are three least safe alternative fuels with the weighing of 0,019, 0,015, and 0,011, respectively.

Table 9 and 10 show lower explosive limit and upper explosive limit evaluation weighing of the alternative fuels. LEL and UEL evaluation weighing includes less number of alternative fuels for evaluation, because the vegetable oils do not have LEL and UEL values. Ammonia, methanol and LNG have higher weighing at LEL evaluation than others with 0,494, 0,150, and 0,110, respectively. Kerosene, pyrolysis oil, and LPG have lower weighing with 0,042, 0,032, and 0,027, respectively. Pyrolysis oil, kerosene, and LPG have higher weighing at UEL evaluation with 0,269, 0,215, and 0,181, respectively. In contrary, hydrogen,

Table 8. *Auto-ignition Temperature Evaluation Weighing of Alternative Fuels*

	A1	A4	A7	A9	A8	A13	A2	A3	A12	A11	A10	A14	A5	A6	W
A1	1,00	3,00	4,00	5,00	5,00	5,00	6,00	7,00	7,00	7,00	8,00	8,00	8,00	9,00	0,251
A4	0,33	1,00	2,00	4,00	4,00	4,00	5,00	6,00	6,00	6,00	6,00	7,00	7,00	8,00	0,177
A7	0,25	0,50	1,00	3,00	3,00	3,00	4,00	5,00	5,00	5,00	6,00	6,00	6,00	7,00	0,135
A9	0,20	0,25	0,33	1,00	2,00	2,00	3,00	3,00	3,00	4,00	4,00	4,00	5,00	6,00	0,085
A8	0,20	0,25	0,33	0,50	1,00	2,00	3,00	3,00	3,00	3,00	4,00	4,00	5,00	6,00	0,075
A13	0,20	0,25	0,33	0,50	0,50	1,00	2,00	3,00	3,00	3,00	4,00	4,00	5,00	6,00	0,066
A2	0,17	0,20	0,25	0,33	0,33	0,50	1,00	2,00	2,00	2,00	3,00	3,00	4,00	5,00	0,046
A3	0,14	0,17	0,20	0,33	0,33	0,33	0,50	1,00	2,00	2,00	2,00	3,00	3,00	4,00	0,036
A12	0,14	0,17	0,20	0,33	0,33	0,33	0,50	0,50	1,00	2,00	2,00	3,00	3,00	4,00	0,033
A11	0,14	0,17	0,20	0,25	0,33	0,33	0,50	0,50	0,50	1,00	2,00	2,00	3,00	4,00	0,028
A10	0,13	0,17	0,17	0,25	0,25	0,25	0,33	0,50	0,50	0,50	1,00	2,00	2,00	3,00	0,022
A14	0,13	0,14	0,17	0,25	0,25	0,25	0,33	0,33	0,33	0,50	0,50	1,00	2,00	3,00	0,019
A5	0,13	0,14	0,17	0,20	0,20	0,20	0,25	0,33	0,33	0,33	0,50	0,50	1,00	3,00	0,015
A6	0,11	0,13	0,14	0,17	0,17	0,17	0,20	0,25	0,25	0,25	0,33	0,33	0,33	1,00	0,011
λ_{max} = 15,216, CI = 0,094, CR = 0,059 < 0,1															

Table 9. *LEL Evaluation Weighing of Alternative Fuels*

	A1	A9	A7	A4	A3	A8	A11	A6	W
A1	1,00	7,00	7,00	8,00	8,00	9,00	9,00	9,00	0,494
A9	0,14	1,00	2,00	3,00	3,00	4,00	4,00	4,00	0,150
A7	0,14	0,50	1,00	2,00	2,00	3,00	4,00	4,00	0,110
A4	0,13	0,33	0,50	1,00	2,00	3,00	3,00	3,00	0,080
A3	0,13	0,33	0,50	0,50	1,00	2,00	3,00	3,00	0,064
A8	0,11	0,25	0,33	0,33	0,50	1,00	2,00	2,00	0,042
A11	0,11	0,25	0,25	0,33	0,33	0,50	1,00	2,00	0,032
A6	0,11	0,25	0,25	0,33	0,33	0,50	0,50	1,00	0,027
λ_{max} = 8,643, CI = 0,092, CR = 0,066 < 0,1									

methanol, and ammonia have lower weighing with 0,063, 0,038, and 0,015, respectively.

Flame speed value of corn oil, jatropha oil, pyrolysis oil, rapeseed oil, and waste cooking oil was not found at the literature, for this reason, Table 11 does not include these alternative fuels. LNG, and LPG have higher weighing with the points of 0,239, 0,176, and 0,151, respectively. Palm oil, soybean oil, and hydrogen are bottom three at the weighing table.

Table 12 shows density evaluation weighing of the alternative fuels. Hydrogen, LNG, and LPG are more safe alternative fuels than the others at the density evaluation with the weighing of 0,290, 0,157, and 0,118, respectively, while jatropha oil, palm oil, and pyrolysis oil are less safe alternative fuels with 0,027, 0,021, and 0,012, respectively.

Table 13 shows the exposure rate evaluation weighing of the alternative fuels. LPG and ethanol are safer than other alternative fuels at the exposure rate evaluation. There is a high difference at the weighing, which is 0,281 for LPG and ethanol, while most close one to these weighing is LNG with 0,093. Less safe alternative fuels are bio-based fuels like corn oil, jatropha oil, palm oil, rapeseed oil, soybean oil, and waste cooking oil with the weighing of 0,022. The reason is that vapor of bio-based fuels highly affects human health when it is inhaled.

Table 10. *UEL Evaluation Weighing of Alternative Fuels*

	A11	A6	A8	A7	A3	A1	A9	A4	W
A11	1,00	2,00	2,00	3,00	3,00	4,00	5,00	9,00	0,269
A6	0,50	1,00	2,00	2,00	3,00	4,00	5,00	9,00	0,215
A8	0,50	0,50	1,00	2,00	3,00	3,00	5,00	9,00	0,181
A7	0,33	0,50	0,50	1,00	2,00	3,00	4,00	8,00	0,127
A3	0,33	0,33	0,33	0,50	1,00	2,00	4,00	8,00	0,092
A1	0,25	0,25	0,33	0,33	0,50	1,00	3,00	7,00	0,063
A9	0,20	0,20	0,20	0,25	0,25	0,33	1,00	6,00	0,038
A4	0,11	0,11	0,11	0,13	0,13	0,14	0,17	1,00	0,015
λ_{max} = 8,463, CI = 0,066, CR = 0,047 < 0,1									

Table 11. *Flame Speed Evaluation Weighing of Alternative Fuels*

	A1	A7	A8	A3	A9	A6	A10	A13	A4	W
A1	1,00	2,00	2,00	2,00	3,00	3,00	4,00	4,00	9,00	0,239
A7	0,50	1,00	2,00	2,00	2,00	2,00	3,00	3,00	9,00	0,176
A8	0,50	0,50	1,00	2,00	2,00	2,00	3,00	3,00	9,00	0,151
A3	0,50	0,50	0,50	1,00	2,00	2,00	3,00	3,00	9,00	0,129
A9	0,33	0,50	0,50	0,50	1,00	2,00	3,00	3,00	8,00	0,104
A6	0,33	0,50	0,50	0,50	0,50	1,00	2,00	3,00	8,00	0,086
A10	0,25	0,33	0,33	0,33	0,33	0,50	1,00	2,00	7,00	0,056
A13	0,25	0,33	0,33	0,33	0,33	0,33	0,50	1,00	7,00	0,046
A4	0,11	0,11	0,11	0,11	0,13	0,13	0,14	0,14	1,00	0,013
λ_{max} = 9,432, CI = 0,054, CR = 0,037 < 0,1										

Table 12. *Density Evaluation Weighing of Alternative Fuels*

	A4	A7	A8	A1	A6	A3	A9	A14	A12	A2	A13	A5	A10	A11	W
A4	1,00	4,00	5,00	6,00	6,00	7,00	7,00	7,00	7,00	7,00	8,00	8,00	8,00	9,00	0,290
A7	0,25	1,00	2,00	3,00	4,00	4,00	4,00	5,00	5,00	5,00	5,00	5,00	5,00	7,00	0,157
A8	0,20	0,50	1,00	3,00	3,00	3,00	3,00	4,00	4,00	4,00	4,00	4,00	4,00	6,00	0,118
A1	0,17	0,33	0,33	1,00	2,00	2,00	2,00	3,00	3,00	3,00	3,00	3,00	3,00	5,00	0,078
A6	0,17	0,25	0,33	0,50	1,00	2,00	2,00	2,00	2,00	3,00	3,00	3,00	3,00	5,00	0,065
A3	0,14	0,25	0,33	0,50	0,50	1,00	2,00	2,00	2,00	2,00	2,00	2,00	3,00	4,00	0,052
A9	0,14	0,25	0,33	0,50	0,50	0,50	1,00	2,00	2,00	2,00	2,00	2,00	3,00	4,00	0,048
A14	0,14	0,20	0,25	0,33	0,50	0,50	0,50	1,00	2,00	2,00	2,00	2,00	2,00	4,00	0,039
A12	0,14	0,20	0,25	0,33	0,50	0,50	0,50	0,50	1,00	2,00	2,00	2,00	2,00	4,00	0,035
A2	0,14	0,20	0,25	0,33	0,33	0,50	0,50	0,50	0,50	1,00	2,00	2,00	2,00	4,00	0,031
A13	0,13	0,20	0,25	0,33	0,33	0,50	0,50	0,50	0,50	0,50	1,00	1,00	2,00	4,00	0,027
A5	0,13	0,20	0,25	0,33	0,33	0,50	0,50	0,50	0,50	0,50	1,00	1,00	2,00	4,00	0,027
A10	0,13	0,20	0,25	0,33	0,33	0,33	0,33	0,50	0,50	0,50	0,50	0,50	1,00	3,00	0,021
A11	0,13	0,14	0,17	0,20	0,20	0,25	0,25	0,25	0,25	0,25	0,25	0,25	0,33	1,00	0,012
λ_{max} = 15,029, CI = 0,079, CR = 0,050 < 0,1															

Table 13. *Exposure Rate Evaluation Weighing of Alternative Fuels*

	A8	A3	A7	A4	A6	A9	A11	A1	A2	A5	A10	A12	A13	A14	W
A8	1,00	1,00	7,00	8,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	0,281
A3	1,00	1,00	7,00	8,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	9,00	0,281
A7	0,14	0,14	1,00	3,00	3,00	3,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	0,093
A4	0,13	0,13	0,33	1,00	2,00	2,00	3,00	3,00	3,00	3,00	3,00	3,00	3,00	3,00	0,062
A6	0,11	0,11	0,33	0,50	1,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	0,044
A9	0,11	0,11	0,25	0,33	0,50	1,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	0,040
A11	0,11	0,11	0,25	0,33	0,50	0,50	1,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00	0,034
A1	0,11	0,11	0,25	0,33	0,50	0,50	0,50	1,00	2,00	2,00	2,00	2,00	2,00	2,00	0,031
A2	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
A5	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
A10	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
A12	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
A13	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
A14	0,11	0,11	0,25	0,33	0,50	0,50	0,50	0,50	1,00	1,00	1,00	1,00	1,00	1,00	0,022
λ_{max} = 14,890, CI = 0,068, CR = 0,043 < 0,1															

Final weighing of the alternative fuels is shown at Table 14. The weighing for LEL, UEL, and flame speed for bio-based fuels and pyrolysis oil could not be calculated due to lack of data. For this reason, final weighing of these alternative fuels were calculated without including these weighing. One can see from the Table 14 and Figure 2 that LPG has the highest final safety weighing of 0,130. LPG has higher weighing at the UEL, flame speed, density, and the exposure rate criteria, and average weighing at auto-ignition temperature, which is effective at the highest final safety weighing of LPG.

Ethanol, ammonia, and LNG follow up LPG with the final safety weighing of 0,120, 0,116, and 0,084, respectively. Ethanol has a higher exposure rate, and average flame speed, LEL, and UEL, while ammonia has higher auto-ignition temperature, LEL, flame speed, and average UEL, and density. LNG has average auto-ignition temperature, LEL, UEL, flame speed, and density.

LPG, LNG, and methanol have commercial application at the shipping industry. Hydrogen has experimental based applications. Methanol has final safety weighing of 0,053, and hydrogen has

Table 14. *Final Weighing of Alternative Fuels*

Alternative Fuels	Flashpoint (0,315)	Auto-ignition (0,207)	LEL (0,0355)	UEL (0,0355)	Flame Speed (0,071)	Density (0,021)	Exposure Rate (0,315)	Final Weighing
Ammonia	0,051	0,251	0,494	0,063	0,239	0,078	0,031	0,116
Corn Oil	0,112	0,046	-	-	-	0,031	0,022	0,052
Ethanol	0,025	0,036	0,064	0,092	0,129	0,052	0,281	0,120
Hydrogen	0,011	0,177	0,080	0,015	0,013	0,290	0,062	0,070
Jatropha Oil	0,092	0,015	-	-	-	0,027	0,022	0,040
Kerosene	0,030	0,011	0,027	0,215	0,086	0,065	0,044	0,042
LNG	0,009	0,135	0,110	0,127	0,176	0,157	0,093	0,084
LPG	0,014	0,075	0,042	0,181	0,151	0,118	0,281	0,130
Methanol	0,023	0,085	0,150	0,038	0,104	0,048	0,040	0,053
Palm Oil	0,137	0,022	-	-	0,056	0,021	0,034	0,041
Pyrolysis Oil	0,044	0,028	0,032	0,269	-	0,012	0,034	0,041
Rapeseed Oil	0,178	0,033	-	-	-	0,035	0,022	0,071
Soybean Oil	0,151	0,066	-	-	0,046	0,027	0,022	0,072
WCO	0,124	0,019	-	-	-	0,039	0,022	0,051

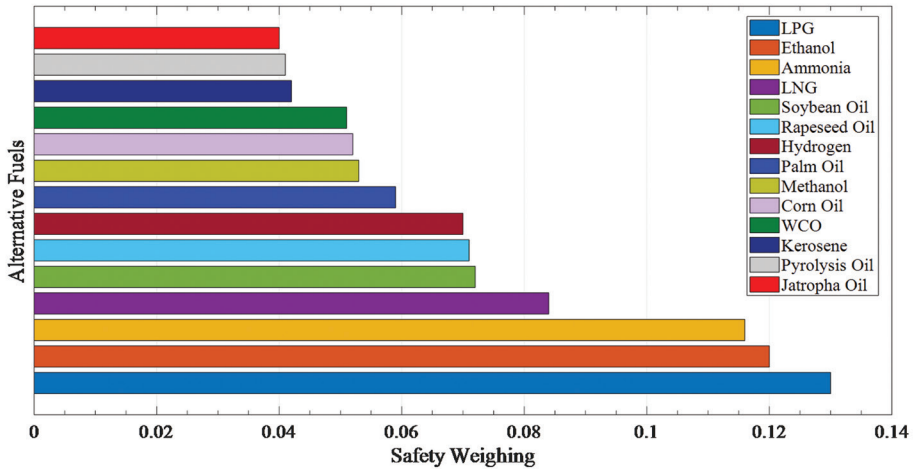


Figure 2. *Graph of Onboard Safety Assessment Result*

0,070. Low weighing values of flashpoint, auto-ignition temperature, UEL, density, and exposure rate of methanol, and low weighing values of flashpoint, LEL, UEL, and flame speed of hydrogen are the reason of low level of final safety weighing of these alternative fuels. Remaining alternative fuels are bio-based fuels, kerosene, and pyrolysis oil. These alternative fuels have lower final safety weighing between 0,052 and 0,040.

Lower final safety weighing does not prevent the alternative fuels to be used on ships by the engine manufacturers and ship builders. The advantage of combustion characteristic with lower emissions is attractive for the shipping industry, and the onboard applications have been made with the extra safety precautions and systems, which also means higher initial and operational costs.

6. Conclusion

The safety evaluation method was formed to assess the alternative fuels by focusing on shipboard handling, storage, and crew health. Recent trend alternative fuels and possible alternative fuels for the future were the assessed fuels. The study aimed to show the safety ranking of the trend alternative fuels and possible ones in the future. Fourteen alternative fuels were used in the safety evaluation.

The criteria were determined to form the safety evaluation method and assess the alternative fuels. These criteria were flashpoint, auto-ignition temperature, flammability limits, flame speed, density, and exposure limit. The criteria weighing were determined by the taken opinions of seven experts who are academicians and have sea experience. The experts determined the weighing of flashpoint and exposure rate as 0,315, auto-ignition temperature as 0,207, flammability limits and flame speed as 0,071, and density as 0,021. The assessment of alternative fuels was done by comparing the physicochemical properties of the alternative fuels. The AHP method was used both to determine the criteria weighing, and to compare alternative fuels.

According to the criteria assessment results, rapeseed oil had the highest weighing at the flashpoint criterion with 0,178. Ammonia got the highest weighing at the auto-ignition temperature with 0,251. Due to lack of information about the LEL and UEL of bio-based fuels, only eight alternative fuels could be assessed at this criterion. Ammonia got 0,494 at the LEL, and kerosene got 0,215 at the UEL as the highest weighing. In addition, there was lack of information about the flame speed of some alternative fuels, for this reason only nine alternative fuels could be assessed at this criterion. Ammonia had the highest weighing with 0,239. Hydrogen had the highest weighing at the density criterion with 0,290, and ethanol and LPG had the highest weighing at the exposure rate criterion with 0,281.

The final safety assessment results showed that LPG got the highest final safety weighing with 0,130. Ethanol and ammonia followed it with 0,120 and 0,116, respectively. LNG and methanol are trend alternative fuels with LPG for shipping industry. LNG had 0,084, and methanol had 0,053 as the final safety weighing.

There were limitations at the study. Some alternative fuels did not have the flammability limits, and the flame speed of some alternative fuels were not found in the literature. Therefore, these fuels could not be assessed at these criteria. The exposure limit of jatropha oil, palm oil, and WCO were not found in the literature. It was assumed that these fuels have same exposure limit with the other vegetable oils. The expert number could be higher, and experts could be selected from the safety experts.

The study aimed to determine the safety rankings of the alternative fuels, which have been used and can be used in the future.

There has not been any previous study, which includes a wide range of alternative fuels for the purpose of the assessment of the fuels from the aspect of shipboard safety. It is first time to include some alternative fuels in a marine-based study. The alternative fuels with lower weighing do not mean that these fuels cannot be used on ships. However, it means more safety systems have to be applied on ships, and higher safety precautions have to be taken while the storage of these fuels and the operation with the fuels. It causes higher initial and operational costs. In addition to this, extra safety equipment increases the weight of the ship, and reduces cargo capacity of the ship. The ship builders/operators have to consider these drawbacks of the alternative fuels before selecting for their ship. Next study can be the combination of shipboard safety assessment results and cost–benefit assessment of alternative fuels.

References

[1] DNV GL: The Future of Shipping, Høvik, 04.2014.

[2] International Maritime Organization, International Convention for the Safety of Life at Sea. Access Date: 18 September 2017. http://www.imo.org/en/About/conventions/listofconventions/pages/international-convention-for-the-safety-of-life-at-sea-(solas),-1974.aspx.

[3] International Maritime Organization, Gas and low-flashpoint fuels code adopted by IMO. Access Date: 18 September 2017. http://www.imo.org/en/mediacentre/pressbriefings/pages/26-msc-95-ends.aspx.

[4] Deniz, C., Zincir, B. (2016). Environmental and economical assessment of alternative marine fuels. Journal of Cleaner Production, 113(2016)438-449.

[5] Gu, Y., Zhang, C. (2014). Alternative energies or fuels for future deep sea container shipping. Master degree thesis, University of Gothenburg, School of Business, Economics and Law.

[6] Mansson, S. (2017). Prospects for renewable marine fuels, a multi-criteria decision analysis of a alternative fuels for the maritime sector. Master thesis, Industrial Ecology, Chalmers University of Technology.

[7] Hossain, A. K., Davies, P. A. (2010). Plant oils as fuels for compression ignition engines: a technical review and life-cycle analysis. Renewable Energy, 35(2010)1-13.

[8] Google Scholar, Alternative fuel research number, 17 March 2017.

[9] University of Nebraska Lincoln. Safe Operating Procedure. Hazards of Flammable Gases, Liquids & Aerosols & Risk Minimization. Access Date: 8 November 2017. https://ehs.unl.edu/sop/s-hazards_flam_gases_liq_aeros_risk_min.pdf.

[10] Reiter, A. J., Kong, S. (2011). Combustion and emission characteristics of compression-ignition engine using dual ammonia-diesel fuel. Fuel 90(2011)87-97.

[11] Praxair. Ammonia Material Safety Data Sheet. Access Date: 11 November 2017. http://www.praxair.com/-/media/documents/sds/ammonia-nh3-safety-data-sheet-sds-p4562.pdf?la=en.

[12] Nozari, H., Karabeyoglu, A. (2014). Chemical kinetics study of combustion characteristics of ammonia-air mixtures under high pressure lean conditions. https://nh3fuel.files.wordpress.com/2014/10/nh3fa-2014-hadi-nozari-arif-karabeyoglu.pdf.

[13] Hossain, A. K., Davies, P. A. (2010). Plant oils as fuels for compression ignition engines: a technical review and life-cycle analysis. Renewable Energy, 35(2010)1-13.

[14] Sidibe, S. S., Blin, J., Vaitilingam, G., Azoumah, Y. (2010). Use of crude filtered vegetable oils as a fuel in diesel engines state of the art: literature review. Renewable and Sustainable Energy Reviews, 14(2010)2748-2759.

[15] Hankinson Renewable Energy. Material Safety Data Sheet Corn Oil. Access Date: 1 November 2017. http://corporate.murphyusa.com/content/documents/MSDS_PDFs/CORN_OIL_Murphy_Oil_HRE_-_CAN_US_V4.1English_US.pdf.

[16] Science Lab Chemicals & Laboratory Equipments. Corn Oil Material Safety Data Sheet. Access Date: 20 November 2017. http://www.sciencelab.com/msds.php?msdsId=9927139.

[17] Parthasarathi, R., Gawri, S., Saravanan, C. G. (2014). Effects of ethanol-diesel emulsions on the performance, combustion and emission characteristics of DI diesel engine. American Journal of Applied Sciences, 11(4):592-600,2014.

[18] Labeckas, G., Slavinskas, S., Mazeika, M. (2014). The effect of ethanol-diesel-biodiesel blends on combustion, performance and emissions of a direct injection diesel engine. Energy Conversion and Management, 79(2014)698-720.

[19] Science Lab Chemicals & Laboratory Equipment. Material Safety Data Sheets Ethyl Alcohol 200 Proof. Access Date: 10 November 2017. https://www.sciencelab.com/msds.php?msdsId=9923955.

[20] Jhang, S. R., Chen, K. S., Lin, S. L., Lin, Y. C., Cheng, W. L. (2016). Reducing pollutant emissions from a heavy-duty diesel engine by using hydrogen additions. Fuel 172(2016)89-95.

[21] National Research Council. (2008). 7 Hydrogen. Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants: Vol. 2. Washington, DC: The National Academies Press. doi: 1017226/12032, pp.154.

[22] Nasim, M. N., Yarasu, R. B., Sarda, R. H. (2013). Experimental investigation on compression ignition engine powered by preheated neat jatropha oil. Journal of Petroleum Technology and Alternative Fuels, Vol 4(7), pp.119-124, doi:10.5897/JPTAF 10.004.

[23] Science Lab Chemicals & Laboratory Equipment. Material Safety Data Sheet Kerosene. Access Date: 14 November 2017. http://www.sciencelab.com/msds.php?msdsId=9924436.

[24] Aydin, H., Bayindir, H., Ilkiliç, C. (2010). Emissions from an engine fueled with biodiesel-kerosene blends. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 33:2,130-137.

[25] Tesoro. (2014). Kerosene Material Safety Data Sheet. Access Date: 23 November 2017. https://tsocorpsite.files.wordpress.com/2014/08/kerosene.pdf.

[26] Wu, Y. (2016). Experimental investigation of laminar flame speeds of kerosene fuel and second generation biofuels in elevated conditions of pressure and preheat temperature. Chemical Physics, INSA de Rouen.

[27] PGW. Liquefied Natural Gas (LNG) Material Safety Data Sheet. Access Date: 20 November 2017. https://www.pgworks.com/uploads/pdfs/LNGSafetyData.pdf.

[28] Lukoil. LNG Material Safety Data Sheet. Access Date: 20 November 2017. http://en.lukoil.com.tr/Upload/Docs/LNG%20(MSDS)-EN.pdf.

[29] OnGas. LPG Material Safety Data Sheet. Access Date: 18 November 2017. https://www.ongas.co.nz/Assets/OnGas%20Material%20Safety%20Data%20Sheet%20OCT%202014.pdf.

[30] Contact Energy. LPG Material Safety Data Sheet. Access Date: 18 November 2017. https://contact.co.nz/-/media/contact/pdfs/residential/reference-guides/safety- data-sheet.ashx?la=en&hash=5AC0B371B71A873D64668E4BFEDA04246590501C.

[31] Shell. LPG Material Safety Data Sheet. Access Date: 18 November 2017. http://www.shell.com/content/dam/shell-new/local/corporate/trading-shipping/downloads/msds/in-country/singapore-sietco/lpg-lpg---sietco---en.pdf.

[32] Liao, S. Y., Jiang, D. M., Cheng, Q., Gao, J., Huang, Z. H., Hu, Y. (2005). Correlations for laminar burning velocities of liquefied petroleum gas-air mixtures. Energy Conversion and Management, 46(2005)3175-3184.

[33] Science Lab Chemicals & Laboratory Equipment. Material Safety Data Sheet Methyl Alcohol. Access Date: 11 November 2017. http://www.sciencelab.com/msds.php?msdsId=9927227.

[34] Science Lab Chemicals & Laboratory Equipment. Material Safety Data Sheet Palm Oil. Access Date: 5 November 2017. http://www.sciencelab.com/msds.php?msdsId=9926383.

[35] Chong, C. T., Hochgreb, S. (2011). Measurements of laminar flame speeds of liquid fuels: Jet-A1, diesel, palm methyl esters and blends using particle imaging velocimetry (PIV). Proceedings of the Combustion Institute, 33(2011)979-986.

[36] Chevron Phillips Chemical Company. Heavy Pyrolysis Oil Material Safety Data Sheet. Access Date: 15 November 2017. http://www.cpchem.com/msds/100000014923_SDS_US_EN.PDF.

[37] CIRAD. Bio-oil Material Safety Data Sheet. Access Date: 15 November 2017. http://www.pyne.co.uk/Resources/user/docs/CIRAD_MSDS-Final.pdf.

[38] Science Lab Chemicals & Laboratory Equipments. Naphthalene Material Safety Data Sheet. Access Date: 15 November 2017. http://www.sciencelab.com/msds.php?msdsId=9927671.

[39] Spectrum Chemical. Rapeseed Material Safety Data Sheet. Access date: 21 November 2017. https://www.spectrumchemical.com/MSDS/R2221.PDF.

[40] Buda-Ortins, K. (2010). Auto-ignition of cooking oils. University of Maryland, Department of Fire Protection Engineering, 19.05.2010.

[41] Science Lab Chemicals & Laboratory Equipments. Soybean Oil Material Safety Data Sheet. Access Date: 21 November 2017. http://www.sciencelab.com/msds.php?msdsId=9925064.

[42] Gomez-Meyer, J. S., Gollahalli, S. R., Parthasarthy, R. N., Quiroga, J. E. (2012). Laminar flame speed of soy and canola biofuels. C.T.F Cienc. Technol. Futuro vol.4 no.5 Bucaramanga, January/June 2012.

[43] Natural Sourcing Specialists in Cosmeceutical Ingredients. Material Safety Data Sheet Soybean Oil. Access Date: 6 November 2017. https://www.naturalsourcing.com/downloads/msds/MSDS_Soybean_Oil.pdf.

[44] ConAgra Foods. Soybean Material Safety Data Sheet. Access Date: 21 November 2017. http://sds.chemtel.net/webclients/cheneybrothers/116009SDS.pdf.

[45] Bioils S.A. Material Safety Data Sheet Used Cooking Oil. Access Date: 6 November 2017. http://www.bioils.com.co/descargas/MSDS.pdf.

[46] Kathirvel, S., Layek, A., Muthuraman, S. (2016). Exploration of waste cooking oil methyl esters (WCOME) as fuel in compression ignition engines: a critical review. Engineering Science and Technology, an International Journal, 19(2016)1018-1026.

[47] Wikipedia, Flashpoint, Access Date: 17.03.2018. https://en.wikipedia.org/wiki/Flash_point.

[48] Wikipedia, Auto-ignition Temperature, Access Date: 17.03.2018, https://en.wikipedia.org/wiki/Autoignition_temperature.

[49] Wikipedia, Flammability Limits, Access Date: 17.03.2018, https://en.wikipedia.org/wiki/Flammability_limit.

[50] Wikipedia, Flame Speed, Access Date: 17.03.2018, https://en.wikipedia.org/wiki/Flame_speed.

[51] American Conference of Governmental Industrial Hygienists. Access Date: 25 September 2017. http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations.

[52] Saaty, T. L. (1980). The Analytic Hierarchy Process: Planning, Priority Setting, and Resource Allocation, McGraw-Hill, New York.

[53] Winebrake, J. J., Creswick, B. P. (2003). The future of hydrogen fueling systems for transportation: an application of perspective-based scenario analysis using the analytic hierarchy process. Technological Forecasting & Social Change, 70(2003)359-384.

[54] Ren, J., Sovacool, B.K. (2015). Prioritizing Low-carbon Energy Sources to Enhance China's Energy Security. Energy Conversion and Management, 92(2015)129-136.

[55] Render, B., Stair, R. M. (1999). Quantitative Analysis for Management, 7th Edition. Pearson. Pp. 522-529.

[56] Saathy, T. L., Tran, L. T. (2007). On the invalidity of fuzzifying numerical judgments in the analytic hierarchy process. ISAHP 2007, Vina del Mar, Chile, August 3- 6, 2007.

Received: 2 April 2018 Accepted: 1 May 2018 *DOI ID: 10.5505/jems.2018.58661*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Ali Cem KUZU

Bağlama Operasyonları Esnasında Kopan Halat Yaralanmalarının Bulanık Hata Ağacı Yöntemi ile Analizi

Ali Cem KUZU[1], Yunus Emre ŞENOL[2], Özcan ARSLAN[2]

[1]Piri Reis Üniversitesi, Denizcilik Meslek Yüksekokulu, Türkiye
[2]İstanbul Teknik Üniversitesi, Denizcilik Fakültesi, Türkiye
ackuzu@pirireis.edu.tr; ORCID ID: https://orcid.org/0000-0001-5594-9158
senolyunusemre@gmail.com; ORCID ID: https://orcid.org/0000-0001-7592-7247
arslano@itu.edu.tr; ORCID ID: https://orcid.org/0000-0003-4769-6941

Öz

Pek çok sektörde olduğu gibi denizcilik sektöründe de ölümlere, yaralanmalara, çevre kirliliklerine veya maddi hasarlara sebep olan kazalar yaşanmaktadır. Denizcilik sektörünün omurgasını oluşturan gemi taşımacılığı operasyonları, yapılan işin doğası gereği ciddi riskler barındırmaktadır. Bu riskleri yok etmek ya da kabul edilebilir risk seviyelerine indirgeyebilmek için pek çok emniyet tedbiri uygulanıyor olmasına rağmen gemi operasyonlarında yaşanan kazaların sayısı oldukça fazladır. Gemi operasyonları ile ilgili yaşanmış kazalar ve kaza istatistik raporları incelendiğinde gemi bağlama operasyonlarında yaşanmış olan kaza oranının oldukça yüksek olduğu görülmektedir. Çalışma kapsamında, Hata Ağacı Analizi yöntemi ile tanker terminal operasyonları için kopan halat yaralanması riski ve buna sebep olan kök sebepler tespit edilmiş olup Bulanık Mantık yöntemi ile de sayısal analizi gerçekleştirilmiştir. Tanker terminal bağlama operasyonlarında görevli gemi ve sahil çalışanlarından oluşan uzman grubu görüşlerine dayandırılarak oluşturulan model ile kopan halat yaralanma kazası risk değerinin hesaplanması ve alınabilecek önlemlerle bu risk değerinin azaltılabileceğinin bilimsel bir yaklaşımla ortaya konması hedeflenmiştir.

Anahtar Kelimeler: *Gemi Bağlama Operasyonu, Bulanık Mantık, Hata Ağacı Analizi, Risk Değerlendirme.*

Fuzzy Fault Tree Analysis of Parted Rope Injuries During Mooring Operations

Abstract

As in many sectors, there are accidents in the maritime industry that cause deaths, injuries, environmental pollution or material damage. Shipping operations, which constitute the backbone of the maritime industry, have serious risks due to the nature of the work being done. Despite there exist many safety measures have been implemented to eliminate these risks or to reduce them to acceptable risk levels, the number of accidents in ship operations is quite high. When the accidents and accident statistical reports on ship operations are examined, it is seen that the rate of accidents in mooring operations is very high. Within the scope of the study, the Fault Tree Analysis (FTA) method is used to determine the risk of parted mooring line injury for tanker terminal operations and the root causes leading to this, and numerical analysis was performed by Fuzzy Logic method. It is aimed to establish a scientific model based on tanker and terminal employees' opinion that can reduce the risk by calculating the risk value of the parted mooring line injury accident and employing related preventive actions.

Keywords: *Mooring Operation, Fuzzy Logic, Fault Tree Analysis, Risk Assessment.*

To cite this article: Kuzu, A. C., Şenol, Y. E. ve Arslan, Ö. (2018). Bağlama Operasyonları Esnasında Kopan Halat Yaralanmalarının Bulanık Hata Ağacı Yöntemi ile Analizi. *Journal of ETA Maritime Science*, 6(3), 215-227.
To link to this article: https://dx.doi.org/10.5505/jems.2018.58661

1. Giriş

Küresel ticaretin ana arterlerinden olan deniz taşımacılığı içerisinde seyir, yükleme, tahliye, manevra, demirleme bağlama operasyonları gibi pek çok operasyonu barındırır. Alınan tüm emniyet tedbirlerine rağmen bu operasyonlar esnasında yaralanmalara, can kayıplarına ve maddi hasarlara sebep olan kazalar yaşanmaktadır. Gemilerde yaşanan kazalar incelendiğinde bağlama operasyonlarındaki kaza oranının oldukça yüksek olduğu göze çarpmaktadır [21, 22]. Günümüzde gemi bağlama operasyonları için en yaygın kullanılan sistem halat ırgat donanımlı bağlama sistemidir. Deniz taşımacılığı tarihi kadar eski olan bu bağlama sistemi kullanılarak yapılan bağlama operasyonlarında insan gücüne duyulan ihtiyaç oldukça fazla olmakla beraber bağlama halatlarının kopma, ani gerilme ve işleyen halatlarda dolaşma riskleri bağlama operasyonuna katılan personeli, çevreyi, gemiyi ve limanı ciddi sonuçlar doğurabilecek şekilde tehlikeliye atmakta ve kazalara sebebiyet vermektedir. Yapılan literatür araştırması ve saha çalışmaları ile bağlama operasyonlarının yaratabileceği riskler tespit edilerek kopan halat yaralanması kazalarının risk değerlendirmesi için hata ağacı oluşturulmuştur. Saha çalışması kapsamında limanlarda ve gemilerde mevcut bağlama sistemleri incelenmiş olup, emniyetsiz durumlar yerinde tespit edilmiştir. Ayrıca gemi bağlama operasyonlarında görev alan gemi ve rıhtım personelinden bağlama operasyonları emniyeti hususundaki görüşleri alınmıştır. Literatür araştırması kapsamında ise konu ile ilgili yapılmış olan akademik çalışmaların yanı sıra kaza analiz ve istatistik raporlarına ulaşılmıştır. Böylece hata ağacında kazaya sebebiyet verebilecek kök sebepler başlangıç olayı olarak belirlenmiş ve mantık kapıları ile bir üst olaya bağlanmak suretiyle tepe olayın yani kopan halat yaralanması riskinin belirlenmesi için uygun yapı oluşturulmuştur. Hata ağacında kullanılmış olan başlangıç olaylarının meydana gelme olasılıkları bulanık mantık yöntemi kullanılarak hesaplanmıştır. Bu çalışmada gemilerin bağlama operasyonlarındaki tehlikeler ve riskler detaylı şekilde irdelenmiş olup, bununla birlikte yaşanan veya yaşanması muhtemel olan halat kopma kazalarının kök sebepleri tespit edilmeye çalışılmıştır.

1.1. Literatür Araştırması

Bağlama operasyonlarında yaşanmış kazalar ve bu kazalara sebebiyet veren kök sebeplerin tespit edilebilmesi ve bağlama operasyonlarında emniyet hususunu ilgilendirebilecek çalışmalardan faydalanılabilmesi için literatür araştırması yapılmıştır. Çalışmada öncelikle gemi bağlama operasyonları ile ilgili yapılan çalışmalar irdelenmiştir. Konu başlığı ile ilişkilendirilebilecek akademik çalışmalardan rıhtıma bağlı çift cidarlı bir tanker için simülasyon senaryosu oluşturularak, bağlama halatlarına binen yüklerin hesabı ve analizi "Optimoor" yazılımı kullanılarak yapılmıştır [13]. Büyük petrol tankerlerinin yanaşacağı terminallerin bağlama sistemleri tasarımı ile ilgili, 200.000 dedveyt tonluk bir petrol tankerinin rıhtıma bağlı durumdaki hareketlerinin analizi için simülasyon çalışması yapılmış ve "yarı durağan analiz" yöntemi ile değerlendirilmiştir [14]. Benzer bir simülasyon çalışmasında Kudela ve Diğ. 300.000 detveyt tonluk bir petrol tankerinin bağlı durumdaki hareketlerini ''Optimoor'' yazılımını kullanarak analiz etmiştir [15]. Uzun periyotlu dalgaların rıhtımda bağlı durumda olan büyük tankerlerin hareketlerine olan etkisinin değerlendirildiği bir çalışmada, örnek simülasyon senaryosu için 266.000 m^3'lük bir LNG tankeri kullanılmıştır [16]. Pripic-Orsic ve Diğ. yaptıkları çalışmada, Adriyatik Denizi'nde bir rıhtım belirleyerek değişen dalga durumunun o rıhtımda

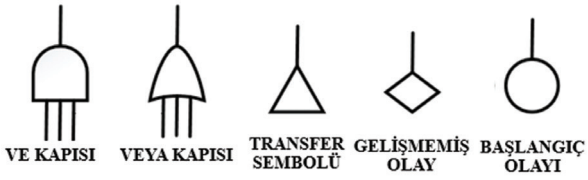
bağlı olan gemi hareketlerine etkisini değerlendirmiştir [17]. Yetkin, (2014) tanker-şamandıra bağlama sistemlerinin değişik çevre şartları altındaki dinamik davranışlarını modelleyebilmek için ''Orcaflex'' yazılımını kullanmıştır [18]. Molen ve Diğ., Geraldton Limanı'nda halat manevra biçiminin geliştirilmesi ile ilgili yaptıkları çalışmada farklı halat manevra sistemlerini ''Quaysim'' yazılımı ile analiz etmiştir [19]. Bağlama operasyonlarının emniyeti konulu çalışmada bağlama operasyonlarının riskleri belirtilmiş olup, operasyonlarda insan faktörü etkisinden bahsedilmiştir [20]. İngiltere Koruma ve Tazminat Kulübü(UK P&I Club) tarafından hazırlanmış olan raporda yaşanmış halat manevra kazaları ve bu kazaların sonucunda meydana gelen yaralanmalar, can kayıpları ve maddi hasarlar ile ilgili yirmi yıllık istatistiki veriler paylaşılmıştır [21]. Hollanda Koruma ve Tazminat Kulübü (NNPC) tarafından yayınlanmış olan halat manevraları esnasında kazaların önlenmesi ile ilgili raporda halatların kullanımı, depolanması, bakım tutumu ve kontrol edilmesi hakkında bilgilere yer verilmiştir [22]. Petrol Şirketleri Forumu tarafından yayınlanmış olan ''Mooring Equipment Guideline'' yayınında emniyetli halatlar, halat manevra sistemleri ve halat manevraları için oluşturulmuş prensiplere yer verilmiştir [23]. Uluslararası Denizcilik Örgütü, Emniyet Konseyi tarafından yayınlanmış olan ''Gemi Yedekleme ve Halat Manevra Ekipmanları Rehberi'' sirkülerinde halat manevra sistemleri için kullanılacak teçhizatlar ve bu standartlardan bahsedilmiştir [24]. Yayınlanmış olan bir operasyon emniyeti çalışmasında 1997-2006 yılları arasında meydana gelen halat kazaları araştırılmış ve araştırma sonucunda gemilerin halat manevrası operasyonlarında yaşanmış 273 kaza kaydına ulaşılmıştır [25].

2. Metodoloji

2.1. Hata Ağacı Analizi

Hata ağacı analizi yöntemi, niceliksel ve niteliksel olarak karmaşık hata sistemlerinin analiz edilmesinde yaygınca kullanılan sistemik bir yaklaşım yöntemidir [1-4]. Hata ağacı analizi pek çok sektörde olduğu gibi denizcilik sektöründe de emniyet değerlendirmesi kapsamında kullanılan bir risk değerlendirme ve analiz yöntemidir. Antao ve Soares ropax türü gemilerin çatışma, karaya oturma, yangın ve batma risklerini değerlendirmek için hata ağacı analizi yöntemini kullanmıştır [26]. Gemi trafiğinin yoğun olduğu Şenzen bölgesinde, gemilerin çatışma risklerini değerlendirmek için hata ağacı analiz yöntemi kullanılmış ve bölgeye ait geçmiş kaza veriler ile trafik yoğunluğu bilgileri de kullanılarak kaza olasılık değerleri ortaya konulmuştur [27]. Hata ağacı analizinde başlangıç olayları, mantık kapıları, başlangıç olaylarının sebep olacağı ara olaylar ve tepe olay kavramları vardır. Tespit edilmiş olan başlangıç olaylar ile kök sebepler "ve", "veya" mantık kapıları ile bir üst olaya bağlanır. Şekil 1'de gösterilen mantık kapıları ile birbirine bağlanan olaylar ile en sonunda tepe olaya ulaşılır [28].

Hata ağacı analiz işlemleri problemin



Şekil 1. *Problem Çözümünde İzlenen Metodoloji*

tanımlanması ve incelenecek alanın sınırlarının belirlenmesi, hata ağacı modelinin oluşturulması, minimum kesme setleri belirlenmesi, hata ağacının mantığa uygunluğunun sözel olarak kontrol edilmesi, tepe olayın sayısal hesaplaması ve raporlama aşamalarından oluşur.

Mantık kapılarının matematiksel olarak ifadesi; t anında tepe olayın meydana gelme olasılığı olsun. i. başlangıç olayının t anındaki meydana gelme olasılığı olsun. j minimum kesme setinin t anındaki gerçekleşme olasılığı olsun.

"ve" Kapısı

$$q_1(t) = P(E_i(t)) \quad (1)$$

Tepe olayı meydana gelme ihtimali;

$$Q_0(t) = P(E_1(t) \cap E_2(t)) = P(E_1(t) \square E_1(t)) = q_1(t) \square q_2(t) \quad (2)$$

n adet başlangıç olayı ve bir VE Kapısı varsa;

$$Q_0(t) = \prod_{j=1}^{n} q_j(t) \quad (3)$$

"veya" Kapısı

$$q_1(t) = P(E_i(t)) \quad (4)$$

Tepe olayı meydana gelme ihtimali;

$$Q_0(t) = P(E_1(t) \cup E_2(t)) = P(E_1(t)) + P(E_1(t)) - E_1(t) \cap E_2(t)$$
$$= q_1(t) - q_2(t) - q_1(t) \square q_2(t) = 1 - (1 - q_1(t)) \square (1 - q_2(t)) \quad (5)$$

n adet başlangıç olayı ve bir VEYA Kapısı varsa;

$$Q_0(t) = 1 - \prod_{j=1}^{n} (1 - q_j(t)) \quad (6)$$

Kesme seti değerlendirmesi: Minimum n adet başlangıç olayının aynı anda gerçekleşmesi durumunda minimum kesme seti meydana gelir. Minimum kesme setinin oluşması ise tepe olayının meydana gelmesi için yeterlidir. j minimum kesme setinin t anında meydana gelme ihtimali;

$$\phi_j(t) = \prod_{i=1}^{n} q_{j,i}(t) \quad (7)$$

Tepe olayı değerlendirmesi: Bu çalışmada oluşturulan hata ağacında belirlenen 43 adet başlangıç olayı ve 18 adet mantık kapısı kullanılarak kopan halat yaralanması tepe olayına ulaşılmıştır. Tablo 1'de kopan halat yaralanma kazası için oluşturulan hata ağacında kullanılmış olaylar, kısaltma ve kodlamaları ile birlikte listelenmiştir. Kopan halat yaralanma kazası hata ağacının yapısı uzman görüşleri ve operasyonel tecrübeler doğrultusunda kurgulanmıştır. Ayrıca hata ağacında yer alan başlangıç olayları uzman görüşleri ve kaza analiz raporları dikkate alınarak belirlenmiştir. Belirlenmiş olan başlangıç olaylarından bir üst olayın meydana gelmesi için tek başına yeterli olan temel olaylar "veya" kapısı ile iki ya da daha fazla temel olayın ya da ara olayın birlikte gerçekleşmesi durumunda meydana gelecek olaylar ise "ve" kapısı ile bağlanmıştır. Şekil 2'de oluşturulan hata ağacı sunulmuştur.

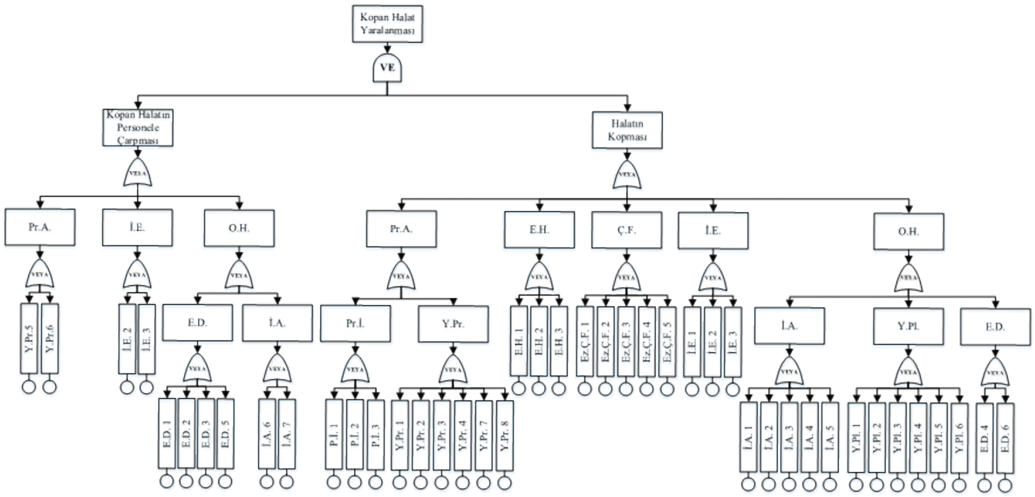
$$Q_0(t) \le 1 - \prod_{j=1}^{k} (1 - \phi_j(t)) \quad (8)$$

2.2. Bulanık Hata Ağacı Analizi

Bulanık mantık yöntemi uzmanların sözel olarak değerlendirdikleri cevapları sayısal sonuçlara dönüştürmeye yarayan bir yöntemdir. Zadeh tarafından önerilen bu yöntem zaman içerisinde geliştirilerek pek çok problemin çözümü için kullanılır hale gelmiştir [30]. Klasik mantıkta bir eleman bir kümenin ya elemanıdır ya da elemanı değildir anlayışı hakim iken, bulanık mantık yaklaşımında elemanların her küme için üyelik derecelerinden bahsedilir. Ford ve Sterman' a göre uzmanlara danışılarak yapılan çalışmaların tam olarak objektif sonuçlar ortaya koymayacağı değerlendirilmiştir [31]. Sübjektif etkinin en aza indirgenmesi amacıyla uzmanların ağırlıklandırması

Tablo 1. *Hata Ağacında Kullanılan Olaylar ve Kodları*

Kodlar			Olayın Tanımı
Prosedür Aksaklıkları (Pr.A.)	Yanlış veya Eksik Prosedür (Y.Pr.)	Y.Pr.1	Bakım-Tutum Aksaklıkları
		Y.Pr.2	Denetleme Aksaklıkları
		Y.Pr.3	SWL, BHC Test ve Markalama Aksaklığı
		Y.Pr.4	Ekipman Kullanma Talimatı Eksikliği
		Y.Pr.5	Geri Tepme Alanı(Snap-Back Zone) Belirleme ve Markalama Aksaklığı
		Y.Pr.6	Risk Değerlendirme Aksaklığı
		Y.Pr.7	Kaptan-Pilot Bilgi Akış Prosedüründe Hata
		Y.Pr.8	Halatların Pervaneye Dolanma Riski ile İlgili Uyarı Eksikliği
	Prosedür İhlali (P.İ.)	P.İ.1	Yapılan İşi Hafife Alma, Sıradanlaştırma
		P.İ.2	Eğitimsizlik
		P.İ.3	Ticari Baskı
Operasyon Hatası (O.H.)	İletişim Aksaklığı (İ.A.)	İ.A.1	Yanlış Bilgilendirme
		İ.A.2	Yabancı Dil Aksaklığı
		İ.A.3	Yanlış Verilen Komut
		İ.A.4	İletişim Cihazlarında Aksaklık
		İ.A.5	Verilen Komutu Yanlış Algılama ve Uygulama
		İ.A.6	Tehlikeyi Fark Eden Personelin Manevra Ekibini Uyarmaması
		İ.A.7	Gemi, Rıhtım veya Römorkör Personeli Arasında Yaşanan İletişim Problemi
	Yanlış Planlama (Y.Pl.)	Y.Pl.1	Yanlış Römorkör Seçimi
		Y.Pl.2	K.Ü. Organizasyon Planlama Hatası
		Y.Pl.3	Yanlış Halat Seçimi
		Y.Pl.4	Yanlış Zamanlama(Trafik ve Hava Durumu)
		Y.Pl.5	Yanlış Bağlama Metodu Seçimi
		Y.Pl.6	Yanlış Rıhtım Planlama
	Emniyetsiz Davranış (E.D.)	E.D.1	Yük Binen Halata Yakın Durma
		E.D.2	Görevli Olmadığı Halde Manevra Sahasında Bulunma
		E.D.3	Manevra Esnasında Başka İşle Uğraşma
		E.D.4	Halatlara Aşırı Yük Bindirilmesi
		E.D.5	Manevrada Yanlış Yerde Konuşlanma
		E.D.6	Halatların Pervaneye Dolaştırılması
Çevresel Faktörler (Ç.F.)	Engellenemez Çevresel Faktörler (Ez.Ç.F.)	Ez.Ç.F.1	Sert Rüzgar
		Ez.Ç.F.2	Yüksek Gel-Git
		Ez.Ç.F.3	Geçiş Yapan Gemi Etkisi
		Ez.Ç.F.4	Yüksek Dalga
		Ez.Ç.F.5	Şiddetli Akıntı
Ekipman Hatası (E.H.)		E.H.1	Yanlış Dizayn
		E.H.2	Yanlış Ekipman Seçimi
		E.H.3	Bakımsız ve Yıpranmış Ekipman
İnsan Etkisi (İ.E.)		İ.E.1	Eğitimsiz Personel
		İ.E.2	Tecrübesiz Personel
		İ.E.3	Eksik Konsantrasyon ve Yorgun Personel



Şekil 2: *Kopan Halat Yaralanması Kazası Hata Ağacı*

yapılarak, uzman değerlendirmeleri sonucu elde edilen verilerin daha objektif olması sağlanır [8]. Bulanık hata ağacı analizi, denizciliğin de dahil olduğu pek çok disiplinler arası problemin çözümünde yaygın şekilde kullanılmaktadır [5-12]. Bulanık hata ağacı analiz işlemleri başlangıç olaylarının ayrıştırılması, olasılıkları bilinmeyen başlangıç olaylarının olasılık hesabı, uzmanların derecelendirilmesi, değerlendirilmelerin toplanması, bulanık sonuçların berraklaştırılması, berraklaştırılan sonuçların hata oranına dönüştürülmesi ve minimum kesme setlerinin ve tepe olayının hesaplanması aşamalarından oluşur.

2.2.1. Başlangıç Olaylarının Ayrıklaştırılması

Yöntemin ilk aşamasında meydana gelme olasılıkları bilinen başlangıç olayları ile meydana gelme olasılıkları geçmiş verilerle tespit edilemeyen başlangıç olaylarının ayrıştırılması yapılır. Bu çalışmada tespit edilen başlangıç olaylarının meydana gelme olasılıkları tespit edilemediği için tümü bulanık mantık yöntemi ile tespit edilmiştir.

2.2.2. Başlangıç Olaylarının Olasılıklarının Hesaplanması

Literatürde olasılıkları bilinmeyen olayların olasılık hesabı için genellikle istatistiksel yöntem, bilinene dayalı tahmin yöntemi veya uzman değerlendirmesi yöntemi kullanılır.

2.2.3. Başlangıç Olaylarının Ayrıklaştırılması

Her uzman için uzmanlık alanları, tecrübeleri, eğitim düzeyleri gibi kıstaslara bağlı olarak ağırlıklandırıp, özgün derecelendirmelerin gerçekleştirildiği aşamadır. Bu çalışmada heterojen uzman grubunun değerlendirmelerinden faydalanılmıştır. Heterojen uzman grubu uzmanların tümünün aynı meslekten olmadığı durum için kullanılır. Literatürde, konuya farklı yaklaşım açıları getirmesi nedeni ile heterojen uzman grubu daha avantajlı olarak değerlendirilmektedir.

2.2.4. Başlangıç Olaylarının Ayrıklaştırılması

Bu çalışmada Hsu ve Chen (1994) tarafından önerilen, uzmanların verdikleri

farklı sözel cevapların toplanarak tek bir cevap haline getirilmesi ve bulanık mantık yöntemine uygun formata dönüştürülmesi yaklaşımı uygulanmıştır.

Benzerlik derecesi: Her bir uzman görüşünün ("*R*") ikili benzerlik dereceleri "*S*" ile gösterilsin. E_u ve E_v uzmanlarının görüşlerinin (R_u ve R_v) benzerlik derecesi hesaplanacaktır. Bulanık mantık yönteminde uzmanların her bir ifadesi ise $\tilde{R}_u = (r_{u1}, r_{u2}, r_{u3}, r_{u4})$ ve $\tilde{R}_v = (r_{v1}, r_{v2}, r_{v3}, r_{v4})$ olarak ifade edilmektedir. $\tilde{R}_v = (r_{v1}, r_{v2}, r_{v3}, r_{v4})$ r_{u1}, r_{u2}, r_{u3} ve r_{u4} bulanık sayılar olarak da adlandırılan üyelik fonksiyonlarının uç noktalarını ifade etmektedir. *u* ve *v* uzmanlarının görüşlerinin benzerlik oranı Bağıntı 9'da gösterilmiştir.

$$S(\tilde{R}_u, \tilde{R}_v) = 1 - \frac{1}{4}\sum_{i=1}^{4} \left| r_{ui} - r_{vi} \right| \quad (9)$$

Benzerlik oranı için verilen $S(\tilde{R}_u, \tilde{R}_v) \in [0,1]$ bağıntısı bu oranın en çok 1 olabileceğini göstermektedir. Oranın 1 değeri alması durumunda uzmanların ifadelerinin aynı olduğu çıkarımı yapılır.

Ortalama benzerlik derecesi: Ortalama benzerlik derecesi (*AA*) tüm uzmanların ifadelerinin benzerlik derecesinin ortalaması anlamına gelir. "N" toplam uzman sayısını ifade etmektedir.

$$E_u (u = 1, 2, ..., N) \quad (10)$$

$$AA(E_u) = \frac{1}{N-1}\sum_{\substack{u \neq v \\ v=1}}^{N} S(\tilde{R}_u, \tilde{R}_v) \quad (11)$$

Bağıl ortalama benzerlik derecesi (*RA*): Her bir uzmanın, tüm uzmanların ifadelerine oranının göstergesidir. Bir başka deyişle, bir uzmanın ifadesinin diğer tüm uzmanların ifadeleri ile benzerlik derecesini ifade eder.

$$RA(E_u) = \frac{AA(E_u)}{\sum_{u=1}^{N} AA(E_u)} \quad (12)$$

Konsensüs Katsayısı: "w" uzmanların ağırlık derecelerini göstermektedir. β indirgeme katsayısı ($0 \leq \beta \leq 1$)olarak ifade edilir ve uzmanların ağırlıklandırma işlemi sonucunda kazandıkları derecelerin, karar verici tarafından artırılması veya azaltılmasını sağlamaktadır. Bu çalışma için β değeri 1 olarak hesaplamalara dahil edilmiştir.

$$CC(E_u) = \beta . w(E_u) + (1 - \beta) \cdot RA(E_u) \quad (13)$$

İfadelerin toplanması ($\tilde{R}_{AG}$):

$$\tilde{R}_{AG} = CC(E_1) \times \tilde{R}_1 + CC(E_2) \times \tilde{R}_2 + ... + CC(E_M) \times \tilde{R}_M \quad (14)$$

2.2.5. Bulanık Sonuçların Berraklaştırılması

Bu çalışmada, literatürde en çok kullanılan ağırlık merkezine göre berraklaştırma yöntemi uygulanmıştır. Berraklaştırılmış çıktı değeri *X**, üyelik fonksiyonlarının toplamı $\mu_i(x)$ ve çıktı değişkeni x.

$$X^* = \frac{\int \mu_i(x) x dx}{\mu_i(x)} \quad (15)$$

Yukarıda belirtilen berraklaştırma bağıntısı üçgen ve yamuk şeklindeki bulanık sayıları için kullanılmaktadır. Tüm bulanık sayılar için geçerli olan genel berraklaştırma işlemi Bağıntı 16' da verilmiştir.

$$X^* = \frac{\int_{r_1}^{r_2} \frac{x - r_1}{r_2 - r_1} x dx + \int_{r_2}^{r_3} x dx + \int_{r_3}^{r_4} \frac{r_4 - x}{r_4 - r_3} x dx}{\int_{r_1}^{r_2} \frac{x - r_1}{r_2 - r_1} dx + \int_{r_2}^{r_3} x dx + \int_{r_3}^{r_4} \frac{r_4 - x}{r_4 - r_3} dx} = \frac{1}{3} \frac{(r_4 + r_3)^2 - r_4 r_3 - (r_1 + r_2)^2 + r_1 r_2}{r_4 + r_3 - r_2 - r_1} \quad (16)$$

2.2.6. Berraklaştırılan Sonuçların Hata Oranına Dönüştürülmesi

Onisawa elde edilen bulanık sonuçların hata oranı (HO_0) için doğrudan kullanılamayacağını ve hata olasılığına (HO_1) dönüştürülmesi gerektiğini savunmuştur [32-34]. Buna göre, gerçeğe

yakın hata olasılıkları Bağıntı 17 ve Bağıntı 18'de belirtilen şekilde hesaplanmıştır.

$$HO_1 = \begin{cases} \frac{1}{10^K}, & HO_0 \neq 0 \\ 0, & HO_0 = 0 \end{cases} \quad (17)$$

$$K = \left[\left(\frac{1-CFP}{CFP}\right)\right]^{\frac{1}{3}} \times 2.301 \quad (18)$$

2.2.7. Minimum Kesme Setlerinin ve Tepe Olayının Hesaplanması

Tepe olayın (TO) meydana gelmesi için yeterli olan minimum sayıdaki başlangıç olayının kombinasyonları minimum kesme seti (*MCS*) olarak isimlendirilir. Her tepe olayının kendine özgü sayıda minimum kesme seti oluşmaktadır. Minimum kesme setlerinin meydana gelme olasılıkları ($P(MCS_i)$) ile tepe olayın meydana gelme olasılığı ($P(TO)$) arasındaki ilişki Bağıntı 19'da gösterilmiştir.

$$P(TE) = P(MCS_1 \cup MCS_2 \cup ... \cup MCS_N) = P(MCS_1) + P(MCS_2)$$
$$+...P(MCS_N) - (P(MCS_1 \cap MCS_2) + (P(MCS_1 \cap MCS_3)$$
$$+...(P(MCS_i \cap MCS_j)...)... + (-1)^{N-1} P(MCS_1 \cap MCS_2 \cap ... \cap MCS_N) \quad (19)$$

3. Kopan Halat Yaralanması Bulanık Hata Ağacı Uygulaması

Bu çalışmada kopan halat yaralanma kazası olayına bulanık mantık yaklaşımı ile hata ağacı uygulaması, tanker terminal bağlama operasyonlarında görevli gemi ve sahil çalışanlarından oluşan 10 kişilik uzman grubuna danışılmak sureti ile gerçekleştirilmiştir. Hata ağacında yer alan başlangıç olaylarının tepe olayının meydana gelmesi üzerindeki etkilerini tespit etmek amacı ile uzman grubuna danışılmış olup, uzman değerlendirmelerine bulanık mantık yöntemi uygulanmıştır.

3.1. Bulanık Halat Ağacı Uygulamasında Uzmanların Ağırlıklandırılması

Bulanık mantık yönteminin uygulanması aşamasında değerlendirmeleri yapan uzmanlar mesleki yeterlilikleri, operasyon tecrübeleri ve eğitim düzeyleri dikkate alınarak ağırlıklandırılmıştır. Böylece her uzmanın verdiği sözel cevapların aynı etkiye sahip olmaması sağlanarak, sübjektif etki minimize edilmeye çalışılmıştır. Uzman ağırlıklandırma parametreleri ve her bir parametrenin uzman ağırlık değerine etkisi Tablo 2'de gösterilmiştir. Kopan halat yaralanması kazasını değerlendiren uzmanların ağırlıklandırma değerleri ise Tablo 3'te gösterilmiştir.

2 ve 8 numaralı uzmanlar % 13 oranında ağırlık değeri ile en yüksek oranda ağırlık değerine sahip iki uzman olarak tespit edilmiştir. Dolayısı ile bulanık hata ağacı hesaplamalarında bu iki uzman tarafından yapılmış olan değerlendirmeler en yüksek etkiye sahip olmuştur.

Tablo 2. *Uzman Ağırlıklandırma Parametreleri ve Puanlama Değerleri*

Parametreler	Sınıflandırma	Puanlama
Mesleki Yeterlilik	Kılavuz Kaptan	5
	Gemi Kaptanı	4
	Terminal Operasyon Sorumlusu (TOS)	3
	2. Kaptan	2
	Personel	1
Operasyon Tecrübesi (yıl)	≥16	5
	11 – 15	4
	6 – 10	3
	3 – 5	2
	≤ 2	1
Eğitim Düzeyi	Doktora	5
	Yüksek Lisans	4
	Lisans	3
	Ön Lisans	2
	Orta Öğretim	1

Tablo 3. *Halat Yaralanma Kazasını Değerlendiren Uzmanların Ağırlıklandırması*

Uzman Numarası	Mesleki Yeterlilik	Operasyon Tecrübesi (yıl)	Eğitim Düzeyi	Ağırlık Faktörü	Ağırlık (w)
1	2. Kaptan	3-5	Doktora	9	0,09
2	Gemi Kaptanı	6 – 10	Doktora	12	0,13
3	2. Kaptan	3-5	Yüksek Lisans	8	0,08
4	Kılavuz Kaptan	6 – 10	Lisans	11	0,12
5	TOS	3 – 5	Lisans	8	0,08
6	Personel	≥ 16	Orta Öğretim	7	0,07
7	2. Kaptan	6-10	Lisans	8	0,08
8	Kılavuz Kaptan	11 – 15	Lisans	12	0,13
9	Gemi Kaptanı	6 – 10	Yüksek Lisans	11	0,12
10	TOS	11 - 15	Ön Lisans	9	0,09

3.2. Bulanık Hata Ağacı Uygulama Sonuçları

Bulanık mantık yönteminin uygulanması hesaplanmış değerleri Tablo 4' te paylaşılmıştır. Yapılan hesaplamalar sonucunda tepe olayının yani "Kopan Halat Yaralanma Kazası" olayının meydana gelme olasılığı 0,0479 olarak tespit edilmiştir. Bu da her 100 tanker terminal bağlama operasyonunda yaklaşık olarak 5 kopan halat yaralanması kaza potansiyelinin olduğunu gösterir.

Tablo 4. *Başlangıç Olaylarının Hesaplanmış Hata Oranları*

Başlangıç Olayı	Hesaplanmış Değerler	Başlangıç Olayı	Hesaplanmış Değerler
Y.Pl.1	0,006294283	İ.E.3	0,02788049
Y.Pl.2	0,007332459	Y.Pr.1	0,0111209
Y.Pl.3	0,00998467	Y.Pr.2	0,0075971
Y.Pl.4	0,012957697	Y.Pr.3	0,000090
Y.Pl.5	0,01118467	Y.Pr.4	0,00025
Y.Pl.6	0,00787393	Y.Pr.5	0,0181778
E.D.1	0,019847437	Y.Pr.6	0,0119466
E.D.2	0,011525135	Y.Pr.7	0,0091587
E.D.3	0,010106613	Y.Pr.8	0,0002214
E.D.4	0,023912295	P.İ.1	0,0140531
E.D.5	0,018484234	P.İ.2	0,0304606
E.D.6	0,010457345		

Tablo 4'te hesaplanmış değerleri verilmiş olan başlangıç olaylarından tepe olayının oluşmasında en etkili olanı, "Prosedür İhlali" ara olayını meydana getiren başlangıç olaylarından 0,0304606 değeri ile "Eğitimsizlik" olduğu saptanmıştır. En etkili olduğu saptanan diğer başlangıç olayları ise "İnsan Etkisi" ara olayını meydana getiren başlangıç olaylarıdır. Elde edilen sonuçlara göre "Kopan Halat Yaralanma Kazası" tepe olayının gerçekleşmesinde en etkili başlangıç olaylarının doğrudan veya dolaylı olarak insan kaynaklı olduğu görülmüştür.

3.3. Bulanık Hata Ağacı Uygulamasında Minimumum Kesme Setleri

Yüksek olasılık değerine sahip olan başlangıç olayları ve tepe olayının, en kısa yoldan meydana gelmesine vesile olması sebebi ile minimum kesme setlerinin tespit edilmesi ve değerlendirilmesi önem arz etmektedir. Meydana gelme olasılıkları en yüksek olan ilk 20 minimum kesme setine ait olasılık değerleri ve tepe olayı riskinin hesaplanan değeri Tablo 5'te verilmiştir.

Oluşturulan hata ağacında "Kopan Halat Yaralanması" tepe olayına sadece "kopan halatın personele çarpması" ara olayı ile "halatın kopması" ara olayı "ve" kapısı ile bağlı olduğundan bu iki ara olayı oluşturan başlangıç olaylarından birer

Tablo 3. *Halat Yaralanma Kazasını Değerlendiren Uzmanların Ağırlıklandırması*

Başlangıç Olayı	Hesaplanmış Değerler	Başlangıç Olayı	Hesaplanmış Değerler
Y.Pr.5*Y.Pl.1	0,000114416	İ.E.2*E.D.4	0,000574795
Y.Pr.5*Y.Pl.2	0,000133288	İ.E.2*E.H.3	0,000573037
İ.E.3*P.İ.2	0,000849257	E.D.5*P.İ.2	0,000563041
İ.E.2*P.İ.2	0,000732202	Y.Pr.5*P.İ.2	0,000553706
İ.E.3*İ.E.1	0,000730599	İ.E.3*Ez.Ç.F.1	0,000550247
İ.E.3*E.D.4	0,000666686	E.D.1*İ.E.1	0,000520095
İ.E.3*E.H.3	0,000664647	İ.E.2*İ.A.3	0,000495944
İ.E.2*İ.E.1	0,000629898	E.D.5*İ.E.1	0,000484373
E.D.1*P.İ.2	0,000604565	Y.Pr.5*İ.E.1	0,000476342
İ.E.3*İ.A.3	0,000575229	E.D.1*E.D.4	0,000474598
Tepe olay risk değeri: 0,0479			

tanesi minimum kesme seti oluşması için yeterli olmuştur. Dolayısı ile yüksek olasılık değerine sahip olan başlangıç olaylarının meydana getirdiği minimum kesme setlerinin tepe olayının oluşmasındaki etkisi daha yüksek olmuştur. Bu çalışmada tepe olayına etkisi en yüksek olan minimum kesme setini "Eğitimsizlik" ile "Eksik konsantrasyon ve yorgun personel" başlangıç olaylarının oluşturduğu tespit edilmiştir. "Eğitimsizlik" başlangıç olayının meydana gelme sıklığı hizmet içi eğitim uygulamaları ve bağlama operasyonları ile ilgili eğitim değerlendirme standartlarının uluslararası kural koyucular tarafından belirlenerek uygulatılması olarak belirlenmesi sureti ile minimize edilebilir. ile "Eksik konsantrasyon ve yorgun personel" başlangıç olayının meydana gelme sıklığı ise personel çalışma saatlerinin ILO (Uluslararası Çalışma Örgütü) standartlarına uygun olması ve denetlenmesi ve personel motivasyonunu artıracak iş ve yaşam standartlarının sağlanması sureti ile minimize edilebilir. Bu faaliyetler gerçekleştirildiği takdirde kaza riski azaltılmış olur.

4. Sonuç

Kopan halat yaralanması kazasının kök sebeplerinin incelendiği bu çalışma, bulanık hata ağacı analizi yöntemi ile gerçekleştirilmiştir. Kopan halat yaralanması kazalarında insan kaynaklı hataların yoğunlukta olduğu tespit edilmiştir. Dolayısı ile kopan halat yaralanma kazası riskinin azaltılabilmesi için öncelikle "Eğitimsizlik" ve "Eksik Konsantrasyon ve Yorgun Personel" başlangıç olaylarının üzerine gidilmesi ve düzeltici faaliyetlerin geliştirilmesi gerekliliği sonucu çıkarılmıştır.Bu çalışma ile tanker terminal bağlama operasyonu yönetim paydaşları olan gemi kaptanlarına, kılavuz kaptanlara ve terminal bağlama operasyonu sorumlularına kopan halat yaralanması kazası riskine neden olan tüm kök sebepleri bir arada görerek kontrol altında tutabilmeleri yönünde sistematik bir yaklaşım sunulmuştur. Bu çalışmada bağlama operasyonları tanker-terminal bağlama operasyonları ile sınırlandırılmıştır. Dolayısı ile tanker dışındaki gemilerde ve rıhtım dışında gerçekleştirilen, şamandıra bağlama operasyonu, gemi-gemi bağlama operasyonu gibi, bağlama operasyonları için kullanılması uygun değildir. İlerleyen çalışmalarda, kopan halat yaralanma kazası risk değerinin yok edilmesi ya da kabul edilebilir risk değerlerine indirgenebilmesi amacıyla risk kontrol seçeneklerinin belirleneceği ve bunların

fayda maliyet analizinin yapılacağı bir çalışma da yapılacaktır. Ayrıca tankerlerin rıhtım bağlama operasyonları dışında kalan bağlama operasyonlarını da içine alan bir çalışma yapılacaktır. Bu sayede alınacak önlemlerin getireceği maliyetlerin ve buna karşılık kopan halat yaralanması kazası riskinin azaltılmasına yönelik elde edilecek faydaların karşılaştırılabilmesi için operasyon yönetim paydaşlarına karar desteği sağlanmış olacaktır.

Çalışmada kullanılan Hata Ağacı Analizi yönteminin bazı zafiyetleri bulunmaktadır. Bunlar; oldukça ayrıntılı ve genelde zaman alıcı olması, analizcinin yaklaşımına göre aynı olay için özellikle şeklen farklılık gösterebilmesi, ayrıntılı teknik bilgi ve dokümana ihtiyaç duyulması ve olaylar arasındaki ilişkinin yalnızca alt-üst olaylar arasında gerçekleştirilebilmesi olarak sıralanması mümkündür. İlerleyen çalışmalarda belirtilen bu zayıf yönlerin en aza indirgendiği, olaylar arasındaki hiyerarşik ilişkinin yalnızca alt-üst yönlü değil aynı zamanda yatay seviyede de kurgulanmasına imkan veren Bayesian Network yöntemi veya alternatif olarak hataları olasılıklarına ve benzerliklerine göre sıralayarak sistemlerin potansiyel hata türlerini analiz eden Hata Modu ve Etkileri Analizi (FMEA) yöntemi ile yaralanmalı halat kazası riskinin hesaplaması yapılacaktır.

Kaynaklar

[1] IMO (International Maritime Organisation) (1997). Interim guidelines for the application of formal safety assessment to the IMO Rulemaking process. MSC circular 829.

[2] IMO (2000). Decision parameters including risk acceptance criteria. Submitted by Norway. MSC circular 72/16. Retrieved from: http://research.dnv.com/skj/FsaLsaBc/MSC72-16.pdf

[3] IMO (2002, 2004, 2006, 2013). Guidelines for Formal Safety Assessment (FSA) for use in the IMO Rule-Making Process. MSC circular 1023/MEPC/Circ.392.

[4] Senol, Y. E., Aydogdu, Y. V., Sahin, B., & Kilic, I. (2015). Fault tree analysis of chemical cargo contamination by using fuzzy approach. Expert Systems with Applications, 42(12), 5232-5244.

[5] Uğurlu, Ö., Köse, E., Yıldırım, U., & Yüksekyıldız, E. (2015). Marine accident analysis for collision and grounding in oil tanker using FTA method. Maritime Policy & Management, 42(2), 163-185.

[6] Kum, S., & Sahin, B. (2015). A root cause analysis for Arctic Marine accidents from 1993 to 2011. Safety science, 74, 206-220.

[7] Turan, O., Öiçer, A. İ., & Martin, P. L. (2003, March). Risk assessment of loss of life for fishing vessels in fuzzy environment. In Safety and reliability (Vol. 23, No. 2, pp. 19-38). Taylor & Francis.

[8] Senol, Y. E., & Sahin, B. (2016). A novel real-time continuous fuzzy fault tree analysis (RC-FFTA) model for dynamic environment. Ocean Engineering, 127, 70-81.

[9] Mentes, A., & Helvacioglu, I. H. (2011). An application of fuzzy fault tree analysis for spread mooring systems. Ocean Engineering, 38(2-3), 285-294.

[10] Pan, N. F. (2006). Evaluation of building performance using fuzzy FTA. Construction Management and Economics, 24(12), 1241-1252.

[11] Yuhua, D., & Datao, Y. (2005). Estimation of failure probability of oil and gas transmission pipelines by fuzzy fault tree analysis. Journal of loss prevention in the process industries, 18(2), 83-88.

[12] Mao, G. Z., Tu, J. W., & Du, H. B. (2010, October). Reliability evaluation based on fuzzy fault tree. In Industrial Engineering and Engineering Management (IE&EM), 2010 IEEE 17Th International Conference on (pp. 963-966). IEEE.

[13] Flory, J.F. & Ractliffe, A. (1994). Mooring arrangement management by computer, Ship Operations, Management and Econommics Symposium, New York, USA: Merchant Marine Academy.

[14] Das, S.N., Kulkarn, S., & Kudale, M. D. (2015). Design of safe mooring arrangement for large oil tankers, Procedia Engineering 116 (2015) 528 – 534.

[15] Kudale, A., Vidula, Sohoni V., & Sadhana, Kulkarni S. (2016). Mooring System for Very Large Ships at Berth, International Journal of Current Engineering and Technology, Vol.6(4), 163-171.

[16] Shi, X.Y., Zhang N.C., Chen, C.B., Jiang, H.Z., Cui, L. (2014). Experimental Study of characteristics of motions of a large mooring ship in long-period waves. Journal of Marine Science and Technology, Vol. 22, No. 2, pp. 240-246.

[17] Prpic-Orsic, J., Slapnicar, V., Turk, A. (2014). Berth operability estimation related to ship motion. Transactions of FAMENA, Vol.38 No.1, pp 13-24.

[18] Yetkin, M. (2014). Tanker Şamandıra Baülama Sistemlerinin Yapay Sinir Ağları Tekniğiyle Optimizasyonu. (Yüksek Lisans Tezi). İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

[19] Molen, van der W., Scott,D., Taylor, D. & Elliot, T. (2015). Improvement of mooring configurations in Geraldton Harbour. Journal of Marine Science and Engineering. 2016; 4(1):3.

[20] Sluiskes, B. (2016). Safety in Mooring. Terra et Aqua Number 143, pp.14-19. Retrieved from:https://www.iadcdredging.com/ul/cms/terraetaqua/document/4/8/5/485/485/1/article-safety-in-mooring-143-2.pdf.

[21] UK P&I Club (2009). Understanding Mooring Incidents. Retrieved March 14, 2017 from:https://www.ukpandi.com/fileadmin/uploads/ukpi/LP%20Documents/LP_Reports/UnderstandingMooringIncidents.pdf.

[22] NNPC (2015). Preventing accident during (un)mooring opertions. Noord Nederlandsche P&I Club. Retrieved from: http://www.nnpczeevaart.nl/hst/n07n06p/nnpc.nsf/0/B3012021C8574AB3C1257E6600360E70 / $FILE/NNPC_MOORING_ENG_LR.pdf.

[23] OCIMF (2008). Mooring Equipment Guidelines, 3rd Edition. Oil Companies International Marine Forum.

[24] IMO (2005a). Guidance on shipboard towing and mooring equipment. MSC circular 1175.

[25] DMA (2006). Safety Study from the division for investigation of maritime accidents, Danish Maritime Authority. Mooring accidents on board merchant ships between 1997-2006.

[26] Antao, P. & Soares, C., G. (2006). Fault-tree models of accident scenarios of RoPax vessels. International Journal of Automation and Computing, 3(2):107-116.

[27] Chen, P., Mou, J. & Li, Y. (2015). Risk analysis of maritime accidents in an estuary: a case study of Shenzhen Waters, Scientific Journals of the Maritime University of Szczecin 42 (114), 54–62.

[28] Larsen F., W. (1974). Fault Tree Analysis Technical Report 4556. Retrieved from: http://www.dtic.mil/dtic/tr/fulltext/u2/774843.pdf

[29] Dhillon, B.S. (2008). Mining equipment reliability, maintainability, and safety, Doi.org/10.1007/978-1-84800-288-3.
[30] Zadeh, L. A. (1965). Information and control. Fuzzy sets, 8(3), 338-353.
[31] Ford, D. Sterman, J. D. (1998). Expert knowledge elicitation to improve mental and formal models. System Dynamics Review, 14(4), 309-340, doi:10.1002/(SICI)1099-1727(199824)14:4<309.
[32] Onisawa, T. Nishiwaki, Y. (1988). Fuzzy human reliability analysis on the Chernobyl accident. Fuzzy Sets and Systems, 28(2), 115-127, doi: 10.1016/0165-0114(88)90194-7 .
[33] Onisawa, T. (1990). An application of fuzzy concept to modelling or reliability analysis. Fuzzy Sets and Systems, 37(3), 267-286, doi:10.1016/0165-0114(90)90026-3.
[34] Onisawa, T. (1996). Subjective analysis of system reliability and its analyzer. Fuzzy Sets and Systems, 83(2), 249-269, doi:10.1016/0165-0114(95)00381-9.

This Page Intentionally Left Blank

Received: 10 April 2017 Accepted: 3 May 2018 *DOI ID: 10.5505/jems.2018.64326*

Journal of ETA Maritime Science JEMS JOURNAL

Corresponding Author: Esra BARAN

How Demographic Factors Affect Job Satisfaction in Shipping Agencies?: A Research Through İzmir-Based Liner Shipping Agencies*

Esra BARAN, Gamze ARABELEN

Dokuz Eylül Üniversitesi, Denizcilik Fakültesi, Türkiye
esra.baran@deu.edu.tr; ORCID ID: https://orcid.org/0000-0002-2235-5617
gamze.arabelen@deu.edu.tr; ORCID ID: https://orcid.org/0000-0001-5280-7875

Abstract

In the globalization and severe competitive environment, especially service organizations in maritime industry can survive only if they offer better services via their employees. High-performance of employees can lead them to organizational success and improve their competitiveness. So as service providers, the employees' satisfaction and motivations become more important in service organizations. This paper aims to measure the job satisfaction level of employees in liner ship agencies operating in İzmir. In addition, whether the job satisfaction levels differ according to demographic characteristics is investigated. In order to reach the aim of the research, as a quantitative research method, the survey method has been used. Collected data have been analyzed by SPSS 20.0 and Amos software programs. The research findings have revealed that the less satisfied items are compensation and advancement, and the more satisfied items are job security and co-worker items. And also, some differences have been observed between demographic characteristics of respondents and their job satisfaction. This research is thought to have a contribution to liner shipping sector and the literature related to the subject.

Keywords: *Job Satisfaction, Ship Agency, Liner Shipping, Demographic Factors, Quantitative Research.*

Gemi Acentelerinin İş Tatminini Demografik Faktörler Nasıl Etkiliyor?: İzmir Bazlı Tarifeli Hat Gemi Acenteleri Üzerine Bir Araştırma

Öz

Küreselleşme ve ciddi rekabet ortamında, özellikle denizcilik endüstrisindeki hizmet işletmeleri, çalışanlarının daha iyi hizmet sunmaları durumunda hayatta kalabilir. Yüksek performanslı çalışanlar işletmelerin örgütsel başarıya ulaşmalarını sağlayabilir ve rekabet edebilirliklerini artırabilir. Dolayısıyla hizmet sağlayıcılar olarak çalışanların tatminleri ve motivasyonları hizmet işletmelerinde daha da önem kazanmaktadır. Bu çalışma, İzmir'de faaliyet gösteren tarifeli gemi acentelerinin çalışanlarının iş tatmini seviyelerini ölçmeyi amaçlamaktadır. Ayrıca, iş tatminlerinin demografik özelliklerine göre farklılık gösterip göstermediği araştırılmaktadır. Araştırmanın amacına ulaşmak için nicel bir araştırma yöntemi olarak anket yöntemi kullanılmıştır. Elde edilen veriler SPSS

* This research was compiled from one part of the master's thesis entitled "The Effect of Internal Marketing on Job Satisfaction: A Research on Ship Agencies" completed in Dokuz Eylül University Graduate School of Social Sciences.

To cite this article: Baran, E.. and Arabelen, G. (2018). How Demographic Factors Affect Job Satisfaction in Shipping Agencies?: A Research Through İzmir-Based Liner Shipping Agencies. *Journal of ETA Maritime Science*, 6(3), 229-242.
To link to this article: https://dx.doi.org/10.5505/jems.2018.64326

20.0 ve Amos yazılım programları ile analiz edilmiştir. Araştırma bulguları, katılımcılara göre daha az tatmin olunan değişkenlerin ücret ve terfi olduğunu ve daha fazla tatmin olunan değişkenlerin iş güvenliği ve çalışma arkadaşları olduğunu ortaya koymaktadır. Ayrıca, katılımcıların demografik özellikleriyle iş tatminleri arasında bazı farklılıklar gözlemlenmiştir. Sonuç olarak, bu araştırma tarifeli gemi acenteleri sektörüne ve ilgili yazına katkı sunmaya çalışmaktadır.

Anahtar Kelimeler: *İş Tatmini, Gemi Acenteciliği, Tarifeli Hat Taşımacılığı, Demografik Faktörler, Nicel Araştırma.*

1. Introduction

There is a common agreement that job satisfaction is the most widely studied topic in the organizational behavior, organizational psychology, human resource management, and other related disciplines [2, 12, 26, 31, 43]. Also, there are considerable number of studies about the relation of job satisfaction with sales force and service quality from the marketing view [6, 8, 27, 41].

Job satisfaction has important influences both on the organizations and the employees. The employees spend most of their times at work, and because of that reason, their happiness and mental well-beings are affected by their satisfaction from the job they do and this reflects to their social life [12, 30, 31, 36]. In the literature, the employees are regarded as the most valuable assets of the organizations, because the satisfied employees can rise the organization to success. For this reason, the organizations must give significant importance to their employees' satisfaction levels in order to reach success.

In the international business context, intermediaries play various vital tasks in facilitating international trade such as legal advice, market research, sales and after-sales services, logistical arrangements etc. [1]. In international maritime trade, ship operators get some supporting, supplementary and facilitating services from the intermediaries such as ship agents, freight forwarders, and ship brokers. Intermediaries in the shipping sector offer very important services in order to maintain the high quality, effective, economical, safe and secure logistics, and maritime transport services. In liner shipping, the intermediaries in the distribution channel include the ship agents and freight forwarders [10]. The main goal of the ship agent is to protect the ship's and the owner's benefits to complete the ship operations with maximum efficiency and minimum cost [11, 24]. Ship agents have crucial responsibilities in the effective maritime service offering and the satisfaction levels of employees as service providers are highly important. Therefore, the research questions of this research are:

- What are the satisfaction levels of the liner ship agency employees toward their job?
- How do demographic factors affect liner ship agencies' job satisfaction levels?

This research consists of six parts. Following the introduction part, the first part reviews the literature related to job satisfaction. The third part focuses on the methodology of the research. The hypotheses of the research are tested and the findings of the research are highlighted in the fourth part, and then the conclusions and discussion are provided. Finally, limitations and further research recommendations are given.

2. Literature Review

There are many definitions of job satisfaction given by different researchers. The main point of the definitions is the affective or emotional reactions of the employees towards their jobs. Hoppock [17] defined the job satisfaction as "any combination of psychological, physiological, and environmental circumstances that causes a person truthfully to say 'I am satisfied with my job'". According to Smith [39] job satisfaction is "an effective

response of the worker to his job. It is viewed as a result or consequence of the worker's experience on the job in relation to his own values, that is, to what he wants or expect from it". Locke's definition is "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" [25]. Job satisfaction is defined by Spector [43] as "simply how people feel about their jobs and different aspects of their jobs. It is the extent to which people like (satisfaction) or dislike (dissatisfaction) their jobs".

Various theories have been developed to explain factors that affect the employee motivation and satisfaction. The theories related to job satisfaction are called as 'Motivation Theories' and classified in two main headings which are 'content theories' focusing on internal factors (i.e. personal needs and wants) and 'process theories' focusing on external factors (i.e. incentives and rewards) [21]. Content theories are Maslow's Hierarchy of Needs, Herzberg's Two Factor Theory, McClelland's Need Theory and Alderfer's ERG Theory. Process theories consist of Vroom's Expectancy Theory, Porter and Lawler Expectancy Theory, Adam's Equity Theory and Locke's Goal Setting Theory.

There are various factors that affect the satisfaction level of employees in the organization, some of them are environmental (organizational) factors and some of them are individual (personal) factors. According to Spector [42], there are nine determinants of job satisfaction which are pay, promotion, supervision, benefits, rewards, operating procedures, coworkers, nature of work, and communication. Smith et al. [40] developed a scale to measure the job satisfaction level and presented five factors (nature of the work, pay, supervisors, coworkers, and promotion) of job satisfaction. The factors affecting job satisfaction and dissatisfaction are categorized under four headings which are personality, values, work situations, and social influences [12].

The work itself and its features such as challenging, interesting, tiring, routine/ monotone etc. influence satisfaction of employees positively or negatively. The employees who find their jobs interesting will be more satisfied than employees who find their jobs tiring or unexciting etc. [12, 26, 30]. Group dynamics and cohesiveness between co-workers positively influence the motivation and satisfaction of them [26, 36]. The supports given by supervisors increase the employees' satisfaction with their jobs. The management style of the organization and leadership style of managers are powerful determinants of employees' job satisfaction [2, 28, 31, 44]. Physical working conditions and working hours are another determinant of job satisfaction level. In order to satisfy their employees, organizations try to ensure safer and more comfortable working areas, and provide all necessary technical and equipment support for their employees [14, 31, 34].

The salaries and compensation provided to employees are considered to be important factors affecting their job satisfaction levels and also result in employee attraction and retention [20, 26]. Promotion and career development opportunities are important to motivate and satisfy the employees with their job [31, 34]. Job security is another determinant of job satisfaction. There is a positive correlation between satisfaction with job security [4, 47].

Besides the organizational factors, there are individual factors such as demographic variables that affect job satisfaction level. Employees with different individual characteristics have different satisfaction feelings from their jobs. The demographic characteristics generally discussed in the studies are; age, gender, education level, experience, occupational position, working years. In the literature review it is seen that

there are many studies in various sectors such as; education [9, 18, 48, 64], health/ hospital [15, 19, 29, 58], hotel [33, 38, 51, 59], public [7, 50], bank [46, 61], finance [60], textile [52], telecommunication [63], insurance [61], fisheries and aquaculture [55] which are examining the differences in job satisfaction level according to demographic variables. The review of the relevant literature has shown that the findings of the studies are different from each other. While some studies have indicated that job satisfaction is positively or negatively affected by some demographic variables, in other studies no relationship is found. For example; three different views on the relationship between age and job satisfaction have been discussed. First, as age gets older, job satisfaction will increase. Second view is; there is a U-shaped relationship between age and satisfaction. The third one is; the level of job satisfaction increases to a certain point depending on the age level and starts to decrease after this point [52]. Sauser and York [57] indicate in their study that while some studies have found that males are more satisfied, some have found that females are more satisfied. However, another study has found no relationship between the gender and job satisfaction [35].

Based on the literature, in order to investigate the difference between the demographic characteristics of liner ship agent employees and their job satisfaction level, the following hypotheses were developed:

H_1: There is a significant difference between demographic characteristics of respondents and their job satisfaction.

H_{1-1}: There is a significant difference between gender and job satisfaction.

H_{1-2}: There is a significant difference between age and job satisfaction.

H_{1-3}: There is a significant difference between education level and job satisfaction.

H_{1-4}: There is a significant difference between department and job satisfaction.

H_{1-5}: There is a significant difference between position/title and job satisfaction.

H_{1-6}: There is a significant difference between sector experiences and job satisfaction.

H_{1-7}: There is a significant difference between working year in organization and job satisfaction.

3. Methodology

In this part, the model and sample of the research, data collection and analysis procedures will be detailed. The conceptual model of the research is presented in Figure 1.

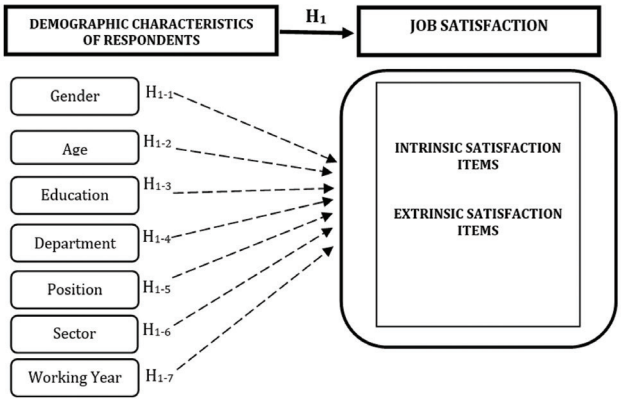


Figure 1. *Conceptual Model of the Research*

3.1. Measurement

The questionnaire form of this research consists of two parts. In the first part, there are 8 nominal and open-ended questions related to profile characteristics of the respondents. In the second part, the short form Minnesota Satisfaction Questionnaire (MSQ) developed by Weiss et al. [45] was used with 5-point Likert scale. According to study of [32], the mostly used job satisfaction scale is MSQ in both master and doctorate thesis (in the field of Business Administration).

For the original English short form MSQ items, the translation by Baycan (1985) [5] which is mostly used in the Turkish literature was used. Then all items in the questionnaire were controlled by an academician who is expert in English and necessary adjustments were revised. A pilot test was carried out with 12 people from academicians and managers in the agency sector in order to identify any possible errors in the questionnaire, control of the content and face validity and determine the average response time of the questionnaire. According to feedback received from managers and academicians, the final version of the questionnaire was arranged.

3.2. Sample and Data Collection

The office employees of container line agents in İzmir were determined as the sample of this research by judgmental and convenience sampling which is non-probability sampling method. In order to identify the sample, the list of ship agents registered in İzmir Chamber of Shipping was obtained from the İzmir branch of IMEAK Chamber of Shipping. To obtain the permission to carry out the survey, telephone interviews were made with the managers or employees in these container line agents. 11 of container line agents accepted to help for survey application. The average total number of office employees in these 11 container line agents were determined as 279. Total 157 questionnaire forms were returned by 56,2 % response rate. 14 questionnaire forms were excluded from the research as they were not suitable for the analysis.

3.3. Data Analysis Procedures

For the analysis of the collected data from the survey, IBM SPSS and Amos statistics programs were used. For the profile of the respondents and job satisfaction items, descriptive statistics were carried out. Confirmatory factor analysis was performed. In order to test the hypotheses of the research, T-test and one-way ANOVA were used.

4. Findings

The descriptive statistics (frequency and percentage) of the respondents' profile are given in Table 1. When the education levels of the respondents were analyzed, it was seen that most of the respondents have a bachelor degree. As the departments of respondents, it was observed that the majority of the respondents are from sales and marketing department and documentation department.

The most common method used to measure the reliability is the Cronbach's Alpha value which describes the reliability of internal consistency [3]. Cronbach's Alpha value which is 0.7 and above is generally accepted in the literature. Cronbach's Alpha coefficient value for the job satisfaction scale, which consists of total 20 items, is 0,923. Therefore, the scale has considerably high-level reliability.

Descriptive statistics were used in the evaluation of the respondents' satisfaction level for the job satisfaction items and the results are presented in Table 2.

It is seen that 'job security' and 'co-workers' items have the highest mean values. 42,7 percent of the respondents are very satisfied and 46,2 percent of

Table 1. *Profile of the Respondents*

Gender	F	%	Age	F	%
			24-29	52	36,4
			30-35	49	34,3
Male	83	58,0	36-41	28	19,6
Female	60	42,0	42-47	9	6,3
			More than 47	5	3,5
TOTAL	*143*	*100,0*	*TOTAL*	*143*	*100,0*
Education Level	**F**	**%**	**Department**	**F**	**%**
			Vessel Operation	6	4,2
			Documentation	37	25,9
High School	7	4,9	Sales and Marketing	41	28,7
Associate Degree	7	4,9	Finance & Accounting	12	8,4
Bachelor Degree	113	79,0	Export & Import Operation	20	14,0
Master Degree	16	11,2	Container Management and Control	8	5,6
			Customer Services	12	8,4
TOTAL	*143*	*100,0*	Foreign Accounts	7	4,9
			TOTAL	*143*	*100,0*
Title/Position				**F**	**%**
Assistant Specialist				52	36,4
Specialist				36	25,2
Customer Representative				18	12,6
Sales Responsible				13	9,1
Team Leader				7	4,9
Assistant Department Supervisor				3	2,1
Department Supervisor				14	9,8
TOTAL				*143*	*100,0*
Experience in the Sector	**F**	**%**	**Working Year**	**F**	**%**
Less than 1 year	8	5,6	Less than 1 year	18	12,6
1-4 years	51	35,7	1-4 years	60	42,0
5-9 years	32	22,4	5-9 years	27	18,9
10-14 years	24	16,8	10-14 years	23	16,1
15 years and more	28	19,6	15 years and more	15	10,5
TOTAL	*143*	*100,0*	*TOTAL*	*143*	*100,0*

Table 2. *Descriptive Statistics of Job Satisfaction Items*

Job Satisfaction Items	Mean	Standard Deviation	Job Satisfaction Items	Mean	Standard Deviation
Activity	3,5455	,95480	Ability utilization	3,5594	1,04560
Independence	3,4755	1,06038	Company policy & practices	3,3497	1,09582
Variety	3,3287	1,07321	Compensation	2,7203	1,11586
Social status	3,7902	,99897	Advancement	3,0559	1,20314
Supervision-human relations	3,6643	1,19237	Responsibility	3,8741	,86291
Supervision-technical	3,6294	1,19670	Creativity	3,7063	,98462
Moral values	3,8951	,90937	Working conditions	3,7413	,93231
Job security	4,2867	,73755	Co-workers	4,0070	,97502
Social service	3,5664	1,00393	Recognition	3,4685	1,05353
Authority	3,5455	,93242	Achievement	3,8881	,90464

the respondents are satisfied with their job security ($\bar{X}$:4,2867). None of the respondents is very dissatisfied with this item. The 'co-workers' item has 4,0070 mean value; therefore, it can be said that the respondents are satisfied with their co-workers in their organization. 32,9 percent of the respondents are very satisfied and 46,2 percent of the respondents are satisfied with the way their co-workers get along with each other.

The lowest mean values belong to the 'compensation' and 'advancement' items. 18,9 percent of the respondents are very dissatisfied and 21,7 percent of the respondents are dissatisfied with their pay and amount of work they do. Only 2 respondents are very satisfied with their pay and the compensation item has 2,7203 mean value. 23,1 percent of the respondents are dissatisfied and 12,6 percent of the respondents are very dissatisfied with their chances for advancement on their jobs. The mean value for advancement item is 3,0559.

In order to investigate the validity and model fit of the scale, confirmatory factor analysis (CFA) was applied. Some necessary modifications and improvements were made in the model. Standardized parameter estimates of CFA model are provided in Figure 2. Three variables were excluded from the model since their factor scores were not sufficient. In addition, covariance between the error terms of some variables were found and included in the model.

Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) are the most widely reported fit indices which values above 0,90 are usually associated with a model that fits well. Root mean square of error approximation (RMSEA) value is regarded as acceptable between the values of 0,03 and 0,08. Standardized root mean square residual (SRMR) need to be less than 0,08 value [53]. There are two different views regarding to acceptable values for $\chi 2/DF$ such as less than 2 or less than 5 [54]. The $\chi 2$ is 209,858 with 114 degrees of freedom ($p < 0,05$), and $\chi 2/DF$ is 1,841. In the model, TLI is 0,913, CFI is 0,927, SRMR is 0,0585 with a RMSEA of 0,077. All of these indices are within the range that would be

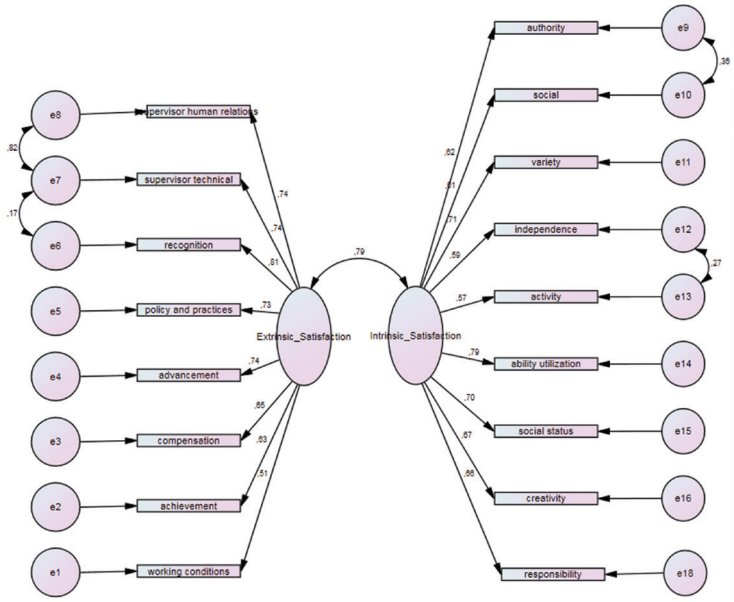


Figure 2. *The Results of Confirmatory Factor Analysis*

associated with good fit (see Table 3). The composite reliability (CR) value is 0,882 for extrinsic satisfaction and 0,872 for intrinsic satisfaction factor.

Table 3. *Goodness-of-Fit Indices for CFA*

χ^2	DF	P	χ^2/DF
209,858	114	,000	1,841
TLI	**CFI**	**RMSEA**	**SRMR**
,913	,927	,077	,0585

T-test analyses the significance of the difference between two samples' means [23]. H_{1-1} hypothesis was analyzed by t-test.

- **H_{1-1}**: There is a significant difference between gender and job satisfaction.

The results of t-test show that only the respondents' satisfaction with moral values item (sig.= ,013) differs with regard to their genders. For other job satisfaction variables, the null hypothesis is supported. Female employees are more satisfied than the male with their ability to do things that don't go against their conscience at work.

While the significance of the difference between the groups of two samples is examined by t-test, the ANOVA (analysis of variance) enables to examine the significance of the variances between more than two sample groups [23]. The developed sub-hypotheses of H_{1-2}, H_{1-3}, H_{1-4}, H_{1-5}, H_{1-6} and H_{1-7} were tested by variance analysis.

- **H_{1-2}**: There is a significant difference between age and job satisfaction.

According to results of ANOVA, the respondents' satisfaction with the chance to tell people what to do (authority-intrinsic satisfaction item) differs with regard to their ages (sig.= ,011). Tukey test was applied to determine which groups are differed significantly. According to Tukey test result, there is significant difference between the 30-35 years ($\bar{X}$:3,32) and 42-47 years ($\bar{X}$:4,33) old employees.

- **H_{1-3}**: There is a significant difference between education level and job satisfaction.

According to the result, the null hypothesis is supported for all job satisfaction variables. The respondents' job satisfaction does not differ with regard to their education levels. Therefore, H_{1-3} is not supported.

- **H_{1-4}**: There is a significant difference between department and job satisfaction.

H_{1-4} is not supported for 19 job satisfaction items. Only the respondents' satisfaction with the way company policies are put into practice in their organization (extrinsic satisfaction item) differs with regard to their departments (sig.= ,044). The significant difference occurs between finance & accounting ($\bar{X}$:2,75) and foreign accounts ($\bar{X}$:4,14) departments.

- **H_{1-5}**: There is a significant difference between position/title and job satisfaction.

From the results of variance analysis, it is observed that H_{1-5} is supported for 'social status' (sig.= ,011), 'social service' (sig.= ,036), 'authority' (sig.= ,001), 'responsibility' (sig.= ,010) and 'creativity' (sig.= ,045) intrinsic satisfaction variables. Therefore, it can be said, the respondents' satisfaction with the chance to be somebody in the community (social status) differs with regard to their positions in the organization. According to the result, the respondents who are working as a department supervisor ($\bar{X}$:4,42) and team leader ($\bar{X}$:4,57) are more satisfied with their social status. The respondents who have department supervisor title are more

satisfied with the chance to do things for other people. The difference occurs between assistant department supervisor ($\bar{X}$:2,33) and team leader ($\bar{X}$:3,71), specialist ($\bar{X}$:3,80) and department supervisor ($\bar{X}$:4,07) groups according to results of Tukey test.

The respondents who are working as a department supervisor, assistant department supervisor, and team leader are more satisfied with the chance to tell people what to do (authority). According to Tukey test, there are significant differences between department supervisor ($\bar{X}$:4,35) and assistant specialist ($\bar{X}$:3,26), sales responsible ($\bar{X}$:3,23) groups.

The respondents' satisfaction with the freedom to use their own judgment differs with regard to their positions in the organization. Department supervisors and team leaders are more satisfied with responsibility variable ($\bar{X}$:4,57 and $\bar{X}$:4,14 respectively). The significant difference occurs between department supervisor ($\bar{X}$:4,57) and sales responsible ($\bar{X}$:3,38) groups.

The respondents' satisfaction with the chance to try their own methods of doing their jobs (creativity) differs with regard to their positions in the organization. Tukey test results showed that there is significant difference between department supervisor ($\bar{X}$:4,35) and specialist ($\bar{X}$:3,38) positions.

- **H_{1-6}**: There is a significant difference between sector experiences and job satisfaction.

The null hypothesis is supported for all job satisfaction items except 'social service' and 'authority' intrinsic satisfaction variables. The respondents' satisfaction with social service differs with regard to their experiences in the sector (sig.= ,018). The respondents, who have 15 years or more sector experiences, are more satisfied with the chance to do things for other people. The significant difference occurs between the groups of 15 years and more ($\bar{X}$:4,03) and 1-4 years ($\bar{X}$:3,25) sector experiences. The respondents' satisfaction with the chance to tell people what to do (authority) differs with regard to their experiences in the sector (sig.= ,006). According to Tukey test, there is significant difference between 15 and more years ($\bar{X}$:4,10) and 1-4 years ($\bar{X}$:3,33) sector experiences groups for authority satisfaction.

- **H_{1-7}**: There is a significant difference between working year in organization and job satisfaction.

The null hypothesis is supported for all job satisfaction items except 'social service' and 'authority' intrinsic satisfaction variables.

The respondents' satisfaction with social service differs with regard to their working years in the organization (sig.= ,043). The significant difference occurs between the groups of 15 years and more ($\bar{X}$:4,26) and 1-4 years ($\bar{X}$:3,37) working years.

The respondents' satisfaction with the chance to tell people what to do (authority) differs with regard to their working years in the organization (sig.= ,001). Tukey test showed that, the difference occurs between 1-4 years ($\bar{X}$:3,32). and 15 and more years working year groups. The respondents, who are working in the organization for 15 years or more, are more satisfied with authority ($\bar{X}$:4,40).

5. Discussion and Conclusion

When the job satisfaction items are analyzed, it is observed that participated employees do not have worries about losing their jobs. And as it is expected, most of the respondents are dissatisfied with their pay and amount of work they do. The respondents are neither satisfied nor dissatisfied with their chances for advancement on their jobs. The organizations should provide more advancement opportunities for their employees in order to motivate them to be more productive and creative in their work.

While extrinsic satisfaction items are

related to organizational (environmental) factors, intrinsic satisfaction is more related to personal and intangible issues. Some differences in the factor loadings are generally seen in different studies [13, 16, 22, 37]. In this study the achievement item was loaded on the extrinsic factor. The respondents might be related their achievement with the organizational factors. Similar to the finding of this research, working conditions which is an organizational item was loaded on the extrinsic satisfaction factor in the studies of [13, 22, 37].

The hypothesis tests show that the hypotheses are generally supported with intrinsic satisfaction variables. Only the company policies and practices which is an extrinsic satisfaction item differs with regard to department of respondents. The respondents whose ages are over 42 years are more satisfied than younger respondents with their chances to tell people what to do. This finding is similar to the views that job satisfaction increases with age [48, 50, 59, 60].

In contrast with findings of [50, 51, 52, 58, 59], no difference between education levels and job satisfaction has been found in this study. According to findings of [49, 60] the level of education does not have a significant effect on the job satisfaction of the employees, which is consistent with the finding of this research.

The upper level position employees such as department supervisors, assistant department supervisors and team leaders are more satisfied with their social status and authority. Department supervisors and team leaders are more satisfied with their freedom to use their own judgment in the organization and their chances to try their own methods of doing their jobs. It can be said that when the position level increases, the job satisfaction increases similar to [56] but in adverse with the result of [60]. The respondents who have 15 years or more sector experiences and working in their organization for 15 years or more, are more satisfied with 'social service' item. And the respondents who have 10 years or more experience in the sector and working in the organization for 10 years or more, are more satisfied with their authority. There is a common perception as seniority and working years increase, the experience of the employee will increase so the opportunities and job satisfaction will increase consequently [29], similar to findings of this study.

6. Limitations and Further Research

Due to time and cost limitations, the research has only been applied to the container line agents' employees operating in İzmir. 11 of the container line agents agreed to participate in the survey application. And also, because of the workloads of the agents and some of the employees were out of office due to customer visits, daily work routines and annual leaves etc. the questionnaire forms could not be reached to the whole sample of the research.

In further researches, the application area can be geographically extended to ship agencies in Turkey and also to the agencies in foreign countries in order to make comparison between Turkey and foreign countries.

References

[1] Ahn, J., Khandelwal, A.K. and Wei, S. J. (2011). The role of intermediaries in facilitating trade. Journal of International Economics, 84(1): 73-85.

[2] Alegre, I., Mas-Machuca, M. and Berbegal-Mirabent, J. (2015). Antecedents of employee job satisfaction: Do they matter? Journal of Business Research, 69:1390-1395.

[3] Altunışık, R., Coşkun, R., Bayraktaroğlu, S. and Yıldırım, E. (2012). Sosyal Bilimlerde Araştırma Yöntemleri SPSS Uygulamalı. Sakarya: Sakarya Kitabevi.

[4] Ashford, S.J., Lee, C. and Bobko, P. (1989). Content, cause, and consequences of job insecurity: A theory-based measure and substantive test. Academy of Management Journal, 32(4): 803-829.

[5] Baycan, A. (1985). An analysis of the several aspects of job satisfaction between different occupational groups. (Unpublished Master Thesis). İstanbul: Boğaziçi Üniversitesi Sosyal Bilimler Enstitüsü.

[6] Brown, S.P. and Peterson, R.A. (1993). Antecedents and consequences of salesperson job satisfaction: Meta-analysis and assessment of causal effects. Journal of marketing research, 30(1): 63-77.

[7] Eğinli, A.T. (2009). Çalışanlarda İş Doyumu: Kamu Ve Özel Sektör Çalışanlarının İş Doyumuna Yönelik Bir Araştırma. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 23(3): 35-52.

[8] Churchill Jr, G.A., Ford, N.M. and Walker Jr, O.C. (1974). Measuring the job satisfaction of industrial salesmen. Journal of Marketing Research, 11(3): 254-260.

[9] Eren, Z. İ. (1999). The Relationship Between the Demographics and The Job Satisfaction of the Research Assistants. Yönetim, 33:45-52.

[10] Deveci and Çetin (2013). Gemi Acenteleri ve Forvarder İşletmeleri: İşlevler ve Hizmetler. Denizcilik İşletmeleri Yönetimi (pp. 471-501). Editors A. Güldem Cerit, D. Ali Deveci and Soner Esmer. İstanbul: Beta.

[11] DTO (Deniz Ticaret Odası) and VDAD (Vapur Donatanları ve Acenteleri Derneği) (2011). Gemi Acenteliği Eğitimi. İstanbul: DTO Yayın No:73.

[12] George, J.M. and Jones, G.R. (2014). Understanding and Managing Organizational Behavior. New Jersey: Pearson Education.

[13] Hancer, M., and George, R.T. (2003). Job satisfaction of restaurant employees: An empirical investigation using the Minnesota Satisfaction Questionnaire. Journal of Hospitality & Tourism Research,27(1): 85-100.

[14] Hellriegel, D. and Slocum, J.W. (2010). Organizational Behavior. USA: Cengage Learning.

[15] Çetin, H., Zetter, S.A., Taş, S. and Çaylak, M. (2013). İş doyumu ve çalışanların demografik özellikleri arasındaki ilişkilerin belirlenmesi: Antalya Atatürk Devlet Hastanesi örneği. Akdeniz İİBF Dergisi, 26: 145-163.

[16] Hirschfeld, R.R. (2000). Does revising the intrinsic and extrinsic subscales of the Minnesota Satisfaction Questionnaire short form make a difference? Educational and Psychological Measurement, 60(2): 255-270.

[17] Hoppock, R. (1935). Job Satisfaction. New York: Harper.

[18] Cano, J. and Miller, G. (1992). A gender analysis of job satisfaction, job satisfier factors, and job dissatisfier factors of agricultural education teachers. Journal of agricultural education, 33(3): 40-46.

[19] Kavanaugh, J., Duffy, J.A. and Lilly, J. (2006). The relationship between job satisfaction and demographic variables for healthcare professionals. Management Research News, 29(6): 304-325.

[20] Judge, T.A., Piccolo, R.F., Podsakoff, N.P., Shaw, J.C. and Rich, B.L. (2010). The relationship between pay and job satisfaction: A meta-analysis of the literature. Journal of Vocational Behavior, 77(2): 157-167.

[21] Koçel, T. (2010). İşletme Yöneticiliği. İstanbul: Beta Yayınevi.

[22] Köroğlu, Ö. (2012). İçsel ve Dışsal İş Doyum Düzeyleri ile Genel İş Doyum Düzeyi Arasındaki İlişkinin Belirlenmesi: Turist Rehberleri Üzerinde Bir Araştırma. Doğuş Üniversitesi Dergisi, 13(2): 275-289.

[23] Kothari, C.R. (2004). Research methodology: Methods and techniques. New Delhi: New Age International.

[24] Latarche, M. (1998). Port Agency. London: Witherby Publishers.

[25] Locke, E.A. (1976). The nature and causes of job satisfaction. Handbook of Industrial and organisation psychology (pp.1297-1343). Editor Marvin D. Dunnette. Chicago: Rand Mc Nally.

[26] Luthans, F. (2010). Organizational Behavior: An Evidence-Based Approach. New York: McGraw-Hill Irwin.

[27] Malhotra, N., and Mukherjee, A. (2004). The relative influence of organisational commitment and job satisfaction on service quality of customer-contact employees in banking call centers. Journal of Services Marketing, 18(3): 162-174.

[28] Mosadegh Rad, A.M. and Yarmohammadian, M.H. (2006). A study of relationship between managers' leadership style and employees' job satisfaction. Leadership in Health Services, 19(2): 11-28.

[29] Mercanlıoğlu, A.Ç. (2012). Demografik Değişkenler Bazında İş Tatmini Boyutlarında Oluşan Farklılıklar: Okmeydanı Eğitim Ve Araştırma Hastanesi Personeline Yönelik Bir Araştırma. Öneri Dergisi, 10(37): 121-138.

[30] Oshagbemi, T. (1999). Overall job satisfaction: how good are single versus multiple-item measures? Journal of Managerial Psychology, 14(5): 388-403.

[31] Özpehlivan, M. and Acar, A.Z. (2015). Assessment of a Multidimensional Job Satisfaction Instrument. Procedia-Social and Behavioral Sciences, 210: 283-290.

[32] Özsoy, E., Uslu, O., Karakiraz, A. and Aras, M. (2014). İş Tatmininin Ölçümünde Ölçek Kullanımı: Lisansüstü Tezler Üzerinden Bir İnceleme.İşletme Araştırmaarı Dergisi, 6(1): 232-250.

[33] Akyurt, H., Turpcu, E. and Çam M. (2015). Otel İşletmelerinde Çalışan Muhasebe Personelinin Demografik Özellikleri ile İş Tatmin Düzeyleri Arasındaki İlişkinin İncelenmesi: Trabzon Otelleri Üzerine Bir Araştırma. Aksaray Üniversitesi İİBF Dergisi, 7(1), 75-85.

[34] Qasim, S. and Sayeed, F.C. (2012). Exploring Factors Affecting Employees' Job Satisfaction at Work. Journal of Management and Social Sciences, 8(1): 31-39.

[35] Rast, S. and Tourani, A. (2012). Evaluation of employees' job satisfaction and role of gender difference: An empirical study at airline industry in Iran. International Journal of Business and Social Science, 3(7):91-100.

[36] Sageer, A., Rafat, S. and Agarwal, P. (2012). Identification of variables affecting employee satisfaction and their impact on the organization. IOSR Journal of Business and Management, 5(1): 32-39.

[37] Schriesheim, C.A., Powers, K. J., Scandura, T.A., Gardiner, C.C. and Lankau, M.J. (1993). Improving construct measurement in management research: Comments and a quantitative approach for assessing the theoretical content adequacy of paper-and-pencil survey-type instruments. Journal of Management, 19(2): 385-417.

[38] Pelit, E. and Öztürk, Y. (2010). Otel işletmeleri işgörenlerinin iş doyum düzeyleri: sayfiye ve şehir otel işletmeleri işgörenleri üzerinde bir araştırma. İşletme Araştırmaları Dergisi, 2(1): 43-72.

[39] Smith, P.C. (1974). The development of a method of measuring job satisfaction: The Cornell studies. Studies in Personnel and Industrial Psychology (pp. 272-279). Editors Edwin A. Fleishman, Alan R. Bass. Homewood, IL: Dorsey.

[40] Smith, P.C., Kendall, L.M. and Hulin, C.L. (1969). The measurement of satisfaction in work and retirement. Chicago: Rand McNally.

[41] Snipes, R.L., Oswald, S.L., LaTour, M. and Armenakis, A.A. (2005). The effects of specific job satisfaction facets on customer perceptions of service quality: an employee-level analysis. Journal of Business Research, 58(10):1330-1339.

[42] Spector, P.E. (1985). Measurement of human service staff satisfaction: Development of the Job Satisfaction Survey. American Journal of Community Psychology, 13(6): 693-713.

[43] Spector, P.E. (1997). Job Satisfaction: Applications, Assessment, Causes and Consequences. Thousand Oaks, CA: Sage.

[44] Tepret, N.Y. and Tuna, K. (2015). Effect of Management Factor on Employee Job Satisfaction: An Application in Telecommunication Sector. Procedia-Social and Behavioral Sciences, 195: 673-679.

[45] Weiss, D.J., Dawis, R.V. and England, G.W. (1967). Manual for the Minnesota Satisfaction Questionnaire. Minnesota studies in vocational rehabilitation.

[46] Belias, D., Koustelios, A., Sdrollias, L. and Koutiva, M. (2013). The influence of demographic features on the job satisfaction of Greek bank employees. International Journal of Human Resource Management and Research, 3(4): 15-28.

[47] Yousef, D.A. (1998). Satisfaction with job security as a predictor of organizational commitment and job performance in a multicultural environment. International Journal of Manpower, 19(3): 184-194.

[48] Baş, T. and Ardıç, K. (2002). The impact of age on the job satisfaction of Turkish academicians. G.Ü.İ.İ.B.F. Dergisi, 2: 89-102.

[49] Bilgiç, R. (1998). The relationship between job satisfaction and personal characteristics of Turkish workers. The Journal of Psychology, 132(5): 549-557.

[50] Emek, M.L., Doğan, B. and Hilal, E. (2015). The Effects of Demographics Factors On Job Satisfaction: An Application On Staff Work at A Public Agency's Adıyaman and It's Town Brunches. Akademik Sosyal Araştırmalar Dergisi, 3(13): 529-537.

[51] Gürbüz, A. (2007). An assesment on the effect of education level on the job satisfaction from the toursim sector point of view. Doğuş Üniversitesi Dergisi, 8 (1): 36-46.

[52] Güven, M., Bakan, İ. and Yeşil, S. (2005). Çalışanların iş ve ücret tatmini boyutlarıyla demografik özellikler arasındaki ilişkiler: Bir alan çalışması. Yönetim ve Ekonomi: Celal Bayar Üniversitesi İİBF Dergisi, 12(1): 127-152.

[53] Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). Multivariate Data Analysis. Upper Saddle River, NJ: Prentice hall.

[54] Hooper, D., Coughlan, J. and Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. Electronic Journal of Business Research Methods, 6(1): 53-60.

[55] Aydın, A., Özmen, M. and Tekin, Ö. (2015). İş Tatmini Ve Demografik Özellikler Arasındaki İlişkiler: Su Ürünleri İşletmeleri Çalışanları Üzerinde Bir İnceleme. Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 6(11): 57-72.

[56] Robie, C., Ryan, A.M., Schmieder, R. A., Parra, L. F. and Smith, P. C. (1998). The relation between job level and job satisfaction. Group&Organization Management, 23(4): 470-495.

[57] Sauser, W.I. and York, C.M. (1978). Sex Differences in Job Satisfaction: A Re-Examination. Personnel Psychology. 31(3): 537-547.

[58] Soysal, A., Öke, P., Yağar, F. and Tunç, M. (2017). Örgütsel İletişim ve İş Tatmini Düzeylerinin İncelenmesi: Bir Özel Hastane Örneği. Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, (37): 243- 253.

[59] Toker, B. (2007). Demografik değişkenlerin iş tatminine etkileri: İzmir'deki beş ve dört yıldızlı otellere yönelik bir uygulama. Doğuş Üniversitesi Dergisi, 8 (1): 92-107.

[60] Yelboğa, A. (2007). Bireysel demografik değişkenlerin iş doyumu ile ilişkisinin finans sektöründe incelenmesi. Sosyal Bilimler Dergisi, 4(2): 1-18.

[61] Özaydın, M. and Özdemir, Ö. (2014). Çalışanların bireysel özelliklerinin iş tatmini üzerindeki etkileri: bir kamu bankası örneği. İşletme Araştırmaları Dergisi, 6(1): 251-281.

[62] Sundar, K.S. and Ashokkumar, P. (2012). Demographic factors and job satisfaction of employees in Life Insurance Corporation of India-Vellore Division. Asia Pacific Journal of Marketing Management, 1(3),56-67.

[63] Urošević, S. and Milijić, N. (2012). Influence of demographic factors on employee satisfaction and motivation. Organizacija, 45(4):174-182.

[64] Iiacqua, J.A., Schumacher, P. and Li, H. C. (1995). Factors contributing to job satisfaction in higher education. Education, 116(1): 51-62.

Received: 5 July 2017 Accepted: 9 May 2018 *DOI ID: 10.5505/jems.2018.83702*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Engin AYDOĞAN

Yat Turizminin Turizm Sektörü İçerisindeki Yeri ve Önemi

Engin AYDOĞAN[1], Muhsin KADIOĞLU[2]

[1]İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Türkiye
[2]İstanbul Teknik Üniversitesi, Denizcilik Fakültesi, Türkiye
aydoganegin@hotmail.com; ORCID ID: https://orcid.org/0000-0001-6799-4650
kadiogm@itu.edu.tr; ORCID ID: https://orcid.org/0000-0001-9543-8272

Öz

Türkiye kıyı turizmi yanı sıra, alternatif turizm gibi turizm türleri açısından da çeşitli imkanlara sahiptir. Turizm türlerinin çeşitliliği göz önüne alındığında turizm yatırım planlamalarında tek bir turizm türü yerine birden fazla turizm çeşidini içeren turizm koridorları oluşturulmasının gerekliliği ortaya çıkmaktadır. Bu çalışma kapsamında Türkiye'nin turist portföyü ile yatçı portföyü incelenmiş ve bu iki sektörün paralellik gösterip göstermediği analiz edilmiştir. Böyle bir analiz ile yatçılık ve marinacılık alanlarında yapılacak yatırımlarda ülkelerin genel turizm önceliklerinin ne oranda dikkate alınması gerektiği hususunda fikir oluşturması amaçlanmıştır. Çalışmada Türkiye'nin turizm ve yatçılık sektörleri sırası ile incelenmiştir. Bu kapsamda T.C. Turizm ve Kültür Bakanlığı'ndan elde edilen 1990 ile 2015 yılları arasında Türkiye'yi ziyaret eden turist ve yat miktarlarına istinaden çizilen serpilme diyagramı ile bahse konu iki değişken arasında pozitif doğrusal ilişki olduğu tespit edilmiştir. Müteakiben her iki veri setine korelasyon analizi uygulanmış ve anılan sektörler arasında orta ve yüksek seviyede doğrusal bir ilişkinin olduğu ortaya konulmuştur.

Anahtar Kelimeler: *Turizm, Turizm Koridorları, Yatçılık, Yatçı, Korelasyon Analizi.*

The Place and Importance of Yacht Tourism in The Tourism Sector

Abstract

Along with coastal tourism, Turkey has various touristic opportunities including alternative tourism. When we consider the versatility of tourism types, apart from focusing on a specific tourism genre, there is an emergent need for the development of tourism corridors consisting of more than one genre while planning tourism investments. This study investigates tourist and yachtsmen profiles in Turkey and seeks to analyse whether the two segments have anything in common. Such an analysis aims at making references to the extent countries should take into account the general tourism priorities in such fields as yachtsmanship and marina management. Within the scope of the study Turkey's tourism and yachtsmanship sectors have been scruntinized respectively. In this context the dispersion diagram pertaining to the number of tourists visiting Turkey as well as the number of yachts between the years 1990-2015, according to statistics obtained from Ministry of Tourism and Culture, has been drawn and a positive corelation between the two has obtained. Next, corelation analysis has been conducted of the two data sets and the anaysis has revealed a mid or high positive corelation.

Keywords: *Tourism, Tourism Corridors, Yachting, Yachtsmen, Correlation Analysis.*

To cite this article: Aydoğan, E. ve Kadıoğlu, M. (2018). Yat Turizminin Turizm Sektörü İçerisindeki Yeri ve Önemi. *Journal of ETA Maritime Science*, 6(3), 243-254.
To link to this article: https://dx.doi.org/10.5505/jems.2018.83702

1. Giriş

Türkiye kıyı turizminin yanı sıra, alternatif turizm (sağlık ve termal turizmi, kış sporları, dağ ve doğa turizmi, kırsal ve eko turizm, kongre ve fuar turizmi, kruvaziyer ve yat turizmi, golf turizmi, vb.) gibi turizm türleri açısından da çeşitli imkanlara sahiptir. Bununla birlikte, bu potansiyel rasyonel anlamda kullanılamamaktadır [1].

Turizm türlerinin çeşitliliği göz önüne alındığında turizm yatırım planlamalarında tek bir turizm türü yerine birden fazla turizm çeşidini içeren turizm koridorları oluşturulmasının gerekliliği ortaya çıkmaktadır. Bu tarz bir planlama ile kıyı şeridinde yoğunlaşmış turizm yatırımlarının sistematik bir şekilde iç bölgelere yayılması sağlanabilecektir. Bu kapsamda turizm yatırımlarının varış noktası (destinasyon) odaklı ve çok fonksiyonlu olarak geliştirilmesi önem arz etmektedir.

Turizm sektörü, çok farklı ve heterojen istek ve beklentileri bulunan turistlerin ihtiyaçlarını optimum bir şekilde karşılayabilmek için benzer istek ve beklentilere sahip turistlere özel bir takım hizmetler sunacak şekilde yapılanmak zorundadır. Bu tarz turizm yatırımları 2000'li yıllardan itibaren turist memnuniyetinin artması açısından faydalı olmuştur.

Varış noktası (destinasyon) odaklı turizm yatırımları Türkiye'de de kısa zamanda hayata geçirilmiş ve golf turizminden inanç turizmine çok farklı alt turizm alanları oluşturulmuştur. Böylece gelen turistlerin beklentilerine özel hizmetler sunulabilmiştir. Turizm sektöründeki tüm bu sınıflandırma işlemleri süre giderken yatçılık ve marinacılık sektöründe müşteri tipine özel bir yapılanma çoğu zaman göz ardı edilmiştir [2].

Türk marinalarının çekiciliğinin neye dayandığını tespit etmek maksadıyla yapılan bir çalışmada 21 marina yöneticisi ile görüşülmüş ve sonuç olarak marinaları çekiciliği yüksek hizmet kalitesine bağlamıştır. Ayrıca uluslararası boyutta hizmet anlayışı ile hareket edilmesi durumunda marina müşterilerinin artacağı ileri sürülmüştür. Bunun yanı sıra marina müşterilerinin marinalardan daha çok kıyıların çekiciliği ile ilgilendiklerini de belirtmiştir. Ancak bu çalışmada objektif ve somut veriler yerine marina yöneticilerinin öznel değerlendirmelerine dayandırılmıştır [3].

Başka bir çalışmada marinaların kuruluş safhasında özellikle marina yeri seçimi konusunda; teknik ve mühendislik alanlarında yetkili otoritelerin görüşlerinin yanı sıra bölge halkının tercihlerinin de göz önünde bulundurulması gerektiği ve yer seçiminde doğaya ve ekolojik yaşama dikkat edilmesi gerektiğini belirtmiştir [4].

Türkiye'nin yatçılık sektöründeki imkanlarını tam anlamıyla kullanamadığı iddia eden diğer bir çalışma, Tuna vasıtası ile Avrupalı yatçıların Karadeniz sahillerinde yatçılık yapabileceği fikrini ortaya atmıştır. Türkiye'nin yatçılık kapasitesi Avrupa ülkeleri ile karşılaştırmalı olarak verilmiş ve onlara kıyasla ne kadar düşük kapasiteye sahip olduğumuz vurgulanmıştır. Türkiye'deki yat hareketleri irdelenmiş ve müşteri potansiyeli olarak İngiltere, Almanya ve Fransa öncelikli ülkeler olarak belirlenmiştir. Türkiye'nin halihazırda ihtiyacının çok altında marina imkan ve kabiliyetlerine sahip olduğu gösterilmiştir. Çalışmada literatür taraması ve İstanbul'da bulunan 2 marinanın yöneticileri ile yapılan mülakatlara istinaden SWOT analizi yapılmıştır [5].

Marina dizaynında insan faktörlerini inceleyen başka bir çalışmada marinaların ne tür özelliklere sahip olması gerektiği irdelenmiştir. Bu kapsamda ideal bir marina için; doğal şartlar ve topoğrafyanın, şehir ile olan ilişkinin, marinanın mevcut iletişim alt yapı ile bağlantısının ve yat limanının inşasının nasıl olması gerektiği anlatılmıştır. Bunun yanı sıra ideal bir

marinada bulunması gereken kolaylıklar açıklanmıştır [6].

İstanbul bölgesinin marina ihtiyacını belirlemek ve olası marina lokasyonlarını tespit etmek maksadıyla yapılan bir çalışmada Marmara'da marina inşası için en uygun yer GIS (Geographic Informaton System) ve AHP yöntemi kullanılarak tespit edilmiştir. Marinaların şehrin dışında ancak insanların kolayca ve hızlıca erişebilecekleri uygun sahil kesimlerine yapılması, bunun yanı sıra yatçıların genellikle yüksek sosyo-ekonomik durumları göz önüne alındığında bölgenin demografik yapısının da analiz edilmesinin gerektiği vurgulanmıştır. Çalışma kapsamında İstanbul'un yaklaşık 160 km.lik Marmara sahil şeridi kapsanmıştır. Boğaz aşırı yoğun trafiğe sahip olması ve Karadeniz kıyılarının yerleşim birimlerine uzak olmalarından dolayı bu bölgeler çalışmanın dışında bırakılmıştır. Çalışma kapsamında ne tür veriler ile çalışılması gerektiğine uzman görüşleri doğrultusunda karar verilmiş ve veriler İstanbul Büyükşehir Belediyesi ile Yıldız Teknik Üniversitesi tarafından yürütülen "Çevre Planının İstanbul Sahil Bölgeleri'ne Etkisi" konulu projesi kapsamında Türkiye İstatistik Kurumu'ndan elde edilmiştir. Kullanılan tüm veriler GCS_ITRF_1996 projeksiyonuna çevrilmiştir. Çalışma kapsamında erozyon, ana ulaşım hatlarına mesafe, tsunami dalga yüksekliği, deniz dibi iletim hatları, deniz dip tabiatı, deniz trafiği, toprak kayması riski, coğrafik sakıncalı bölgeler, arazi durumu ve demografik veriler kullanılmıştır. Bu veriler ArcGIS adlı bir yazılım ile analiz edilmiştir. Daha sonra çıkan değerler alan uzmanlarının görüşleri doğrultusunda AHP ile analiz edilmiştir [7].

Marinaların birer destinasyon olarak ele alınması gerektiğini belirten diğer bir çalışmada bu destinasyonların çekim unsurları ile yatçı müşterilerini yatçılığa iten motivasyon faktörlerini tespit edilmeye çalışılmıştır. Ayrıca bu faktörlerin yatçıların bazı profil özelliklerine göre farklılık gösterip göstermediği de incelenmiştir. Bu çalışma sonucunda marina çekiciliklerinin; güvenlik, hizmet ve altyapı kalitesi ve itici motivasyon sebeplerinin ise özgür hissetmek, istediğini yapabilmek, aile ve arkadaşlarla birlikte vakit geçirmek olarak tespit edilmiştir [8]. Ancak bu çalışma da objektif ve somut veriler yerine marina müşterilerinin öznel değerlendirmelerine dayandırılmıştır.

Bu çalışma kapsamında Türkiye'nin turizm portföyü ile yatçılık portföyü incelenmiş ve bu iki sektörün paralellik gösterip göstermediği analiz edilmiştir. Böyle bir analiz ile yatçılık ve marinacılık alanlarında yapılacak yatırımlarda ülkelerin genel turizm önceliklerinin ne oranda dikkate alınması gerektiği hususunda fikir oluşturması amaçlanmıştır.

1.1. Yat Tanımı, Çeşitleri ve Pazarı

İngiltere Denizcilik ve Sahil Güvenlik Acentesi tarafından ortaya atılan ve Marshall Adaları, Malta, Fransa ve İtalya'nın da taraf olduğu "Large Commercial Yacht Code" a göre;

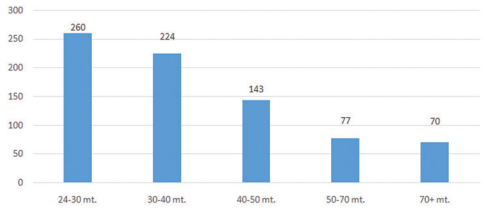
- Kısa Menzilli Yat: 500 GT'dan veya 21 Temmuz 1968'den sonra inşa edilmiş ise 300 GT'dan daha hafif, azami 14 bofor kuvvetinde rüzgarda seyir yapabilen ve sahile 60 mil uzaklıktaki bölgelerde emniyetli seyir yapabilen (safe heaven) teknelerdir.
- Büyük Ticari Yat: 24 mt'den daha uzun veya 21 Temmuz 1968'den önce inşa edilmiş ise 150 GT'dan daha ağır,12'den daha az yolcu taşıyan ve spor ve eğlence maksatlı kullanılan ticari teknelerdir[9].

Yatın tanımı milli olarak 2009/15212 sayılı Deniz Turizmi Yönetmeliğinde yapılmıştır. Bu tanıma göre yatlar, deniz turizminde kullanılmaya elverişli, 12 veya daha az yolcu kapasitesine sahip, yolcu veya balıkçı gemisi olarak nitelendirilemeyen deniz aracıdır [10].

Yata ilişkin yapılan bu tanımların yanı sıra 2004/25509 sayılı Amatör Denizci Yönetmeliğinde özel tekne tanımı yapılmıştır.

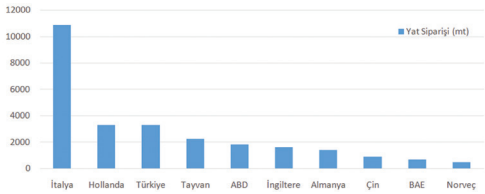
Bu tanıma göre gezi, eğlence, spor ve amatör balıkçılık gibi faaliyetlerde kullanılmak üzere imal edilmiş, ticari amaca hizmet etmeyen, boyu 2,5-24 metre arasında olan tekneler özel tekneler olarak adlandırılır[11].

Günümüzde süper yat olarak tanımlanan (boyu 24 mt.'den uzun)çok değişik boy, tonaj ve tipte yatlar üretilmektedir (Şekil-1).



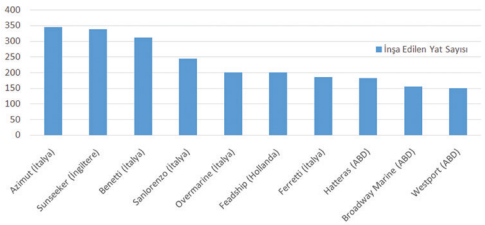
Şekil 1. *2016 Yılı Süper Yat Siparişlerinin Boylarına Göre Dağılımı [12]*

Süperyat inşa marketini İtalya, Hollanda, Türkiye, İngiltere, Almanya ve Norveç gibi Avrupa ülkeleri domine etmekte olup 2016 yılında verilen 719 adetsüperyat siparişinin boy cinsinden % 78'ibu ülkeler tarafından karşılanmıştır (Şekil 2) [13].



Şekil 2. *2016 Yılı Süper Yat Siparişlerinin Karşılanma Oranlarının Ülkelere Göre Dağılımı[13]*

Yatların inşa edildiği tersaneler incelendiğinde İtalya'nın Azimut tersanesinin bugüne dek inşa ettiği 346 yat ile dünya çapında ilk sırada yer aldığı görülmektedir (Şekil 3) [12].



Şekil 3. *2016 Yılı Süper Yat Siparişlerinin Karşılanma Oranlarının Ülkelere Göre Dağılımı [12]*

Almanya'nın Lürssen Tersanesinde inşa edilen M/Y Azzam 180 mt.'lik boyu ile dünyanın en büyük yatı ünvanını taşımaktadır (Tablo 1).

Tablo 1. *Dünyanın En Büyük 5 Yatı*

Sıra	Boyu (mt.)	İsmi	İnşa Yeri	Üretim Yılı
1	180	Azzam	Lurssen/ Almanya	2013
2	164	Fulk Al Salamah	Mariotti Yachts/İtalya	2016
3	164	Eclipse	Blohm+Voss/ Almanya	2010
4	162	Dubai	Lurssen ve Blohm+Voss/ Almanya	2006
5	156	Dilbar	Lurssen/ Almanya	2016

Bunun yanı sıra yatlar lüks yaşamın bir simgesi olarak da ön plana çıkmaktadır. Günümüzde milyarlarca dolar değerinde, altın,pırlanta gibi değerli madenlerle süslenmiş çok pahalı yatlar üretilmiştir. Bunlardan M/Y History Supreme yaklaşık 100 kg. altın donanımı,meteorit taşından imal edilmiş alabandaları ve 4,5 milyar dolarlık değeri ile dünyanın en lüks yatı ünvanını kazanmıştır (Tablo 2).

Çalışmada yukarıda yapılan tanımlara uyumlu olarak Türkiye limanarına gelen ve boyları 6-25+ mt. arasında değişen ve yat olarak belgelendirilmiş tekneler incelenmiştir.

2. Yöntem

Çalışmada öncelikle Türkiye'nin turizm sektörü, müteakiben yatçılık sektörü incelenmiştir. Bu kapsamda öncelikle literatür taranmış ve konu ile ilişkili yayınlanmış makale ve kitaplar incelenmiştir. Yapılan çalışmaların turizm ile yat turizmini ayrı ayrı ele aldıkları, bu iki turizm türünün gelişimini ve ülke ekonomisine olan katkılarını birbirlerinden bağımsız olarak inceledikleri, ancak bahse konu turizm sektörlerinin birbirleri ile olan

Tablo 2. *Dünyanın En Büyük 5 Yatı*

S.	Değeri ($)	İsmi	Boyu	İnşa Yeri	Özellikleri	Üretim Yılı
1	4,5 Milyar	M/Y History Supreme	100 ft.	Stuart Hughes İngiltere	Donatımda yaklaşık 100 kg. altın ve platin kullanılmıştır. Meteorit taşından ve dinazor fosillerinden imal edilmiş özel bir süs alabadası (duvarı) mevcuttur. Körü üstünde 68 kg. 24 ayar altından imal edilmiş bir akvaryum ve 18,5 karatlık mücevherden imal edilmiş likör şişesi bulunmaktadır.	2011
2	1,5 Milyar	M/Y Eclipse	164 mt.	Blohm+Voss Almanya	24 kamarası, 2 yüzme havuzu, birçok sıcak hamamı, iki adet helikopter platformu ve füze savunma sistemi bulunmaktadır.	2010
3	1,1 Milyar	M/Y Streets of Monaco	152,4 mt.	Yacht Island İngiltere	Yat üzerinde Monako şehrinin minyatürü inşa edilmiştir. Yat güvertesine Monte Carlo Kasinosu, yarış pisti ve Hotel Paris gibi sembolik yapıların küçük ölçekli minyatürleri yapılmıştır.	-
4	650 Milyon	M/Y Azzam	180 mt.	Lurssen Almanya	Dünyanın en büyük yatıdır, bunun yanı sıra 30 kts. sürati ile en hızlı yatlar arasında yer alır.	2013
5	350 Milyon	M/Y Dubai		Lurssen ve Blohm+Voss Almanya	Bir çok güneşlenme alanları, jakuzileri ve havuzları vardır. İç alanlar el yapımı mozaikler ve yukarıdan yatın içine giren gün ışığı ile rengi değişen camlar ile döşenmiştir.	2006

ilişkilerine değinmedikleri tespit edilmiştir. Bu nedenle çalışma tespit edilen bu literatür açığını kapatmak üzere turizm sektörü ile yat turizmi sektörünün arasındaki ilişkinin tespit edilmesi üzerine yoğunlaşmıştır.

Çalışmada kullanılan veri setleri T.C. Turizm ve Kültür Bakanlığı'nın internet adresinde bulunan Türkiye'nin 1990 ile 2015 yılları arasındaki turizm ve yat turizmi istatistiklerinden derlenmiştir.

Bu veri setlerinin aralarında herhangi bir ilişki olup olmadığını görsel olarak tespit edebilmek maksadıyla1990-2015 yıları arasında Türkiye'ye gelen turist sayıları ile yat sayılarının serpilme diyagramından faydalanılmıştır.

Daha sonra tespit edilen ilişkinin yönünü ve derecesini tespit etmek maksadıyla turizm verileri ile yatçılık verleri korelasyon analizine tabi tutulmuştur. Korelasyon analizi bağımlı veya bağımsız değişkenlerin aralarındaki ilişkinin kuvvet ve istikametini belirlemek amacıyla kulanılan bir istatistik yöntemidir [14].

Korelasyon analizi sonucunda hesaplanan Pearson kolerasyon katsayısı, bağımlı veya bağımsız değişkenler arasındaki doğrusal ilişkinin kuvvet ve istikametini tespit etmek için kullanılanılır. Pearson korelasyon katsayısı (r) ile sembolize edilir. Bu değer -1 ile +1 arasında değişim göstermekte olup, -1 ile 0 arasındaki değerler değişkenler arasındaki negatif istikametli ilişkiyi, 0 ile +1 arasındaki değerler ise pozitif istikametli ilişkiyi belirtir. Pearson kolerasyon katsaysının 0'a eşit oması değişkenler arasında herhangi bir ilişkinin olmadığını gösterir[15].

Pearson korelasyon katsayısının aldığı değerlere göre ifade ettiği ilişki kuvvet dereceleri Tablo-3'te gösterilmiştir.

Tablo 3. *Pearson Korelasyon Katsayısının İfade Ettiği İlişki Kuvvet Dereceleri [16]*

Pearson Kolerasyon Karsayısı (r)	İlişki Kuvvet Derecesi
0,00 – 0,25	Çok zayıf düzeyde ilişki
0,26 – 0,9	Zayıf düzeyde ilişki
0,50 – 0,69	Orta düzeyde ilişki
0,70 – 0,89	Yüksek ilişki
0,90 – 1,00	Çok yüksek ilişki

Korelasyon katsayısı kullanımında dikkat edilmesi gereken üç temel nokta bulunmaktadır. Bunlar veri setleri arasında doğrusal bir ilişkinin bulunması, örnek sayısının düşük yada fazla olması ve veri setinde aykırı değerlerin bulunmamasıdır.

Bu kapsamda korelasyon analizinden önce her iki veri setinin (turizm verileri ile yatçılık verleri) veri yapıları analiz edilmiş ve aralarında doğrusal bir ilişki bulunup bulunmadığı incelenmiştir. Bu inceleme görsel yollarla serpilme diyagramı çizilerek yapılmıştır.

Daha sonra örnek sayısı incelenmiş ve çalışmada kullanılan veri setlerindeki örnek sayılarının 30'dan az olmasından dolayı parametrik olmayan Kendall ve Spearman Testlerinin uygulanmasına karar verilmiştir. Veri setlerinin aykırı değerlerin bulunup bulunmadığı incelenmiş ve aykırı değer olmadığı tespit edilmiştir.

Veri yapılarının incelenmesini müteakip veri setleri "SPSS 15 Evaluation "yazılımı kullanılarak analiz edilmiş ve analiz sonuçları tablolaştırılarak veri setleri arasındaki ilişkinin türü ve kuvveti ortaya konulmuştur.

3. Sonuçlar

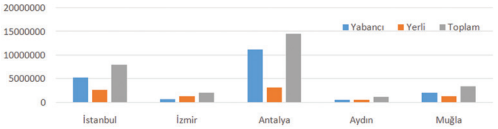
3.1. Türkiye'nin Turizm Portföyü

Türkiye sahip olduğu tarihi ve turistik güzellikleri ile turistlerin gözde uğrak yerlerindendir. Bu turistik çekicilik yıllara bağlı olarak gittikçe artmış ve artmaya devam etmektedir. T.C. Kültür ve Turizm Bakanlığı'nın verilerine göre Türkiye'de 1990 yılında hemen hemen yarısı yerli, yarısı ise yabancı olmak üzere yaklaşık 7,5 milyon turist bulunmaktadır. Turist sayısı zaman zaman azalma gösterse de yıllara bağlı olarak artmış ve 2015 yılında 23 milyon civarında yabancı, 20 milyon civarında yerli olmak üzere toplam 43 milyon civarına ulaşmıştır [16]. Bu kapsamda Türkiye'nin turizm potansiyelinin yıllık ortalama %8'likbir artış ile son 25yılda toplam %570 oranında artış gösterdiğini söylemek mümkündür.

Turizm gelirleri açısından turist sayılarının yanı sıra turistlerin konaklama süreleri de önemlidir. Turistlerin ortalama konaklama süreleri incelendiğinde 1990'da 2,7 gün olan ortalamanın 15 yıl içerisinde 3,9 güne kadar çıktığı görülmektedir [16].

Türkiye'ye gelen turistler milliyetlerine göre incelendiğinde; 2015 yılı verilerine göre Alman turistlerin %23'lük bir oran ile en kalabalık grubu oluşturduğu, bu ülkeyi %11 ile Rusya'nın takip ettiği görülmektedir. Turist portföyü bölgesel bazlı incelendiğinde ise %55'lik bir oran ile Avrupan'nın ilk sırada geldiği bu bölgeyi %17 ile Bağımsız Devletler Topluluğu'nun (%11'i Rusya Federasyonu), ve %16 ile Asya ülkelerinin takip ettiği görülmektedir.

Turistler Türkiye'de ağırlıklı olarak Muğla, Aydın, Antalya, İzmir ve İstanbul çevrelerini tercih etmektedirler. En fazla turist %49'luk bir oranla Antalya'ya gelmekte, bu şehri % 27 ile İstanbul ve %12 ile Muğla takip etmektedir (Şekil 4).



Şekil 4. *2015 Yılı Turist Sayılarının İllere Göre Dağılımı [17]*

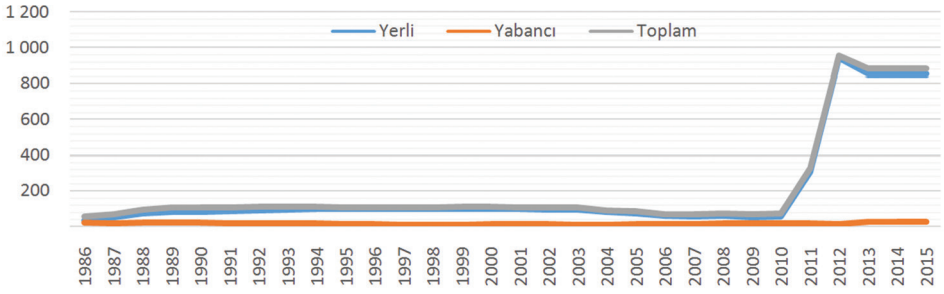
3.2. Türkiye'nin Yatçılık Portfoyü

Türkiye'deki yat turizmi son 25 yılda hızlı bir gelişme göstermiştir. 1986'da 57 olan yat işletme sayısı 2010 yılına kadar

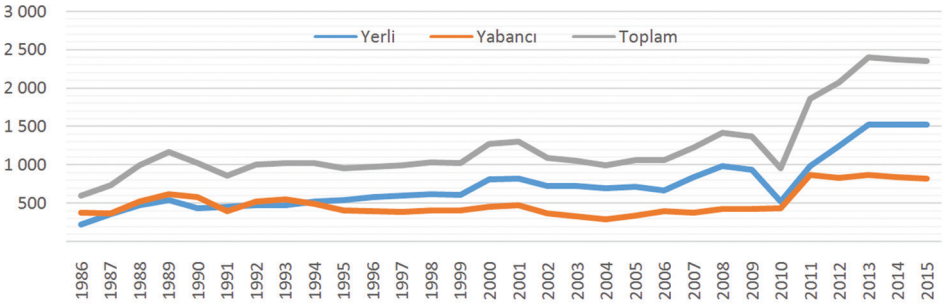
kademeli bir artışla 76'ya ulaşmış, 2011 yılında ise %420'lik bir artışla 326'ya bir sonraki yıl ise %290'lık bir arışla 954'e kadar çıkmıştır (Şekil 5).

Yat işletme sayısına paralel olarak Türkiye'ye gelen yat sayısı da gelişme göstermiştir. Türkiye limanlarına gelen yat sayısı 1986 yılında 226'sı yerli, 378'i yabancı olmak üzere toplam 604 iken bu sayı 2012 yılında %340'lık artışla 2075'e ulaşmıştır. 2015 itibarıyla Türkiye limanlarına uğrayan yat sayısı 1.529'u yerli, 826'sı yabancı olmak üzere toplam 2.355 olmuştur (Şekil 6). Bu kapsamda Türkiye yat turizm potansiyelinin yıllık ortalama %6,5'luk bir artış ile son 15 yılda toplam %390 oranında artış gösterdiğini söylemek mümkündür.

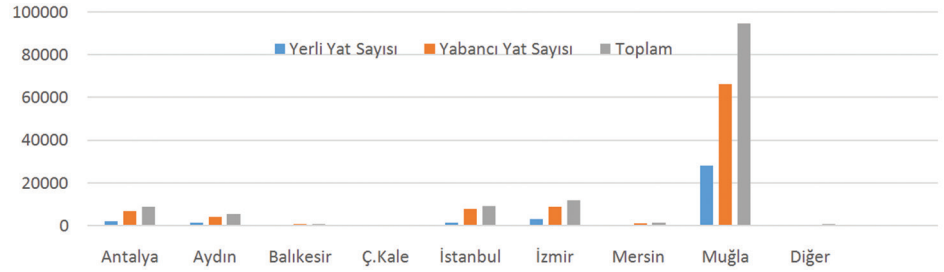
Türkiye'deki yat turizmi genel olarak Muğla, İzmir, Antalya ve İstanbul bölgelerinde yoğunluk göstermektedir. 2015 yılı içerisinde Türkiye'ye gelen yatların %70'i Muğla'ya, %9'u İzmir'e, %7'si İstanbul'a ve %6'sı Antalya'ya gelmiştir (Şekil 7). Görüleceği üzere Muğla ili yat turizminde merkezi bir rol üstlenmektedir. Yat turizmi Muğla ili özelinde incelendiğinde yatların % 29'unun Marmaris'e, %20'sinin Bodrum'a, %16'sının Fethiye'ye, %15'inin Göcek'e ve %15'inin Datça'ya geldiği görülmektedir.



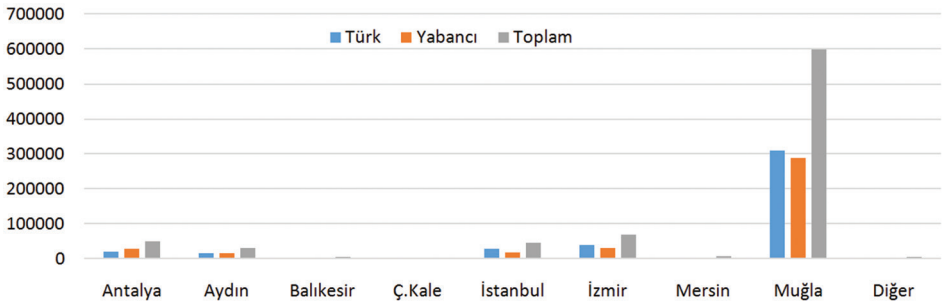
Şekil 5. *Türkiye'deki Yat İşletmelerinin Yıllara Göre Gelişimi [11]*



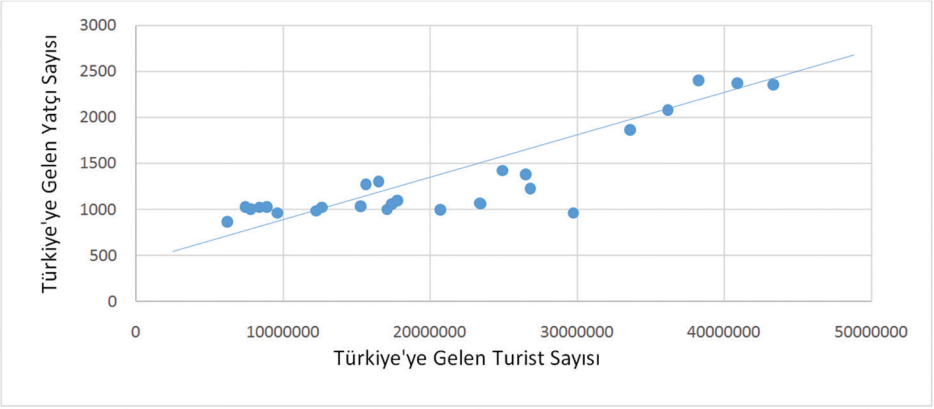
Şekil 6. *Türk Limanlarına Uğrayan Yatların Yıllara Göre Dağılımı [11]*



Şekil 7. *Türkiye'ye Gelen Yatların Şehirlere Göre Dağılımı [17]*



Şekil 8. *Türkiye'ye Yatlar İle Gelen Turist Miktarlarının Şehirlere Göre Dağılımı [17]*



Şekil 9. *Türkiye'ye Gelen Turist Miktarı ile Yat Sayısının Serpilme Diyagramı*

Yatlar ile birlikte gelen turistlerin sayıları incelendiğinde Muğla, Antalya, İzmir ve İstanbul'un ön plana çıktığı görülmektedir. 2015 yılı içerisinde Türkiye'ye yat ile gelen turistlerin %73'ünün Muğla'yı,

%9'unun İzmir'i, %6'sının Antalya'yı ve %6'sının İstanbul'u tercih ettiği görülmektedir (Şekil 8).

3.3. Verilerin İşlenmesi

1990-2015 yıları arasında Türkiye'ye gelen turist sayıları ile yat sayıları arasında ne tür bir ilişki olduğunu tespit edebilmek için her iki veri setine ait serpilme diyagramı çizilmiştir.Serpilme diyagramında görüleceği üzere turist sayısı artarken, yat sayısı da artış göstermektedir (Şekil 9). Bu durum iki değişken arasında pozitif doğrusal bir ilişki (r>0) olduğunu göstermektedir [14].

Her iki veri setinde de 26 adet veri bulunduğu için (<30) parametrik bir yöntem olan Pearson kolerasyon analizi yerine parametrik olmayan Kendall ve Spearman Testlerinin uygulanmasına karar verilmiştir. Spearman ve Kendall kolerasyon katsayıları Pearson kolerasyon katsayısı gibi -1 ile +1 arasında değerler alır. Bu değer her iki değişken arasındaki doğrusal ilişkinin kuvvetini gösterir.

Çalışma kapsamında H0 hipotezi olarak "Türkiye'ye gelen turist miktarı ile yat sayısı arasında bir ilişki yoktur" olarak belirlenmiştir. Müteakiben Tablo 4'te bulunan SPSS çıktısında da görüleceği üzere Kendall ve Spearman analizleri uygulanmıştır. Kendall tablosuna bakıldığında p değeri 0,00<0,01 olduğu için H0 hipotezi reddedileceğinden Türkiye'ye gelen turist miktarı ile yat miktarı arasında anlamlı bir ilişki olduğu görülecektir. Kendall korelasyon katsayısı

Tablo 4. *Korelasyon Test Sonuçları*

			Turist Miktarı	Yat Miktarı
Kendall'ın Tau B Testi	Türkiye'ye Gelen Turist Miktarı	Korelasyon Katsayısı	1,000	,577(**)
		Çift Kuyruklu T Testi	.	**,000**
		N	26	**26**
	Türkiye'ye Gelen Yat Sayısı	Korelasyon Katsayısı	,577(**)	**1,000**
		Çift Kuyruklu T Testi	,000	**.**
		N	26	**26**
Spearman'ın Rho Testi	Türkiye'ye Gelen Turist Miktarı	Korelasyon Katsayısı	1,000	,722(**)
		Çift Kuyruklu T Testi	.	**,000**
		N	26	**26**
	Türkiye'ye Gelen Yat Sayısı	Korelasyon Katsayısı	,722(**)	**1,000**
		Çift Kuyruklu T Testi	,000	**.**
			26	**26**

0,577 olduğundan değişkenler arasındaki ilişki pozitif ve orta seviyede olarak yorumlanır. Aynı tablonun alt kısmında yer alan Spearman's rho satırında p değeri 0,00<0.01 olduğundan H0 hipotezi reddedilir, bu da Türkiye'ye gelen turist miktarı ile yat miktarı arasında anlamlı bir ilişki olduğu şeklinde yorumlanacaktır. Spearman's rho katsayısının 0,722 olması nedeniyle değişkenler arasındaki ilişkinin yüksek seviyede olduğuna karar verilir.

4. Tartışma

Türkiye sahip olduğu doğal, tarihi ve coğrafi güzellikleri ile turizm sektöründe hızla ilerleyerek dünya çapında etkili bir aktör olmayı başarmıştır. Bu başarının altında günün gereklerini ve müşterilerin beklentilerini iyi anlayıp ona göre hizmet üretme stratejisi yatmaktadır. Bu strateji beraberinde her talebe aynı tür hizmet sunma mantığından kurtulup, varış noktası (destinasyon) odaklı ve çok fonksiyonlu hizmet sunma mantığına sahip olmayı gerektirmektedir.

Yapılan çalışmada öncelikle turizm sektörü incelenmiştir. Bu kapsamda Türkiye turizminin 1990'lı yıllardan itibaren kademeli bir şekilde geliştiği, gerek yerli gerekse yabancı turist miktarının son 25 yıl içerisinde beş kattan fazla artış gösterdiği, bununla birlikte turizm gelirlerinde önemli bir faktörü oluşturan konaklama sürelerinde yüzde elliye yakın bir süre uzaması meydana geldiği resmi kayıtlara istinaden tespit edilmiştir. Ayrıca, Türkiye'ye gelen turistlerin yarıdan fazlasını Avrupalı turistlerin oluşturduğu, bunu Rusya ve diğer Asya ülkelerin takip ettiği görülmüştür. Bahse konu turistlerin Türkiye'de öncelikli olarak Antalya ve İstanbul şehirlerini tercih ettikleri, bu yerleri İzmir, Aydın, Muğla gibi Ege ve Akdeniz kıyılarında bulunan yerleşim yerlerinin takip ettikleri tespit edilmiştir.

Çalışmanın ikinci aşamasında ise yatçılık

sektörü mercek altına alınmıştır. Türkiye'de bu sektöründe turizm sektörüne paralel bir şekilde kademeli olarak geliştiği, yat işletme sayısının 1980'lerin ortalarından 2010 yılına kadar düşük bir eğimle, bu yıldan itibaren ise çok dik bir ivme ile artış gösterdiği tespit edilmiştir. Bunun yanı sıra yat işletme sayısındaki artışın beraberinde Türkiye'ye gelen yat ve yatçı sayısını da artırdığı ve son 25 yıl içerisinde yatçılık sektörünün turizm sektörüne çok benzer bir oranda olacak şekilde, yaklaşık dört katlık bir büyüme gösterdiği tespit edilmiştir. Türkiye'ye gelen yatçıların %70'lik gibi çok büyük bir kısmını oluşturanların Muğla ilini tercih ettikleri, bu şehri ise İzmir ve İstanbul'un takip ettiği belirlenmiştir.

Müteakiben, her iki sektöre ilişkin tespit edilen resmi veriler, istatistiki yöntemler ile analiz edilerek bu iki sektör arasında orta ve yüksek seviyede doğrusal bir ilişkinin olduğu ortaya konulmuştur. Bu kapsamda ülke turizminin bir alt kolu olan yatçılık ve marinacılığın, genel turizm eğilimlerinden bağımsız olarak düşünülemeyeceği, marinacılık faaliyetlerinin planlanmasında hizmet kalitesi ve uluslararası boyutta hizmet anlayışının [3] tek başına yeterli bir planlama faktörü olmadığı tespit edilmiştir.

Ayrıca marinaların kuruluş safhalarında özellikle marina yeri seçimi konusunda teknik ve mühendislik alanlarında yetkili otoritelerin görüşleri ve bölge halkının tercihleri [4] ile erozyon, ana ulaşım hatlarına mesafe, tsunami dalga yüksekliği, deniz dibi iletim hatları, deniz dip tabiatı, deniz trafiği, toprak kayması riski, coğrafik sakıncalı bölgeler, arazi durumu ve demografik veriler gibi oşinografik ve topoğrafik faktörlerin [7] yanı sıra bölgenin turizm potansiyelinin de kesinlikle dikkate alınması gerektiği değerlendirilmiştir.

Çalışma ile oldukça yakın bir ana fikre sahip olan, marinaların birer destinasyon olarak ele alınması gerektiğini belirten ve bu destinasyonların çekim unsurları ile yatçı müşterilerini yatçılığa iten motivasyon faktörlerini tespit etmeyi amaçlayan çalışma [8] ve literatürde mevcut diğer bir çok çalışmada veri seti olarak marina yöneticileri veya marina müşterilerine uygulanan anketlerden elde edilen sonuçların kullanıldığı, bu durumun ise öznel yorumlara istinaden değerlendirme yapılmasına yol açtığı tespit edilmiştir. Bu açıdan değerlendirildiğinde yapılan çalışmanın yatçılık ve marinacılık trendleri ile genel turizm trendleri arasındaki ilişkiyi resmi objektif veriler ile ortaya koyarak bu hususstaki literatür açığını kapattığı değerlendirilmiştir.

Bunun yanı sıra çalışma kapsamında Türkiye turizmi ile marinacılık sektörünün benzer coğrafi bölgelerde gelişme sağladıkları, ancak bu bölgesel benzerliğin şehir bazlı incelemede küçük çapta ayrışmalar gösterdiği tespit edilmiştir. Örneğin Antalya, Türkiye turizminde en ön sırada yer almasına rağmen, marinacılık sektöründe bu pozisyonu Muğla'ya devretmiştir. Bu hususun, marinacılık sektörünün turizm sektörü ile paralellik göstermesine rağmen, marina planlamalarında oşinografik ve topoğrafik şartların hiçbir zaman göz ardı edilemeyeceği gerçeğinden kaynaklandığı değerlendirilmiştir.

Bu değerlendirmeye istinaden gelecekte yapılacak marinaların yer tespitinde, oşinografik ve topoğrafik şartların yanı sıra turizm açısından cazibesi yüksek destinasyonların ve bu destinasyonlarda icra edilen turizm türlerinin de karar faktörü olarak kullanılması uygun olacaktır. Örneğin İzmir'de bulunan ve Hıristiyanlığın kutsal hac yerlerinden kabul edilen Meryem Ana Evi'ne istinaden yapılan inanç turizminin bölgedeki marinacılık faaliyetleri ile ilişkilendirilmesi gerek marinacılık gerekse inanç turizmine olumlu katkılar sağlayacaktır.

Ayrıca turistlerin milliyetleri, kültürel yapıları ve dini görüşleri ile tercih ettikleri turizm türleri ve destinasyonlarının analiz

edilmesi sonucunda elde edilecek veriler ışığında, belirli turist gruplarına özel destinasyonları içeren ve destinasyonlar arası intikallerin yatlar ile yapıldığı alternatif bir turizm türünün ülke turizmine katkı sağlayacağı değerlendirilmektedir.

Yatçılık ve turizm sektörü arasındaki ilişki incelenirken yatçılar ve turistlerin milliyetleri ve geldikleri ülkeler ile Türkiye'de tercih ettikleri bölgeler analizlere dahil edilmemiştir. Bu hususun yapılacak müteakip çalışmalarda incelenmesi gereken bir literatür açığı olduğu düşünülmüştür.

Sonuç olarak, yatçılık ve marinacılık sektörünün turizm sektöründen bağımsız olarak düşünülemeyeceği, yat turizmi planlama çalışmalarında; yatçı turistlerin turistik maksatlı faaliyet beklentilerinin, dini ve milli tercihleri de göz önünde bulundurularak, varış noktası (destinasyon) odaklı ve çok fonksiyonlu olarak yapılmasının bir karar faktörü olarak kullanılabileceği değerlendirilmektedir.

Kaynaklar

[1] T.C. Turizm ve Kültür Bakanlığı. (2007), Türkiye Turizm Stratejisi 2013 Eylem Planı 2007-2013. Erişim Tarihi: 04 Mayıs 2017, http://www.kultur.gov.tr/

[2] Paker, N. ve Vural, A.C. (2016). Customer Segmentation for Marinas: Evaluating Marinas as Destinations. Tourism Management, 56 (2016) 156-171.

[3] Eriş, E. D. (2007).Uluslararası pazarlarda Türk marinalarının çekiciliği ve pazarlama stratejileri. Ege Akademik Bakış, 7(1), 37-55.

[4] MUSLU, A. Yaşanabilir Kıyı Kentleri İçin Marinaların Yönetim ve Organizasyonunun Önemi. Kent Akademisi, 10(30), 123-138.

[5] Sariisik, M., Turkay, O., & Akova, O. (2011). How to manage yacht tourism in Turkey: A swot analysis a n d related strategies. Procedia-Social and Behavioral Sciences, 24, 1014-1025.

[6] Bilski, M. (2015). Selected human factors in marina design. Procedia Manufacturing, 3, 1646-1653.

[7] Gumusay, M. U., Koseoglu, G., & Bakirman, T. (2016). An assessment of site suitability for marina construction in Istanbul, Turkey, using GIS and AHP multicriteria decision analysis. Environmental monitoring and assessment, 188(12), 677.

[8] Paker, N., & Vural, C. A. (2015). Destinasyon Olarak Marinaların Çekim Unsurları Ve Yatçılığa Yönelmede Etkili İtici Motivasyon Faktörleri. Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi, 7(2).

[9] Maritime and Coastguard Agecy. (2012). LY3 The Large Commercial Yacht Code. Erişim Tarihi: 04 Mayıs 2017, https://www.gov.uk/

[10] Ulaştırma Denizcilik ve Haberleşme Bakanlığı. (2009).Deniz Turizm Yönetmeliği, Karar Sayısı : 2009/15212. Erişim Tarihi: 03 Mayıs 2017, http://www.mevzuat.gov.tr/

[11] Resmi Gazete.(2004). Amatör Denizci Yönetmeliği,Karar Sayısı : 2004/25509. Erişim Tarihi: 03 Mayıs 2017, http://www.mevzuat.biz.tr/mevzuat/21915.html

[12] Boat International. (2017). Erişim Tarihi: 06 Mayıs 2017, http://www.boatinternational.com/

[13] Global Order Book. (2016). Erişim Tarihi: 04 Mayıs 2017, http://cdn.boatinternational.com/

[14] Durmuş, B., Yurtkoru, E.S. ve Çinko, M. (2013), Sosyal Bilimlerde SPSS'le Veri Analizi, İstanbul: Beta Yayınları.

[15] Özdamar, K. (2011). Paket Programlar İle İstatistiksel Veri Analizi, Eskişehir:Kaan Kitabevi.

[16] Beşikçi, E. (2015).Gemi Sefer Yönetiminde Enerji Verimliliğinin Optimizasyonu, Doktora Tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

[17] T.C. Turizm ve Kültür Bakanlığı Yatırım ve İşletmeler Genel Müdürlüğü. (2017).Turizm ve Yat Turizmi İstatistikleri. Erişim Tarihi: 04 Mayıs 2017,http://yigm.kulturturizm.gov.tr/.

Received: 15 March 2018 Accepted: 14 June 2018 *DOI ID: 10.5505/jems.2018.48343*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Gül DENKTAŞ ŞAKAR

Value Creation in Project Cargo Logistics: A Delphi Study

Gül DENKTAŞ ŞAKAR, Esra YILDIRIM, Ezgi MANSUROĞLU

Dokuz Eylül Üniversitesi, Denizcilik Fakültesi, Türkiye
gul.denktas@deu.edu.tr; ORCID ID: https://orcid.org/0000-0002-1072-6150
esra_canbaz@hotmail.com; ORCID ID: https://orcid.org/0000-0003-2048-1828
mansurezgi@gmail.com; ORCID ID: https://orcid.org/0000-0003-2107-3949

Abstract

Project cargo logistics, with its idiosyncratic logistics processes and transportation of large, heavy and high-value cargoes, is a developing industry in Turkey. Value creation for project cargo transportation plays a critical role in gaining competitiveness in such a unique industry. Hence, the duties of related parties, the main value creation enablers, value creation outcomes and the barriers restricting such value creation should be explored. This paper sets out to provide an understanding on value creation concept of project cargo logistics. Its purpose is to identify the critical enablers of value creation as well as the main outcomes of value creation. An exploratory Delphi study with two rounds is employed. Key enablers include the partner-related and project cargo logistics operations-related dimensions. Critical outcomes have been classified as operational efficiency, service effectiveness and technology adoption/innovation. Findings can assist both operators and governmental bodies in aligning their services and procedures within the value creation perspective.

Keywords: *Project Cargo Logistics, Delphi Study, Value Creation, Turkey.*

Proje Yük Lojistiğinde Değer Yaratımı: Bir Delfi Çalışması

Öz

Proje yük lojistiği, geniş, ağır ve yüksek değerli yüklerin taşınması ve kendine özgü lojistik süreçleri ile Türkiye'de gelişmekte olan bir sektördür. Proje yük lojistiğinde değer yaratma, rekabet gücü elde etmede önemli bir rol oynamaktadır. Bu nedenle, ilgili tarafların görevleri, temel değer yaratıcı öğeler, değer oluşum çıktıları ve değer oluşumunu engelleyen bariyerlerin incelenmesi gerekmektedir. Bu çalışma, proje yük lojistiğinde değeri yaratma kavramına yönelik bir bakış açısı sağlamaktadır. Çalışma, değer yaratıcı öğeler ile ve değer yaratmanın ana sonuçlarını tanımlamayı amaçlamaktadır. Çalışmada yöntem olarak Delphi kullanılmaktadır. Değer yaratmanın ana sonuçları operasyonel etkinlik, hizmet etkililiği ve teknolojiye uyum/yenilik olarak sınıflandırılmıştır. Bulgular, hem uygulayıcılara hem de devlet kurumlarına, hizmetlerini ve prosedürlerini değer yaratma perspektifine uyumlu hale getirmede yardımcı olabilir.

Anahtar Kelimeler: *Proje Yük Lojistiği, Delfi Çalışması, Değer Yaratımı, Türkiye.*

To cite this article: Denktaş Şakar, G., Yıldırım, E. and Mansuroğlu, E. (2018). Value Creation in Project Cargo Logistics: A Delphi Study. *Journal of ETA Maritime Science*, 6(3), 255-274.
To link to this article: https://dx.doi.org/10.5505/jems.2018.48343

1. Introduction

Logistics is considered as a value-creating driver for the customers [1, 2] and characteristics of logistics services provided to the customers determine the features of the value created. Some challenges in meeting the expectations of the customers in logistics services are discussed in the literature [3, 4, 2]. Such challenges are evaluated in terms of difficulties in balancing value and related costs and update of services based on the drivers of value [5, 4, 3]and building of relationship experiences encouraging a deeper understanding of value creation [2]. Reflections of such challenges can be catastrophic in the project cargo logistics operations where such cargoes pose different transportation challenges than traditional cargoes and each delivery is different from another [6]. Despite the increasing attention on project cargo in logistics industry due to the specific requirements of this type of cargo, current literature lacks studies concentrated on project cargo logistics. The relevant literature also overlooks critical enablers in project cargo logistics. The same applies to the studies focusing on Turkey's project cargo logistics.

Turkey is strategically located in the proximity of energy resources and trade routes and its foreign trade volume has increased from $88 billion in 2002 to $391 billion in 2017. Transportation and energy infrastructure projects dominate the public-private-partnership market in Turkey and infrastructure investments totaling up to 362 billion Turkish Liras were realized including various projects in road, railway, maritime and air transport [7]. Considering favorable conditions for the development of project cargo logistics both from the perspectives of energy infrastructure projects and infrastructure investment in Turkey, there is a gap in the literature in evaluating the current situation of project cargo operations in Turkey. This paper focuses on the perspectives of different actors in the project cargo logistics through a Delphi study. Since each project cargo operation has unique characteristics, to what extent the logistics system satisfies the specific requirements of each project has become a critical determinant for project cargo logistics operations in Turkey. Project cargo logistics is unique in terms of the size, weight, and characteristics of the cargo as well as the considerable distinction of the logistics processes. Therefore, it is critical to put an emphasis on the project cargo logistics concept considering the main components and enablers in value creation. Hence, this study aims to identify the critical enablers of value creation in project cargo logistics through Delphi. The study also attempts to reveal the main barriers for project cargo logistics and the possible outcomes in the case of project cargo logistics value creation. The study is guided by three research questions:

1. What are the critical enablers for project cargo logistics value creation in Turkey?
2. What are the barriers preventing the development of project cargo logistics operations in Turkey?
3. What are the main outcomes for project cargo logistics value creation in Turkey?

An introduction to project cargo logistics and value creation in project cargo logistics is given in the following sections. Thereafter, the methodology of the study is presented, followed by the findings and discussion.

2. Project Cargo Logistics

Project cargo can be considered as heavy-lift, break bulk or out-of-gauge cargoes. UK P&I Club [8] defines project cargo as cargo or equipment that may be large, heavy or out-of-gauge, which may require specialized stowage, lifting, handling, may consist of high value or critical items and involve numerous goods

connected to the same project, and may be loaded from different ports. According to Sarı [9], project cargo logistics, as a niche area, is a transportation of the cargoes that are large, heavy, high value or critical pieces of equipment from one point to a destination with special tools by means of measures. Damage and loss of project cargo can cause very large costs, extensive delays and potentially lengthy and expensive litigation [8]. Due to the existence of a combination of different phases and actors and complex nature of delivery processes, it requires governing special caution and planning to ensure fluent transportation [10]. The process and the key success factors are described as planning and scheduling; determination of the route, cost analysis and research; creating an optimal budget with cost and related benefit analysis, operational suitability; checking the availability and applicability of the required team and equipment, regulatory compliance: obtaining clearance from local authorities for operations required by operations, operation phase; operations realized in accordance with the plan, controlling and supervision; control of the suitability of operations for the environment and human health [11]. All these point to the fact that the project cargo delivery process is particularly specialized work that strongly needs a pro-active planning structure in order to avoid problems that may occur.

There are critical investments for transportation projects in Turkey. Turkey is expected to play a critical role in future projects to be carried out in Caucasus, Middle East, and North Africa utilizing the benefits of its geographical position [12]. According to The International Transporters Association (UND) research, project cargo logistics has risen to the first place with a 17% market share in the logistics industry. Approximately 23% of logistics companies are specialized in this area. As Turkey aims to be an actor in the global economy, increasing investment in industry, energy, and logistics leads to an increase in the share of project cargo operations. According to experts, Turkey remarkably has become conspicuous by new nuclear plants, pipelines that enable the construction of energy bridges [13] and power plants. Advanced transportation is vital for the carriage of large-scale investments. Energy investments have also become the heart of project cargo. The Turkish government is expected to have invested $122 billion in the energy sector by 2023. There will be opportunities for 'project cargo' operations through natural gas and oil projects, nuclear power plants, and the construction of new Istanbul airport [14].

3. Project Cargo Logistics Value Creation

Value concept has received great attention as a major area for study in the marketing discipline [15, 16] and value is basically defined as a trade-off between benefits and sacrifices [17].According to Vargo et al.[18], value creation plays a very critical role in the economic exchange. From the competitive advantage of a firm view, Porter [19] identifies two main perspectives for the demonstration of value. The first perspective is about the perception of value as the certain amount of cost that the customers pay for company's products or services. The second perspective focuses on the view that value is obtained through the successful execution of nine separate activities, namely value chain[20]. Logistics processes constitute a major role in value chain. Most of the primary activities taking place in the value chain are integrated to the logistics processes such as inbound and outbound logistics activities. Hence, generation of logistics value is critical for organizations to achieve competitiveness and create superior value for their customers.

Logistics customer value is generally created through effectiveness, efficiency, and/or differentiation. According to Baudin [21],in logistics, the ultimate goals are to increase organizational efficiency and effectiveness. Logistics efficiency depends on how a company can provide its services at a lower cost and faster speed; and effectiveness can be reflected in how the organization provides the organization with more flexibility, more responsiveness, and reliability [22]. Wang et al. [23] propose that the total customer value concept is complex and consists of four main categories: service, quality, lead-time, and cost. Similarly, according to Mentzer et al. [24], customer service, cost/profit balance, and quality can create logistics value, which is also a competitive advantage. Logistics is considered as a critical component for value creation in many industries especially in terms of providing customized services for the customers. When considering the role of supply chain management for the transportation, logistics managers have experienced a paradigm shift from logistics cost cutting to more flexible and specialized offerings. While, Saatçioğlu and Saygılı [25] indicate that supply products and services to target market and consumers should be under suitable conditions of place, time and price, total cost needs to be reduced and demand needs to be met on time. Today logistics service providers must be ready to adapt to the changing customer needs; therefore, supplier-customer-relationships can be flexible to ensure maximum value creation for the customer. Considering the project cargo logistics perspective, creation of value is vital since each project's performance is determined according to the value created by the service providers.

Project-cargo logistics operations involve the use of various transportation modes, and maritime logistics operations play a critical role in the process. Panayides and Song [26]state that arrangement of the physical flow of goods in maritime transport, organization of the information flows between the parties as well as the execution of interfaces in the overall chain constitute the maritime logistics concept. The related parties range from manufacturers to end customers involved in maritime logistics chain. Lai et al.[22] group maritime logistics value criteria into two as efficiency related value (cost, assets) and effectiveness related value (reliability, flexibility, and responsiveness). Similarly, project cargo logistics value can be achieved by focusing on [27] each project's efficiency in terms of the main cost items and the assets required to run the operations safely and [8] effectiveness where there must be high level of flexibility in the operational levels, reliability in mostly the delivery processes of project cargoes and responsiveness to the needs and requirements of the customers since the cargo is mostly risky and high-value cargo.

In maritime logistics operations, while there are three key players of maritime transportation as shipping companies, port operators, and freight forwarders [28], additional parties as logistics service providers, road transportation companies, shipping agencies, and brokers can also be needed in project cargo logistics value creation. Compared to the traditional role of ports, recent years have witnessed a dramatic change in port logistics systems where various value-adding services have been added to the service scope of ports. The main parties taking the overall control and logistics of the project cargo can also provide such value-adding services. There are various implementations of Porter's [19] value chain to shipping and logistics cases. For instance, Song and Panayides [29] adapted value chain to maritime logistics in order to identify the main stages and activities in maritime logistics value chain. A similar approach may also be taken

for project cargo logistics operations. Value creation in project cargo involves many participants in order to satisfy customer's needs. Value creation needs integration and collaboration between all actors so that the partner selection component is viewed as a prerequisite to successful project cargo logistics value creation. In the project cargo process, all coordination and planning should be managed effectively with possible risk analysis and use of required modes of transport. Elimination of barriers, which impedes the creation of a true project-cargo logistics value, is also required. Lastly, value creation is achieved by the integration of critical elements of operational efficiency, service effectiveness with high quality, and technology adoption/innovation. Especially in terms of project cargo logistics, which mostly includes high value and hazardous cargoes; experienced staff, equipment, financial strength, governmental support, IT background are considered crucial in order to create superior value.

Although project cargo logistics operations attracting considerable attention and investment opportunities both in the world and in Turkey require specialized work, expertise, control and planning, related literature in project cargo logistics is quite scarce. Depending on the evolving nature of project cargo operations, studies on the relevant area are also quite new. By focusing on the shipping perspective of project cargo operations, Fagerholt et al. [6] present a mathematical model for ship routing and scheduling problem by considering stowage onboard and cargo coupling issues. Apart from the shipping perspective, road network in project cargo operations is studied and criteria are suggested for planning and designing project cargo transportation routes [30]. Petraška and Palšaitis [31] suggest an instrument for evaluation of the overall route for project cargoes transportation. Another study concentrates on identifying the characteristics and success factors of project cargo operations by presenting a lean system including the key parts for project delivery [32]. By focusing on a specific region, namely Barents Region, Aamuvuori [10] discusses the main barriers and opportunities in project cargo logistics by focusing on two project deliveries. From Turkey's perspective, Sarı [9] highlights the permits and regulations to be considered during project cargo logistics operations by concentrating on legal issues. Considering such scarce literature, it is observed that mainly routing-related issues, as well as criteria determination for achieving success in project cargo operations, have been studied by foreign scholars recently. However, critical components to be considered in project cargo logistics by focusing on a value creation perspective have not been discussed from Turkey's perspective. Besides, exploratory research focusing on the determination of the critical steps for project cargo value creation is needed in such a limited academic field. Hence, proposing the critical steps starting from partner selection to project cargo logistics value creation through the discussion of barriers as well as the project cargo logistics process is considered as the main motivation of the study.

4. Methodology

Exploratory Delphi study has been employed to assess the main factors in project cargo value creation in Turkey. Since there is limited research in the relevant literature both in project cargo logistics and critical components for value creation, an exploratory Delphi study has been employed. As Turoff [33] outlines, the use of Delphi method is appropriate for exploring the current research field and exposing underlying assumptions leading to different judgements. Since there are various actors involved in project cargo logistics and components of project cargo

logistics as well as value creation are not previously determined in Turkey, such Delphi approach is considered appropriate for the study. Delphi study is defined as an iterative process for combining opinions into group consensus [34] and for seeking out information for the generation of consensus [33]. Considering the research questions and the aim of the research, common points regarding the main components of value creation in project cargo logistics as well as the main barriers in Turkey have been investigated. Extraction of common points obtained from various actors in the industry would be possible through the use of such technique rather than other qualitative research methods (e.g. qualitative interviews). Loo [35] highlights the main advantages of Delphi approach over other group methods such as nominal group technique, focus groups that experts are not pressured by other participants and each participant generates his/her own idea independently. Secondly, interpersonal conflicts and communication problems do not exist because panel members do not interact. In addition, Delphi studies overcome the time and cost problems that may prevent experts from meeting at a single place and time [36]. Also, it has considerable benefits in terms of the research in which representatives from competing companies are involved in the study. Since most of the participants located in Istanbul and some of the experts are from competing companies, such a technique is also considered appropriate.

Several different types of Delphi techniques have been developed or identified as numeric, policy or historic [37], or as classical, policy, and decision Delphi methods [38, 39]. Classical Delphi is a decision- making tool and a forum for facts [39] that has been used in many Delphi studies and this type has been chosen in this research. Linstone and Turoff [40] point out that the Delphi technique is a research method for building communication between groups of people for dealing with a certain problem. The main aim of the Delphi technique is to collect various opinions from a group of experts supported by a series of questionnaires integrated with opinion feedback [41]. Having a consensus is important in this case since the researchers can understand the critical issues or components in their research and facilitate their framework conceptualization process [42].The main stages of the Delphi study are shown in Figure 1.

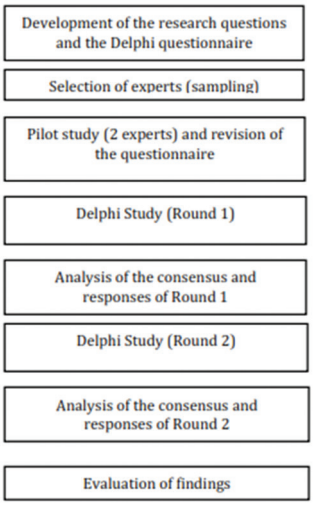


Figure 1. *Delphi Procedure of the Study*

4.1. Questionnaire Development

Considering the critical components in the project cargo logistics process and value creation, the authors have suggested critical enablers, possible barriers and value creation outcomes. Such enablers, barriers and outcomes have been borrowed from the related literature on project cargo logistics, logistics value and maritime logistics value. Statements in the Delphi questionnaire have mainly been developed considering the related literature. Figure 2 shows the main enablers, barriers, and outcomes within project cargo logistics value creation. As seen in Figure 2, two enablers exist for the generation of project cargo logistics value

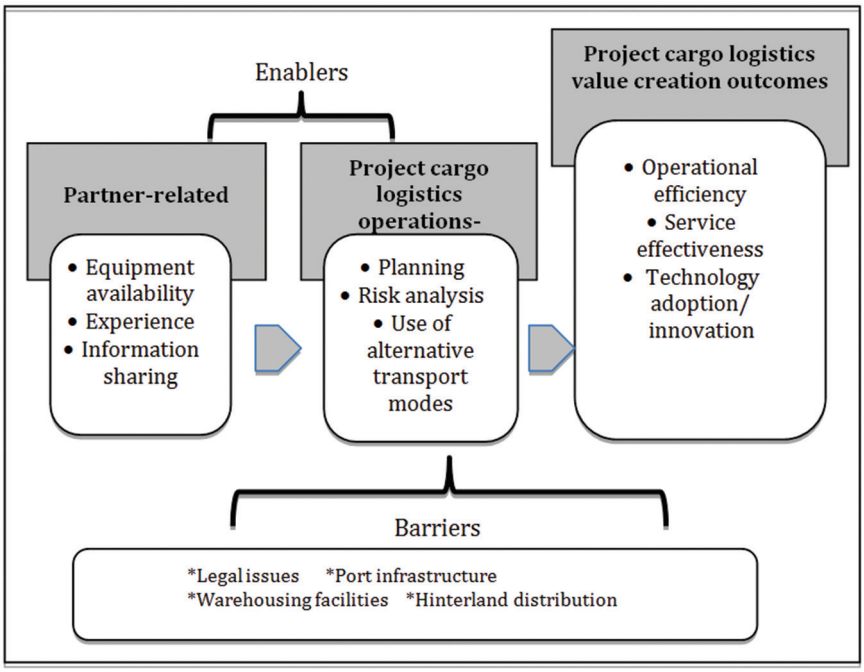


Figure 2. *Components in the Delphi Study*

outcomes as; partner-related and project cargo logistics operations-related.

Partner-related: As seen in Figure 2, the first enabler in the Delphi study is a **partner-related enabler**. Project cargo logistics services are considered as complex operations requiring security and attention. Selecting true partners in the execution of project cargo logistics services is expected to minimize the risks and difficulties throughout the overall process. Considering related literature on project cargo logistics, three main dimensions as equipment availability, experience, and information sharing have been considered.

Specific equipment used in project cargo operations facilitate the movement of project cargoes without possible risk and damage to the cargoes so that the parties providing such services should consider possible investment schemes to use specific handling equipment. By shedding light on the importance of equipment availability and use in project cargo operations, Andersson et al. [27]; Fagerholt et al. [6] state that actors should consider the availability and the type of the handling equipment required for specific project cargo. Hence, equipment availability dimension has been added.

In project cargo operations, the presence of parties who are committed and cooperative is required to ensure the smooth flow of project cargoes. Heidemann and Gehbauer [32] assert that effective communication and information sharing between actors results in time savings and increased customer satisfaction. Experience of the actors involved in the project cargo logistics is also another critical factor. When the actors involved in the project cargo logistics have low levels of experience, it is much harder to conduct effective project cargo operations. Experienced partners orchestrate the overall process, even starting from the manufacturing stage of the equipment or units to be transported. Project cargo logistics' unique requirements necessitate the consultancy of experienced logistics experts together

with engineers involved in the process [27] [6]. Value is created through the know-how, capabilities and skills of the experienced logistics experts and engineers.

Information sharing is closely linked with experience levels of the actors. Involvement in project cargo operations necessitates efficient collaboration and information sharing between actors, which are basically driven by experiences from earlier projects [10]. Hence, seamless information exchange between the partners is necessary for the execution of value-added services for each project cargo operation.

Project cargo logistics operations-related: The second enabler is about **project logistics operations**. Such enabler includes correct planning and execution, mapping the possible risks throughout the process and using alternative modes of transport (other than mainly sea and road transport modes) in case of a possible need in the project cargo operations. Branch [43], Guzman and Norgaard [44] and Aamuvuori [10] point out the importance of planning in project cargo logistics by focusing on cargo handling processes. There are sub-processes that should work efficiently in order to ensure that each component is delivered at the right time [6]. Apart from the planning dimension, risk analysis should be considered to reveal the possible risk factors in project cargo logistics. Branch [43] highlights that it is crucial to stay in schedule and implement the project carefully, and combination of plans including effective risk management techniques should be incorporated to project cargo logistics. Lastly, the use of alternative transport modes is considered as one of the dimensions of project cargo process. Since project cargoes are usually transported with several transport modes, the involvement of possible mode variations as well as actors can be evaluated [43, 10, 30]. Hence statements related to the use of air and road transportation in project cargo deliveries have been added to the questionnaire.

Project cargo logistics value creation outcomes: Considering the characteristics of project cargo operations, some elements mainly highlighted in maritime logistics value creation, and logistics value literature generated the main outcomes listed under this component as operational efficiency, service effectiveness, technology adoption/ innovation. Project cargo logistics value should reflect how efficiently and effectively the system meets the needs of the customers. Building on the studies of Lai et al. [22], Lee et al. [45] and Song and Lee [28], first two outcomes of project cargo logistics value creation have been considered as operational efficiency and service effectiveness. While efficiency is concerned with the utilization of resources, service effectiveness determines the reliability, responsiveness/flexibility of the service providers in logistics [22]. Since project cargo operations differ from each other, a customized care towards the projects is needed both from operational efficiency and service effectiveness. The level of performance for two aspects in project cargo logistics should be monitored by the service providers with regards to what the customer values. Zhao et al. [46] propose customer-focused (responsiveness, flexibility etc.) and information focused (information technology, information sharing and connectivity) capabilities in logistics value. Yazdanparast et al.[2] concentrate on the skills and knowledge of the employees in logistics operations in the creation of logistics value. Hence, a statement regarding the human resources in project cargo operations has been added to the questionnaire. The last outcome builds upon the inevitable requirement for most logistics service providers, namely technology adoption and innovation. As Yazdanparast et al. [2] highlight the service

delivered to the customer should include some aspects of innovation and it should be customized to the requirements rather than a service menu of the provider. Panayides and So [47] highlight the importance of organizational learning and innovation in increasing the overall performance in logistics and supply chain operations.

Barriers: When project cargo operations and value creation is the case, the current situation of the operating environment and the country should also be considered. As the third component, barriers in project cargo operations in Turkey impact the current operations negatively, and project cargo logistics value creation can be interrupted accordingly. Especially poor port infrastructure, limited warehousing facilities, interconnectivity and infrastructure-related problems in hinterland distribution of project cargoes as well as government regulations give rise to changes, which have profound impacts on logistics decisions in project cargo logistics. These barriers also have a negative impact on the value creation processes of service providers. Dimensions related to the barriers have basically been taken from the studies of Aamuvuori [10], Sarı [9] and Bazaras et al. [30].

4.2. Sampling and Data Collection

In this study, purposive and snowball sampling methods have been used for sample selection. The purposive sampling technique is a kind of non-probability sampling that is most effective when one needs to study a specific field with knowledgeable experts. Also, snowball sampling has been used in which the contacted experts suggest other potential experts who could contribute to the study. In order to reflect important outcomes from the Delphi study, it has been decided to include experts from industries including logistics service providers, freight forwarders, maritime agencies, port businesses, shipping companies, brokers and government bodies. The main logic behind the participation of such parties is that they are involved in project cargo logistics operations. Moreover, Linn [20] states that main actors in maritime logistics are shippers, carriers, port operators and freight forwarders. Besides, maritime logistics players include the government authorities, which deal with customs and port management, warehousing operators, inland transport operators, customs agents, shipping agents, and insurance and banking companies. Some Delphi studies conducted in this area such as Saldanha and Gray [48], Islam et al.[49], Deveci and Cerit [50], Brett and Roe [51] also include a panel of experts from different industries, such as shippers, academia, road, rail and sea transport operators, government etc. In the light of these, twenty-five experts have been contacted for the study, however, the final number of experts in the first round have been fifteen due to some excuses and busy schedules of the potential participants. The response rate has been 60%. The response rate has also been 60% in the second round of the study since there have been no dropouts. Table 1 shows the profile of the respondents in the study.

It may be concluded that most of the sample have experience in the industry for 5-10 years. In selecting the sample for the Delphi study, participants considered to be experienced in the field such as general manager or operations manager have been chosen. Most of the participants have a graduate degree. It has been decided that the Delphi study rounds should be conducted by e-mail due to time and financial constraints. Also most of the participants are located in Istanbul. The first round of the Delphi study was conducted on Dec. 24, 2017 through Jan. 05, 2018. The second round of the Delphi study was conducted on Jan. 06, 2018 through Jan. 12, 2018 and sent to the same experts who participated in the

Table 1. *Profile of the Respondents Included in the Study*

Position	**N (%)**	**Experience in the industry**	**N (%)**
General manager	5(33%)	5-10 years	7(47%)
Operations manager	6(40%)	11-15 years	1(7%)
Specialist	4(27%)	16-20 years	2(13%)
Industry	**N (%)**	More than 20 years	5(33%)
Logistics service provider	4(26%)	**Education**	**N (%)**
Freight forwarder	3(20%)	Graduate	9(60%)
Broker	3(20%)	Postgraduate	4(27%)
Port business	2(13%)	PhD	2(13%)
Maritime agency	1(7%)		
Shipping company	1(7%)		
Ministry of Transport, Maritime Affairs and Communications	1(7%)		

first round of the study by e-mail. After evaluation of the first round and the results related to each statement, new statements were re-formulated and it was aimed to reach a consensus with the second round. After receiving comments and answers of 15 experts for the second round of the study, the same procedure was applied as in the first round. As for the analysis of the second round, frequencies were calculated for each statement and the degree of consensus (70%) was determined.

4.3. Design of the Delphi Study

For Round I, the Delphi questionnaire was used after the feedback regarding the pilot survey had been evaluated. Following the pilot survey necessary changes were made. Pilot questionnaires were sent to two experts (one academician and one practitioner) involved in project cargo logistics operations. They provided useful insight especially in terms of the wording of the questions. Subjective criteria or descriptive statistics have been used in many Delphi studies for the determination of consensus and the quantification of its degree [52]. In order to determine if consensus has been reached, the APMO (The Average Percentage of Majority Opinion) technique has been employed as a consensus measurement. It has calculated by Kapoor [53] as:

$$APMO = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}}$$

In the calculation process, statements with "agreement", "disagreement" and "no comment" have been calculated. Statements with a percentage over 50 % have been accepted as the ones with a majority. Second, the researcher had to sum up the majority agreements and disagreements [52]. According to the Brett and Roe [51]; a statement achieves consensus when it reaches 70% or more. There are Delphi studies where the consensus is defined as 51% while some others use a consensus rate of 70% or 80% [54].The comments and the responses for each question have firstly been listed on the Excel spreadsheet and then frequencies for each statement have been calculated. For this research, 70% was chosen as a consensus rate because the agreement/disagreement of 15 experts over 25 experts has been considered as a sufficient rate and is keeping with previous empirical work. A second round has been conducted since there were six no-consensus statements from the first round and consensus has been achieved in five statements in the second round. Consensus rates of five statements in the first round are respectively 50%, 53.3%, 60%, 60% and 64.3%. According to the feedback from 15 participants, APMO cut-off percentage rate for the second round Delphi study has been

found 95%. The first round of the Delphi study has included sixteen questions with "agree", "disagree" or "unable to comment-neutral" options.

Validity of the study has been considered by following some steps suggested by Fink et al. [55] and Murphy et al. [56]. Appropriateness of the method chosen for addressing the problem, choice of relevant experts, explanation of data collection procedures, revealing justifiable consensus levels, as well as dissemination and implementation, can be considered as the features determining the validity of Delphi studies Fink et al. [55] and Murphy et al. [56]. Delphi method is preferred in resolving situations where no definite evidence is available by considering the knowledge and experience of experts [57]. Project cargo logistics is widely neglected in logistics literature and such exploratory research supported by experts' opinions can be useful in understanding the main factors as shown in Figure 2. Also as shown in Table 1, the experts selected for the study represent the main actors involved in project cargo operations with considerable experience in the logistics industry. Consensus levels appropriate with previous research have been selected as explained in the design of the Delphi study. In addition, the researchers have followed all the procedures required for the execution of two rounds.

5. Findings

Findings of the study have been evaluated and discussed by considering the enablers, barriers, and outcomes as shown in Figure 2. Statements with related consensus degrees are provided in Table 2 for the first round and in Table 3 for the second round. The first enabler was related to partner selection for the value creation in project cargo logistics since the performance levels of each partner in collaboration and coordination mainly determine the success of the overall process. Even though all participants have had a consensus on the importance of information sharing, some of them have been hesitant and mentioned that the exchange of 'all' information can be harmful both for the process and the partners so this statement has been revised in the second round, as 'required information should be shared'(2nd statement).According to the findings, in the partner selection, the experience has been perceived as the most important factor compared to equipment availability, portfolio and information sharing with 80% consensus rate(4th statement). Some participants even argued that experience in project cargo logistics has equal importance with equipment portfolio and cost factor. This supports the view that the level of experience in project cargo logistics is mainly related to dealing with unexpected issues such as loss and damage, managing the process smoothly and providing superior value-added services. Since no consensus has been achieved in the role of equipment portfolio in partner selection, that statement has been revised in the subsequent round (3rd statement). Similarly, the brand name and the company's past businesses have not been considered more important than the cost factor so that this statement has also been revised (5th statement). In the statement related to role of parties (10th statement) in terms of value creation in project cargo logistics, freight forwarders have been accepted as the most important partner in project cargo logistics (80% consensus). Apart from freight forwarders, experts have declared that maritime transport companies, shipping agencies and logistics service providers are also critical partners who should work in coordination with each other in order to avoid additional costs and delays.

Table 2. *Results of the First Round of the Delphi Research*

Delphi Statements	Number of Answers			TOTAL RESULTS	
	Agree	Disagree	Unable to Comment	Consensus	Non* Consensus
	N	N	N	N	%
S1.Planning is the most critical step in project cargo logistics operations.	15 (100%)	0	0	100% agreed	
S2.In project cargo logistics, it is necessary to share all the information about the project in order to rely on business partners and to ensure smooth transport.	12 (80%)	3 (20%)	0	agreed with 80%	
S3.In project cargo logistics, the most decisive factor of partner selection is the availability of equipment portfolio .	6 (40%)	9 (60%)	0		40% (a) 60%(d) (Second-round applied)
S4.In project cargo logistics, the most deterministic factor in choosing a partner is the experience.	12 (80%)	3 (20%)	0	agreed with 80%	
S5.When choosing partners for project cargo logistics, the brand name and the company's past actions are more decisive than cost factor.	9 (64.3%)	5 (35.7%)	1		64.3% (a) 35.7% (d) (Second-round applied)
S6.In project cargo logistics, port infrastructure and handling equipments are at satisfactory level.	3 (20%)	12 (80%)	0	disagreed with 80%	
S7.In project cargo logistics, the port's storage activities that can safely keep the cargo are at sufficient level.	3 (20%)	12 (80%)	0	disagreed with 80%	
S8.There is a congestion (traffic/vehicle intensity) which interferes with the project cargo operation, in the distribution of the hinterland areas of ports.	14 (93.3%)	1 (6.7%)	0	agreed with 93.3%	
S9.In project cargo logistics, operational efficiency (reducing costs and time at a minimum) is more important than service effectiveness (flexibility, responsiveness and reliability in services).	8 (53.3%)	7 46.7%)	0		53.3% (a) 46.7% (d) (Second-round applied)
S10.A forwarder who undertakes the logistics process of the project burden is the most important part in terms of coordination of all the parties.	12 (80%)	3 (20%)	0	agreed with 80%	
S11.Turkey's regulations and rules related project cargo transport adversely affect the flow of the process.	6 (60%)	4 (40%)	5		60% (a) 40% (d) (Second-round applied)
S12.The actors involved in the project cargo logistics process can adapt to the latest changes in technology.	4 (26.6%)	11 (74.4%)	0	disagreed with 74.4%	

./..

Table 2. *Results of the First Round of the Delphi Research (Cont')*

Delphi Statements	Number of Answers			TOTAL RESULTS	
	Agree	Disagree	Unable to Comment	Consensus	Non* Consensus
	N	N	N	N	%
S13.The packaging servicesduring the transportation of the project cargo areat the level that meets the needs.	6 (50%)	6 (50%)	3		50% (a) 50%(b) (Second-round applied)
S14.There is lack of human resources with the sufficient knowledge to manage the project cargo transportation processes.	14 (93.3%)	1 (6.7%)	0	agreed with 93.3%	
S15. Risk analysis is carried out from the beginning to the end of the process with the partners before the initiation of the transportation processes.	13 (86.6%)	2 (13.4%)	0	agreed with 86.6%	
S16.In project cargo logistics, air transportation mode is used at delivery points that are not suitable for road transportation.	3 (25%)	9 (75%)		disagreed with 75%	

Table 3. *Results of the Second Round of the Delphi Research*

Delphi Statements	Number of Answers			TOTAL RESULTS	
	Agree	Disagree	Unable to Comment	Consensus	Non* Consensus
	N	N	N	N	%
1.In project cargo logistics, although there are some important factors in partner selection, the partner's large and sufficient equipment portfolio is important too.	15 (100%)	0	0	100% agreed	
2.In project cargo logistics, cost factor is an important criterion in choosing partners.	14 (93.3%)	1 (6.7%)	0	agreed with 93.3%	
3.Operational efficiency (reducing cost and time) is important in the project cargo transportation process.	15 (100%)	0	0	100% agreed	
4.Service effectiveness (flexibility, responsiveness and reliability) is important in the project cargo transportation process.	15 (100%)	0	0	100% agreed	
5.The rules and regulations must be well defined in project cargo logistics in Turkey.	14 (93.3%)	1 (6.7%)	0	agreed with 93.3%	
6. During the project cargo transportation, the packaging service (open-top container, foam, pallet etc.) is demanded by the customers.	9 (64.3%)	5 (35.7%)	1		64.3% (a) 35.7% (d)

The second enabler in the study focuses on the project cargo logistics operations. All the experts are aware of the importance of planning process (100% consensus), which includes contingency plans, permissions, and routing alternatives (1st statement). Project cargoes differ from the other cargo types with a high-risk profile. 86.6% consensus agreement rate shows that the participants of the study are aware of the risks of project cargoes. Risk analysis has been categorized under project cargo logistics operations since it should be integrated to each movement or the stage of the project cargo logistics operations (15th statement). The last dimension categorized under project cargo logistics operations is the use of alternative transport modes(16th statement). The findings related to the statement (In project cargo logistics, air transportation mode is used at delivery points that are not suitable for road transportation)revealed that although some delivery points are not suitable for road transportation, in most cases airway is not considered as a possible alternative by the actors. Especially, project cargoes' characteristics are considered quite limited for the use of such high-value cargoes. Hence, the participants have reached a consensus with 75% disagreement on the probability of air transport use for project cargo logistics.

Statements related to the barriers impeding the development of project cargo logistics operations have been included in order to gain an insight regarding the operations in Turkey. Experts have mainly concentrated on the problems that they had faced in their operations in Turkey. Port infrastructure and handling equipment availability in Turkish ports are mainly considered insufficient which negatively affects project cargo logistics. Findings show that experts have reached 80% consensus on port infrastructure and handling equipment as well as ports' storage and warehousing facilities insufficiency (6^{th} and 7^{th} statements). Remaining 20% have agreed that port operations have been developing in favor of project cargo logistics and such improved port services are expected to grow in the future. Apart from the maritime transportation leg of the project cargo operations, it is inevitable to use land transportation for the safe distribution of project cargoes. Concerning barriers experienced in Turkey, another statement with high consensus degree (93.3%) is related to the hinterland distribution of project cargoes (8th statement).Since most of the cost items are mainly experienced in the road transportation leg of project cargoes with certain risks of accidents, damage to the cargo, insurance-related costs, claims, road and railway connections to the ports should be developed by considering alternative routes in the hinterland distribution of project cargoes. Another barrier related to project cargo logistics is considered as regulations and rules slowing down and restricting the logistical processes of project cargo operations. No consensus has been achieved in this statement (11th statement) so it has been revised in the second round. Non-consensus could be due to the fact that there are no specific procedures, rules or codes for the logistical processed of project cargo in Turkey. Hence, the gap in the project cargo industry with regards to legal implications of the processes should be removed.

Project cargo logistics value creation outcomes have been suggested to identify the main areas for development. No consensus (53.3%) has been achieved in the statement (9th statement) "In project cargo logistics, operational efficiency (reducing costs and time at a minimum) is more important than service effectiveness (flexibility, responsiveness and reliability in services)". The value is referred to as how well a project cargo logistics system

responds to customer demands, which is largely reflected in operational efficiency and service effectiveness. Project cargo logistics value is expected to cover both efficiency (reducing costs and time at a minimum) and effectiveness (flexibility, responsiveness and reliability in services), and 9th statement aims to find out which one is the more critical from perspectives of actors in the project cargo logistics process. Experts with both agree or disagree opinions have laid emphasis on inseparability of these two concepts and the service providers should maintain all of these factors to create value in the project cargo logistics process. Only 53.3% consensus has been achieved on operational efficiency's importance, therefore this statement has been revised in the second round of Delphi study. One of the value creation outcomes is added as technology adoption/ innovation by the partners involved in the project cargo logistics. However, no consensus (74.4%) has been achieved in the statement of "The actors involved in the project cargo logistics process can adapt to the latest changes in technology" (12th statement). This can be due to the fact that the actors and the experts in the study are still not well equipped with regards to technology adoption. Another dimension investigated in the study regarding value creation is about the satisfaction regarding the packaging services for project cargoes. There has been 50% agreement and 50% disagreement with the statement (13th statement) with three no-comment participants. The experts who disagree with the statement highlight that packaging is not viewed as the top priority so it has been was revised in the second round of the study. As a supporting finding to the value creation concept in project cargo logistics, most of the participants (93.3%) agreed that there is lack of human resources with the sufficient knowledge to manage the project cargo transportation processes in Turkey. Hence, skills and capabilities of both the employees in the field operations (ports, warehouses, hinterland distribution etc.) as well as the employees involved in the activities such as marketing, cargo-related dispute settlement, scheduling etc. are accepted as value creation factors in project cargo logistics.

The second round of Delphi research includes six revised questions with the feedback obtained from the same experts participated in the first round. According to the answers of 15 participants, APMO cut-off percentage rate for the second round Delphi study is considered as 97 %.According to the results of second round of Delphi Research, 1st, 3rd, and 4th statements as shown in Table 3 have achieved consensus degree with 100%. The results show once again that the factors such as partners' large and sufficient equipment and portfolio, operational efficiency and service effectiveness are considered very important during the project cargo logistics process. In addition, 2nd and 5th statements have achieved the consensus with the 93.3%. The second statement highlighting the role of cost factor in choosing partners in project cargo logistics has been accepted. Only one expert has disagreed and he has stated that cost factor was insignificant due to the high value of the project cargoes. Considering the statement on the necessity for specification and definition of the rules and regulations for project cargo transportation in Turkey, only one expert has stated that the current outlook on the legislation regarding project cargo operations is very satisfactory. This mainly shows that regulatory bodies involved in logistics and transportation should shed light on the specification of rules and regulations in project cargo logistics. In the second round, consensus has not been achieved (64.3%) in the last statement. The meaning of packaging has been asked more descriptively and the results showed

again that packaging service is not widely used during project cargo transportation in Turkey.

6. Conclusions, Limitations and Suggestions for Further Research

Although studies in logistics domain have made a remarkable development during years, literature on project cargo logistics remains limited in many ways. This study attempts to shed light on value creation enablers and outcomes of project cargo logistics and generate an understanding of the main barriers hampering the development of project cargo logistics from the perspectives of main actors who perform their operations in Turkey. Due to the unique and distinctive characteristics of each project, it is considered to be the most complex cargo types whose movements require skilled rigger, training, lifting and moving equipment and teamwork. Therefore, there is an increasing need for both academics and practitioners to observe and understand the critical components of project cargo logistics operations from value creation perspective. In addition, this research provides both theoretical contribution and managerial implications by describing project cargo logistics value from the viewpoint of related parties. To the best of authors' knowledge, this study is a pioneer research on understanding and identifying the value creation enablers and outcomes of project cargo logistics operations from the case of Turkey.

The study provides an attempt to support the literature on logistics value creation by focusing on the specific case of project cargo operations by combining the relevant outcomes of the previous studies. Enablers describe the critical factors to be considered in value creation for achieving operational efficiency and service effectiveness. Operational efficiency and service effectiveness have mainly been discussed by scholars in maritime logistics field [47][28][2]. Findings show that the participants consider both operational effectiveness and service effectiveness critical for project cargo logistics value creation. Another outcome is suggested as technology adoption/innovation. In line with the previous literature Lynch et al. [58], Langley and Holcomb, [59], Yazdanparast et al. [2],Panayides and So [47], such outcome is considered critical for increasing customer satisfaction in project cargo operations. However, participants are mainly dissatisfied with the current situation of service providers concerning technology adoption/innovation. Hence investments for improving IT systems, handling equipment can be suggested for developing the current situation in project cargo operations in Turkey.

In terms of managerial implications, the enablers, as well as the outcomes, intend to provide a starting point for understanding the project cargo logistics value creation. Enablers show the critical factors to be considered by the practitioners prior to and during the project cargo logistics operations. These enablers suggest that managers should focus on partner selection and operations-related factors in order to achieve value creation by eliminating possible barriers in the system. Specifically, continuous information sharing with experienced partners and skilled personnel should be achieved in operations. Risk analysis should also be conducted to achieve a smooth flow of project cargoes. Governmental bodies should focus on developing the required infrastructure, namely port storage areas, road and railway connections of the ports to the hinterland. Enablers, barriers and the outcomes offer the initial knowledge of what is needed to constitute a value-creating project cargo logistics operation.

Delphi method has been applied in this research to gain insight about value creation perspectives of main actors

involved in project cargo operations. The study consists of 2 rounds. Statements over 70% consensus degree have been accepted. Project cargo logistics can be highly costly and risky, so not only freight forwarders but also various partners have significant importance. In the partner selection, the experience is seen as the most critical factor. In addition, equipment portfolio is heavily highlighted as a decisive factor in the partner selection. Moreover, cost, brand name, and experiences are viewed as critical criteria in the partner selection for project cargo logistics processes. There is a strong emphasis on the existence of barriers for the creation of superior project cargo logistics value with high consensus degree. Most of the participants declared that Turkey has a great potential in terms of the project cargo logistics but the current logistics environment is considered poor regarding limited port infrastructure, hinterland connections with alternative modes of transportation, legal procedures hampering the smooth flow of cargoes and lack of developed warehousing facilities.

There are some limitations in this study. One of the limitations of the study is the limited number of academic studies on project cargo logistics in the literature. This scarcity has directed the authors to adopt some of the concepts from maritime logistics to project cargo logistics and value creation as well. In addition, there is a very limited sample in project cargo logistics operations in Turkey so great attention has been given to selection process of the experienced participants from such limited sample. Considering the limited academic resources on project cargo logistics process, this study may provide a basis for future studies on project cargo logistics. The components with sub-components in this study may be employed in a future survey research aiming to identify the relationships between the value-creating activities in project cargo logistics. Such empirical research may provide fruitful outcomes to understand the impact of firm size, nationality, operation and service scope on the value creation capability of the firms. Descriptive statistics and hypotheses tests may be employed to identify such relationships. Qualitative studies such as in-depth interviews or focus group studies may also be conducted to gain a deeper insight on the views of the experts in the field regarding value creation processes and components.

References

[1] Gourdin, K.N. (2001). Global logistics management: a competitive advantage for the new millennium. Oxford: Blackwell.

[2] Yazdanparast, A., Manuj, I. and Swartz, S. M. (2010).Co-Creating Logistics Value: A Service-Dominant Logic Perspective. International Journal of Logistics Management,21(3): 375-403

[3] Mentzer, J.T., Flint, D.J. and Hult, T. (2001). Logistics service quality as a segmentation-customized process. Journal of Marketing, 35(4): 82-100.

[4] Bowersox, D.J., Closs, D.J. and Stank, T.P. (2000). Ten mega trends that will revolutionalize supply chain and logistics. Journal of Business Logistics, 21(2): 1-15.

[5] Mentzer, J.T., Rutner, S.T. and Matsuno, K. (1997). Application of the means-end value hierarchy model to understanding logistics service value. International Journal of PhysicalDistribution & Logistics Management, 27(9/10): 630-43.

[6] Fagerholt, K., Hvattum, L.M., Johnsen, T.A.V., and Korsvik, J.E. (2013). Routing and scheduling in project shipping. Ann Oper Res, 207:67–81

[7] Investment Support and Promotion Agency. (2018). Investing in infrastructure and public-private partnership in Turkey. Accessed on 30 May 2018, http://www.invest.gov.tr/en-US/infocenter/publications/Documents/INFRASTRUCTURE.INDUSTRY.pdf

[8] UK P&I Club. (2014). How to safely load, stow heavy lifts and project cargo. Online available at http://www.agcs.allianz.com/assets/PDFs/ARC/Risk%20Bulletins/Load-stow-secure-and-discharge-heavy-lifts-and-project-cargo.pdf Accessed Date: 22 November 2017.

[9] Sarı, A. (2016). Proje yük taşımacılığında yol izin belgeleri ve kuralları. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 30(3): 545-551.

[10] Aamuvuori, A. (2014). Project deliveries: Barriers & opportunities of transport logistics in the Barent region, Master's Thesis, University of Oulu, Finland.

[11] Çınar, H. (2014). Proje taşımacılığı. Dünya Gazetesi. Online available at https://www.dunya.com/kose-yazisi/proje-tasimaciligi/20232. Accessed Date: 23 November 2017

[12] Yeni enerji.com (2013). Proje Taşımacılığında Sorunlara Rağmen Kapasiteler Artıyor. Online available at http://www.yenienerji.info/dosya/proje-tasimaciliginda-sorunlara-ragmen-kapasiteler-artiyor. Accessed Date: 23 November 2017

[13] Kuleyin, B. and Cerit A.G. (2017). Turkish seaborne trade and the effects of the strategic developments in the international energy and transport corridors: A qualitative research. Journal of ETA Maritime Science, 5(2): 120-138

[14] TOBB (2016). Proje taşımacılığının umudu mega projeler ve enerji yatırımları. Online available at https://haber.tobb.org.tr/ekonomikforum/2017/270/068_073.pdf Accessed Date: 22 November 2017 .

[15] Anderson, E. (1995). Value in ethics and economics. Massachusetts, Harvard University Press.

[16] Parasuraman, A. (1997). Reflections on gaining competitive advantage through customer value. Journal of the Academy of Marketing Science, 25(2): 154-61.

[17] Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. Journal of Marketing, 52(3): 2-22.

[18] Vargo, S. L. (2008). Customer integration and value creation: paradigmatic traps and perspectives. Journal of Service Research, 11(2): 211-215.

[19] Porter, M. (1985). Competitive advantage: Creating and sustaining superior performance. New York: The Free Press.

[20] Linn, S. (2015). Relationship structures, their integration and value in maritime logistics networks, Unpublished Post-Doctoral Dissertation, UK: Cardiff University.

[21] Baudin, M. (2004). Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods. New York: Productivity Press.

[22] Lai, K. H., Ngai, E. W. T. and Cheng T. C. E. (2002). Measures for evaluating supply chain performance in transport logistics. Transport Research, 38(E): 439-456.

[23] Wang, Y., Lo, H. P., Chi, R. and Yang, Y. (2004). An integrated framework for customer value and customer-relationship-management performance: A customer-based perspective from China. Managing Service Quality, 14(2/3): 169–182.

[24] Mentzer, J. T. and Flint D. J. (1997). Validity in logistics research.Journal of Business Logistics, Vol. 18(2) : 199-216.
[25] Saatçioğlu, S. and Saygılı M. (2013). Intermodal taşımacılıkta denizyolu – demiryolu entegrasyonunun ekonomik ve çevresel açıdan değerlendirilmesi. Journal of ETA Maritime Science, 1(2): 19-26.
[26] Panayides, P. M. and Song, D. W. (2013). Maritime logistics as an emerging discipline. Maritime Policy & Management,40(3): 295-308.
[27] Andersson, H., Duesund, JM. and Fagerholt, K. (2011) Ship routing and scheduling with cargo coupling and synchronization constraints. Computers & Industrial Engineering, 61(4): 1107–1116.
[28] Song, D. W. and Lee, P. (2009). Maritime logistics in the global supply chain. International Journal of Logistics: Research And Applications, 12(2): 83–84.
[29] Song, D. W. and Panayides P. M. (2012). Maritime logistics: A complete guide to effective shipping and port management. UK: Kogan Page.
[30] Bazaras, D., Batarlienė, N., Ramūnas, P. R. and Petraška, A. (2013). Optimal road rote selection criteria system for oversize goods transportation. The Baltic journal of road and bridge engineering, 8 (1): 19-24.
[31] Petraška, A. and Palšaitis, R. (2012). Evaluation criteria and a route selection system for transportating oversize and heavyweight cargoes. Transport Journal, 27(3): 327-334.
[32] Heidemann, A. and Gehbauer, F. (2011). The way towards cooperative project delivery. Journal of Financial Management of Property and Construction, 16(1): 19-30.
[33] Turoff, M. (1970). The design of a policy Delphi. Technological Forecasting and Social Change, 2: 149-171.
[34] McKenna, H.P. (1994). The Delphi technique: a worthwhile approach for nursing. Journal of Advanced Nursing, 19(6): 1221-1225.
[35] Loo, R. (2002) The Delphi method: a powerful tool for strategic management. Policing: AnInternational Journal of Police Strategies and Management. 25(4): 762-769.
[36] Mitchell, V. W. and McGoldrick P. J. (1994). The role of geodemographics in segmenting and targeting consumer markets: a Delphi study. European Journal of Marketing, 28 (5): 54-72.
[37] Strauss, H.J. and Zeigler, H.L. (1975). The Delphi technique and its uses in social science research. The Journal of Creative Behavior, 9(4): 253–259
[38] Rauch, W. (1979). The decision Delphi. Technological Forecasting and Social Change, 15 (3): 159-169
[39] Woudenberg, F. (1991). An evaluation of Delphi. Technological Forecasting And Social Change. 40: 131-150
[40] Linstone, H. A. and Turoff, M. (1975). The Delphi method: Techniques and applications. MA: Addison-Wesley.
[41] Dalkey, N. and Helmer, O. (1963). An experimental application of the Delphi Method to the use of experts. Management Science. 9(3): 458-467.
[42] Greatorex, J. and Dexter, T. (2000). An accessible analytical approach for investigating what happens between the rounds of a Delphi Study. Journal of Advanced Nursing. 32: 1016–1024.
[43] Branch, A. E. (2009). Global supply chain management and international logistics. New York: Routledge.
[44] Guzman, F. and Norgaar, J. (2000). Project cargo comes of age. World Trade, 13(10): 72-74.
[45] Lee, E. S., Nam, H. S. and Song, D.W. (2012). Maritime logistics: a new definition. Defining maritime logistics and its value (pp. 53-64). London: Kogan Page

[46] Zhao, M., Droge, C. and Stank, T.P. (2011). The effects of logistics capabilities on firm performance: Customer-focused versus information-focus capabilities. Journal of Business Logistics, 22(2): 91-107.

[47] Panayides, P. M. and So, M. (2005), Logistics service provider-client relationships. Transportation Research: Part E, Logistics and Transportation Review, 41(3): 179-200.

[48] Saldanha, J. and Gray, R. (2002) The potential for British coastal shipping in a multimodal chain. Maritime Policy & Management, 29(1): 77-92

[49] Islam, D. M. Z., Dinwoodie, J. and Roe M.(2006) Promoting development through multimodal freight transport in Bangladesh, Transport Reviews, 26(5): 571-591.

[50] Deveci, D. and Cerit, A. (2007) Competition and conflict in distribution channels of combined transport services. In: Proceedings of 12. National Marketing Conference. Sakarya, Turkey.

[51] Brett, V. and Roe, M. (2010). The potential for the clustering of the maritime transport sector in the Greater Dublin Region. Maritime Policy & Management, 37(1): 1-16.

[52] Von der Gracht, H. A. (2012). Consensus measurement in Delphi Studies. Technological Forecasting and Social Change. 79 : 1525-1536.

[53] Kapoor, P. (1987). Systems approach to documentary maritime fraud, Unpublished Doctoral Dissertation, Plymouth Polytechnic, Plymouth.

[54] Hasson F., Keeney S. & McKenna H. (2000). Research guidelines for the Delphi survey technique. Journal of Advanced Nursing: 32, 1008–1015.

[55] Fink, A., Kosecoff, J., Chassin, M. R. and Brook, R. H. (1991). Consensus methods characteristics and guidelines for use. California: Rand.

[56] Murphy M. K., Black, N.A., Lamping D. L., McKee C. M., Sanderson, C. F. B and Askham J. (1998). Consensus development methods and their use in clinical guideline development. Health Technol Assessment, 2(3).

[57] Thangaratinam, S. (2005). We Redman Charles The Delphi technique. The Obstetrician& Gynaecologist, 7:(120-125).

[58] Lynch, D. F., Keller, S. B. and Ozment, J. (2000). The effects of logistics capabilities and strategy on firm performance. Journal of Business Logistics, 21(2): 47-67.

[59] Langley, C. J. Jr and Holcomb, M. C. (1992). Creating logistics customer value. Journal of Business Logistics, 13 (2): 1-27.

Received: 14 May 2018 Accepted: 28 June 2018 *DOI ID: 10.5505/jems.2018.17136*

Journal of ETA Maritime Science

JEMS JOURNAL

Corresponding Author: Abdullah AÇIK

Efficiency in Dirty Tanker Market

Sadık Özlen BAŞER, Abdullah AÇIK

Dokuz Eylül Üniversitesi, Denizcilik Fakültesi, Türkiye
ozlen.baser@deu.edu.tr; ORCID ID: https://orcid.org/0000-0001-6632-2617
abdullah.acik@deu.edu.tr; ORCID ID: https://orcid.org/0000-0003-4542-9831

Abstract

The maritime industry is highly capital intensive. From this point of view, it is very important that the return of the investments made is healthy. This can be achieved by efficiency of the freight market. The aim of this study is to contribute to the literature by testing the efficiency of the dirty tanker freight market used for the transportation of crude oil, which still has a great demand in the world economy, using an alternative test. In this direction, the daily values of the 1-year times charter rates of Aframax, Suezmax and VLCC ship types were used and the efficiencies of these three sub markets were tested using the Brock, Dechert and Scheinkman (BDS) independence test. The data set covering the years 2005 and 2017 and consisting of 663 observations per ship type on a weekly basis was used. As a result of the study, it is determined that the dirty tanker market does not exhibit random walk, in other words, does not have the characteristics of the Efficient Market Hypothesis (EMH), and that the time charter rates are related to their past values. This situation makes it possible to obtain excess profits using past data and some trading strategies.

Keywords: *Efficient Market Hypothesis, Dirty Tanker Market, BDS Test.*

Kirli Tanker Piyasasında Etkinlik

Öz

Denizcilik sektörü oldukça sermaye yoğun bir sektördür. Bu açıdan yapılan yatırımların karşılığının sağlıklı bir şekilde geri dönmesi oldukça önemlidir. Bu da navlun piyasasının etkin olmasıyla sağlanabilir. Bu çalışmanın amacı, dünya ekonomisinde hala büyük bir talep gören ham petrolün taşımacılığında kullanılan kirli tanker navlun piyasasının etkinliğini alternatif bir test kullanarak test ederek literature katkıda bulunmaktır. Bu doğrultuda Aframax, Suezmax ve VLCC gemi tiplerinin 1 yıllık zaman kiralama bedellerinin günlük değerleri kullanılmıştır ve bu üç alt piyasanın etkinlikleri test edilmiştir. 2005 ve 2017 yıllarını kapsayan ve haftalık bazda her gemi türü için 663'er gözlemden oluşan veri seti kullanılmıştır. Veri seti Brock, Dechert ve Scheinkman (BDS) bağımsızlık testi kullanılarak analiz edilmiştir. Çalışmanın sonucunda kirli tanker piyasasının rassal yürüyüş sergilemediği, başka bir deyişle Etkin Piyasa Hipotezi (EPH) özelliklerine sahip olmadığı ve zaman kiralama bedeli değerlerinin geçmiş değerleriyle aralarında bir bağlantı olduğu tespit edilmiştir. Bu durum, geçmiş verilerin ve bazı stratejilerin kullanılarak olağanüstü karlar elde edilebilmesini mümkün kılmaktadır.

Anahtar Kelimeler: *Etkin Piyasa Hipotezi, Kirli Tanker Piyasası, BDS Test.*

To cite this article: Başer, S. Ö. and Açık, A. (2018). Efficiency in Dirty Tanker Market. *Journal of ETA Maritime Science*, 6(3), 275-287.
To link to this article: https://dx.doi.org/10.5505/jems.2018.17136

1. Introduction

There is a strong relationship between the energy demand and the economic growth [1], and the world economy fundamentally depends on fossil fuel energy resources such as coal, oil and natural gas. The share of these three main fossil fuel types in total consumption are about 30% for each. This great share of oil is very important in world economy since, in addition to its importance in electricity production and household heating, the main source of energy for transportation is oil. The economy needs transportation for the move of raw materials, final products, people and information [2].

Pipelines, tanker ships and land vehicles are generally used for transportation of oil. Tankers and pipelines are more economical options among them. Especially tanker shipping provides an economical and sufficient way to transport liquid bulk even compare to pipeline for long distance international and cross-continental seaborne trade[3]. Also, in some cases, dirty tankers are used as floating storage in order to store crude oil.

The maritime industry consists of two main markets; namely dry cargo and liquid cargo markets. These basic markets are also divided into sub markets; like dry cargo market is divided into two; General cargo markets and dry bulk markets. General cargo market is also divided into two; Break bulk markets and container markets. Liquid market which is our topic in this article is divided into two; Crude oil market and product market, but product market is also divided into two as dirty and clean markets. General definition of dirty market is also used for the crude oil, heavy fuel oil and unrefined condensates [3]. Like all others, crude oil market contains four closely related markets which are the freight (chartering the vessel by voyage or time charter basis, as well as chartering the bigger tonnage like Suezmax and VLCC for floating storage facilities especially passing last 2-3 years), sale and purchase, newbuilding and demolition markets. The freight market trades in sea transport to earn freight income; the sale and purchase market trades second-hand ships; the newbuilding market trades newly built ships; and the demolition market deals in ships for scrapping and recycling [4]. This study is interested in testing the Efficient Market Hypothesis (EMH) in the dirty freight market.

EMH which is the cornerstone of the modern finance theory was originally introduced by Fama [5]. An efficient market means that all information is instantly distributed on the market and there is no distortion in this system [6]. In other words, the prices on the market should contain all the information. Conventionally, the efficient market hypothesis may take on three forms; (1) If the current price incorporates all information in past prices, it is called weak form; (2) if the current price incorporates all publicly available information, it is called semi-strong form; or (3) if the current price incorporates all information, including private information, it is called strong form. [7]. In efficient markets, technical trading rules based on historical data cannot yield excess profits [8]. Because in such a market prices move randomly. In this respect, it is crucial for the market to have an efficient structure to provide a fair competitive environment for investors and stakeholders.

Freight rates used in transportation activities cannot be traded and stored. Therefore, the efficient market hypothesis in the traditional form cannot be used at freight rates. However, according to Adland and Strandenes [7], the concept of efficient market hypothesis can still be applied in the freight market. In this direction, the efficient market hypothesis in earnings of VLCC, Suezmax and Aframax vessels which are carrying out their operations in the

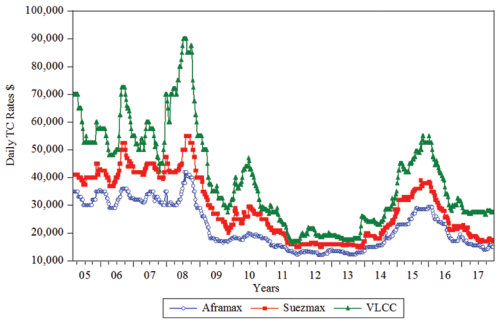


Figure 1. *Graphical Display of the One Year Time Charter Rates*

crude market was tested by using their daily rate of one-year time charter hire earnings.

Figure 1 presents the daily values of the one-year time charter rates for Aframax, Suezmax and VLCC tanker markets covering the years 2005 and 2017 based on weekly observations [9]. For example, in the VLCC market, even though rates peaked at around $ 90,000 on boom periods, they fell to as low as $ 16,000 during the collapse periods. When these extreme values are considered, estimating future values by looking at the past prices gives some stakeholders extraordinary returns. In this respect, the fact that the markets have an efficient structure contributes to a fair competitive environment.

This paper contributes to the literature by proposing an alternative test of market efficiency in the tanker freight market. The BDS Independence Test, designed by Brock, Dechert and Scheinkman [10], was used in this study to measure the randomness of the series. As a result of the study, it was determined that despite the structural differences between the tested markets, they did not have efficient market hypothesis characteristics.

The content of the study is organized as follows; in the literature review section, previous similar studies are examined and this study is positioned within them; in the methodology section, method and data set used in the study are introduced; in the findings section, results of the econometric analysis are presented; and lastly in the conclusion and discussion section, the findings of the study are evaluated and some proposals are presented to policy makers and stakeholders in the industry.

2. Literature Review

The efficient market hypothesis is not very popular in the maritime literature, but it is seen that the freight market and the sale and purchase market have been studied in general. Adland and Koekebakker [8] test the validity of the efficient market hypothesis in the sale and purchase market for bulk ships. They find that except some lower segments, sale and purchase market doesn't offer chance for excess profits. Same market is also investigated by Alizadeh and Nomikos [11]. They use some technical rules and find that these strategies are helping to generate excess profits. On the other hand, one of the studies that examines EMH in freight market is investigated by Tsioumas and Papadimitrou [12]. They have analyzed trip charter rates and time charter rates by implementing some trading strategies and they have found that following technical rules is helping to make excess profits. Another study by Nomikos and Doctor [13] shows that FFA markets can't have the characteristics of efficient market hypothesis as well. The investigation of the efficient market hypothesis in the tanker market subject to this study is also examined by the Adland and Stradenes [7]. They analyze past spot prices by technical methods and develop strategies. As a result they find that can make profits by using these techniques which are based on historical spot prices.

In addition to these, the efficient market hypothesis in the dry bulk market has been examined by the authors of the current study by several methods including the BDS independence test. Baltic Dry Index (BDI) has been used as a representative of dry

bulk freight earnings and as a result it has been found that BDI doesn't follow random walk. In other words, there have been a dependence between the index and its past values, indicating that future values could be estimated using past values and market has not been efficient in weak form [14]. As suggested at the end of that study, the same test has been also applied in this study to test EMH in the dirty tanker market.

This paper has been expected to contribute to the literature by proposing an alternative test of market efficiency in the tanker freight market. In the next section, the method and data used in the study have been introduced.

3. Methodology

There are many ways to test non-linear structures in time series. These tests are generally divided into two groups; general tests and special tests. General tests are used to determine deviations from the randomness in the data [15]. Among these tests, the BDS Independence Test, designed by Brock, Dechert and Scheinkman[10], has been used in this study to measure the randomness of the series.

The BDS test is applied to residuals of an estimated series of and checks whether the residuals are independent and identically distributed. The null hypothesis for this test implies that the data in a time series is independent and identically distributed [16]. Rejection of null hypothesis means that residuals contain some hidden, possibly non-linear structure in consequence of inefficient market.

For this purpose, Eviews 10 which is widely used and accepted econometric software has been used in this study. Firstly, Aframax, Suezmax and VLCC time charter values were converted into return series using the equation (1) below.

$$R_{TCRATE} = ln(TCRATE_t) - ln(TCRATE_{t-1}) \quad (1)$$

where;

$TCRATE_t$ is value of the related charter rate on week *t*

$TCRATE_{t-1}$ is value of the related charter rate on week *t-1*

After getting the return series for all variables, ARMA models which have the lowest value of Akaike were selected for each series using Automatic ARIMA function of the software. Then, the three proposed models were estimated and the residuals were extracted. This method also helps to improve the results of the analysis by reducing the variance studied. Lastly BDS Independence tests were applied to the residuals of each series in order to determine whether there were dependencies between residual values or not.

3.1. Data

Tanker types used in transporting crude oil are Handymax (<50,000 dwt), Panamax (50,000-80,000 dwt), Aframax (80,000-120,000 dwt), Suezmax (120,000-200,000 dwt), VLCC (200,000-320,000 dwt) and ULCC (>320,000 dwt) in general [17]. In terms of accessibility to the data, the types subject to this study are Aframax, Suezmax and VLCC.

Descriptive statistics of the dataset used are shown in Table 1. The data covers the dates between 23rd February 2005 and 20th December 2017 on a weekly basis and consists of 663 observations. All of the return series are not normally distributed according to the Jarque-Bera statistic. Also when the Kurtosis and Skewness values of the return series are examined, it can be seen that the data are skewed and the tail effects are excessive. Additionally, for Suezmax and VLCC charter rates, skewness values are positive but negative for Aframax charter rates. The fact that a positive value indicates that the market is more influenced by positive news, while the negative value indicates the opposite

Table 1. *Descriptive Statistics for Variables*

	AFRAM.	SUEZM.	VLCC	R. AFRA	R. SUEZ	R. VLCC	RES. AF.	RES. SU.	RES. VL.
Mean	22274.43	29026.02	9763.57	-0.001280	-0.001330	-0.001411	-7.41E-06	1.31E-08	1.33E-05
Median	8750.00	6500.00	5000.00	0.000000	0.000000	0.000000	0.000836	0.001039	0.000957
Maximum	2000.00	5000.00	0000.00	0.121361	0.131028	0.287682	0.115801	0.120015	0.275475
Minimum	2000.00	4750.00	6000.00	-0.154151	-0.111226	-0.125163	-0.156628	-0.104010	-0.110047
Std. Dev.	211.199	1157.25	7703.44	0.023899	0.027528	0.033541	0.023023	0.026441	0.031846
Skewness	.461638	.386504	.684717	-0.230261	0.683766	1.397020	-0.375987	0.551844	1.349160
Kurtosis	.810227	.847791	.753769	10.70107	9.372349	14.36803	11.14114	8.325288	13.71446
Jarque-Bera	2.65348	3.18169	3.48143	1641.718	1171.657	3779.984	1843.768	815.8272	3367.387
Probability	.000000	.000000	.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	663	663	663	662	662	662	662	662	662
Std.Dv./ Mean	37%	38%	45%						

Source: *Fearnley Review*

situation. This means that the Aframax market has different characteristics than the other two markets. The last row of the table contains values showing the volatility of the markets, and according to this table, the riskiest market is the VLCC market with 45%. Aframax is relatively less risky market (37%) since mainly operated in short and medium distances in Continental and MediterraneanEurope, West Africa, US Gulf and Far East.

When the movements of the three markets involved in the study were examined, it was obvious that there were significant correlations between them in the positive direction because of the fact that they are naturally in the same market. Table 2 shows both Pearson's and Spearman's correlations coefficients. The directions of movement are in the same direction, but the reactions they give to macroeconomic events are different as deduced from the skewness values.

Table 2. *The Results of the Correlation Analysis*

(t statistics) Probabilities		Pearson's Correlation		
		R AFRA	**R SUEZ**	**R VLCC**
Spearman's Correlation	**R AFRA**	1.000000	0.398479	0.420371
		-----	(11.16155)	(11.90226)
		-----	0.0000	0.0000
	R SUEZ	0.404510	1.000000	0.470585
		(11.36321)	-----	(13.70147)
		0.0000	-----	0.0000
	R VLCC	0.436240	0.427833	1.000000
		(12.45481)	(12.16036)	-----
		0.0000	0.0000	-----

In the next step, the BDS Independence test was implemented along with the Findings section in order to check whether three submarkets under the same market have efficient market characteristics or not.

4. Findings

The findings section was first initiated by selecting the most appropriate ARMA models for the return series of Aframax, Suezmax and VLCC time charter rate values. For this purpose, the optimal model for each variable was determined by using the automatic ARIMA forecasting function in the econometric software. In Attachment 1, the return series of each variable and the figures of the most appropriate model values are presented. Models that offer the lowest Akaike Information Criteria value were selected. At the analysis interface, the maximum AR and MA values were selected as 12, and the maximum difference value was selected as 0.

After analysis for each variable was completed, for Aframax, the ARMA (5, 4) model, which provides Akaike value of -4.672, was selected. For Suezmax, the ARMA (9, 12) model with a Akaike value of -4.374 was selected. Lastly for VLCC, the ARMA (5, 5) model which has -4.008 Akaike value was selected. After the optimal models for each variable were determined, the next step was the estimation of ARMA equations.

The determined ARMA (5, 4) model was estimated for Aframax and the results were presented in Attachment 2.At this point, the individual significance of the variables does not mean much, and it is more important that the model is meaningful as a whole. F test shows the significance of the model as a whole, and as seen in Attachment 2, the model established for Aframax is significant ($p<0.05$). Another important point is that AR and MA roots should be smaller than 1. When all the indicators in the table were examined, it was seen that all of the roots meet this necessity.

The estimation results of the ARMA (9, 12) model for Suezmax were shown in Attachment 3. When the F test and the AR and MA roots were examined, it was seen that the model was significant as a whole ($p<0.05$) and the roots were smaller than 1.

Finally, the ARMA (5, 5) model for the VLCC was estimated and the results were presented in Attachment 4. The established model was significant as a whole and the all roots were less than 1. As a result, all ARMA models were found to be utilizable for further analysis. In the next process, residuals were separated from the 3 established models and the BDS analysis was implemented.

Graphical display of residuals separated from ARMA models were presented in Figure 2. Volatility is most commonly encountered in the Suezmax data set, and VLCC is the least volatile one. This situation can be interpreted as the fact that EMH is stronger in the Suezmax market.

Then the Fraction of Pairs method was chosen and 6 was selected as the maximum DIM from the software interface. Also Bootstrap option was used by selecting 1000 repetitions. The results of the BDS test are shown in Table 3. Independence was rejected in all dimensions of all

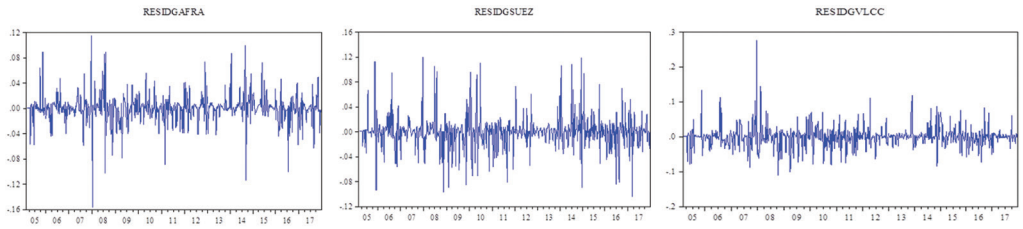


Figure 2. *Residuals of ARIMA Models*

Table 3. *BDS Independence Test Results*

Markets	Dimension	BDS Statistic	Std. Error	z-Statistic	Normal Prob.	Bootstrap Prob.
AFRAMAX	2	0.015454	0.004916	3.143507	0.0017	0.0040
	3	0.027535	0.007856	3.505104	0.0005	0.0000
	4	0.035906	0.009412	3.814833	0.0001	0.0000
	5	0.033761	0.009874	3.419183	0.0006	0.0020
	6	0.031553	0.009586	3.291427	0.0010	0.0060
SUEZMAX	2	0.010848	0.004944	2.194116	0.0282	0.0500
	3	0.016058	0.007882	2.037340	0.0416	0.0580
	4	0.022723	0.009421	2.411922	0.0159	0.0220
	5	0.026598	0.009860	2.697591	0.0070	0.0080
	6	0.027396	0.009550	2.868643	0.0041	0.0040
VLCC	2	0.021551	0.004645	4.639571	0.0000	0.0000
	3	0.033154	0.007403	4.478434	0.0000	0.0000
	4	0.040548	0.008846	4.583757	0.0000	0.0000
	5	0.042797	0.009254	4.624483	0.0000	0.0000
		0.041764	0.008960	4.661392	0.0000	0.0000

markets according to normal probabilities. According to the bootstrap probabilities, independence for all markets was rejected once again, but the probabilities of the Suezmax market were close to the critical values. But their rejection did not constitute major problems in terms of the reliability of the results of the test. As a result, the tanker market consisting of Aframax, Suezmax and VLCC markets were not efficient in the weak form.

5. Conclusion

Raw materials, final products, people and information need transportation for economic and social activities [2]. There are many modes of transport for this requirements and sea transport is one of the most utilized modes within them since it is the most economical mode for long range transportation of big lots of cargoes which has low value. Like other modes of transport, the demand for sea transport is a derived-demand from international trade. So, transport service providers do not have significant control power and influence over this demand [18].Also free and fair competition rules is valid and effective in the market, since one or two ship owners cannot dominate the market with their tonnage supply. As well as current and valid antitrust law does not permit this kind of applications. Freight occurs in the market under full competition rules. Due to these reasons, freight revenues are vital for shipowners and the return on investment in ships relies on seaborne trade volume [4], especially in the tanker market, which is known as a capital intensive industry [19]. At this point, a random walk of freight rates contributes to ensuring a fair competitive environment for relatively small investors.

This can be achieved through market efficiency.

In this study, it was tested whether the daily values of 1-year time charter hiring rates of the Aframax, Suezmax and VLCC ship types, which have important share in the tanker market, are efficient or not. Previously, freight markets have been examined in the literature and the results have shown that freight markets are not efficient [12, 13, 7].EMH was also tested by us with BDS test in dry bulk market, and it was found that there were dependencies between past values of the Baltic Dry Index which was an indication of inefficient market conditions [14].

This paper was expected to contribute to the literature by proposing an alternative test (BDS Independence Test) of market efficiency in the tanker freight market and it plays a complementary role.As a result of the analyzes carried out, it was determined that time charter rates of the all three markets had dependencies between their past values and the markets did not have EMH characteristics in the weak form. Thanks to this dependence, it can be said that technical and commercial rules or strategies can be followed to achieve excess profits in the tanker market.

The most important limitation of the study is that data has been compiled from 663 free reports and consists of weekly observations. Even though the time charter rates are not instantly variable values, it may be more useful to use the daily frequency. Further studies may generate trading scenarios in the freight market and test excess profitability based on the results of different econometric methods. Also as investigated by Skewness values of the series in the data section, different structure of Aframax market can be analyzed.

References

[1] Kuleyin, B., & Cerit, A. G. (2017). Turkish Seaborne Trade and The Effects of the Strategic Developments in The International Energy and Transport Corridors; A Qualitative Research. Journal of ETA Maritime Science, 5(2): 120-138.

[2] Carmalt, S. W. (2017). The Economics of Oil: A Primer Including Geology, Energy, Economics, Politics. Springer.

[3] Lun, Y. V., Hilmola, O. P.,Goulielmos, A. M., Lai, K. H. and Cheng, T. E. (2012). Oil Transport Management. Springer Science & Business Media.

[4] Stopford, M. (2009). Maritime Economics. Routledge, New York

[5] Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. Journal of Finance, 25(2): 373–417.

[6] Engelen, S., Dullaert, W.andVernimmen, B. (2009). Market Efficiency within Dry Bulk Markets in The Short Run: A Multi-Agent System Dynamics Nash Equilibrium. Maritime Policy & Management: The Flagship Journal of International Shipping and Port Research, 36(5): 385-396.

[7] Adland, R.and Strandenes, S. (2006). Market Efficiency in The Bulk Freight Market Revisited.Maritime Policy & Management: The Flagship Journal of International Shipping and Port Research, 33(2): 107-117.

[8] Adland, R. amdKoekebakker, S. (2004). Market Efficiency in the Second-hand Market for Bulk Ships. Maritime Economics & Logistics, 6: 1–15.

[9] Fearnley Weekly Review. (2018). 1 Year Time Charter Earnings. Access Date: 20.02.2018, https://www.fearnleys.com/weekly-research.

[10] Brock, W. A., Dechert, W. D. and Scheinkman, J. A. (1987). A Test for Independence Based On the Correlation Dimension, Manuscript, Social Systems Research Unit, University of Wisconsin.

[11] Alizadeh, A. H., and N. K. Nomikos. 2007. Investment Timing and Trading Strategies in the Sale and Purchase Market for Ships.Transportation Research Part B: Methodological, 41(1): 126–143.

[12] Tsioumas, V. and Papadimitriou, S. (2015). Excess Returns in The Spot Market for Bulk Carriers. Maritime Economics & Logistics, 17(4): 399-415.

[13] Nomikos, N. and K. Doctor. (2013). Market Timing Strategies in the Freight Derivatives Market.Transportation Research Part E: Logistics and Transportation Review, 52: 77–93.

[14] Açık, A. and Başer, S. Ö. (2018). Is Baltic Dry Index Efficient?.Journal of Yasar University, 13(50):140–149.

[15] Brooks, C. (2014). Introductory Econometrics for Finance. Cambridge University Press.

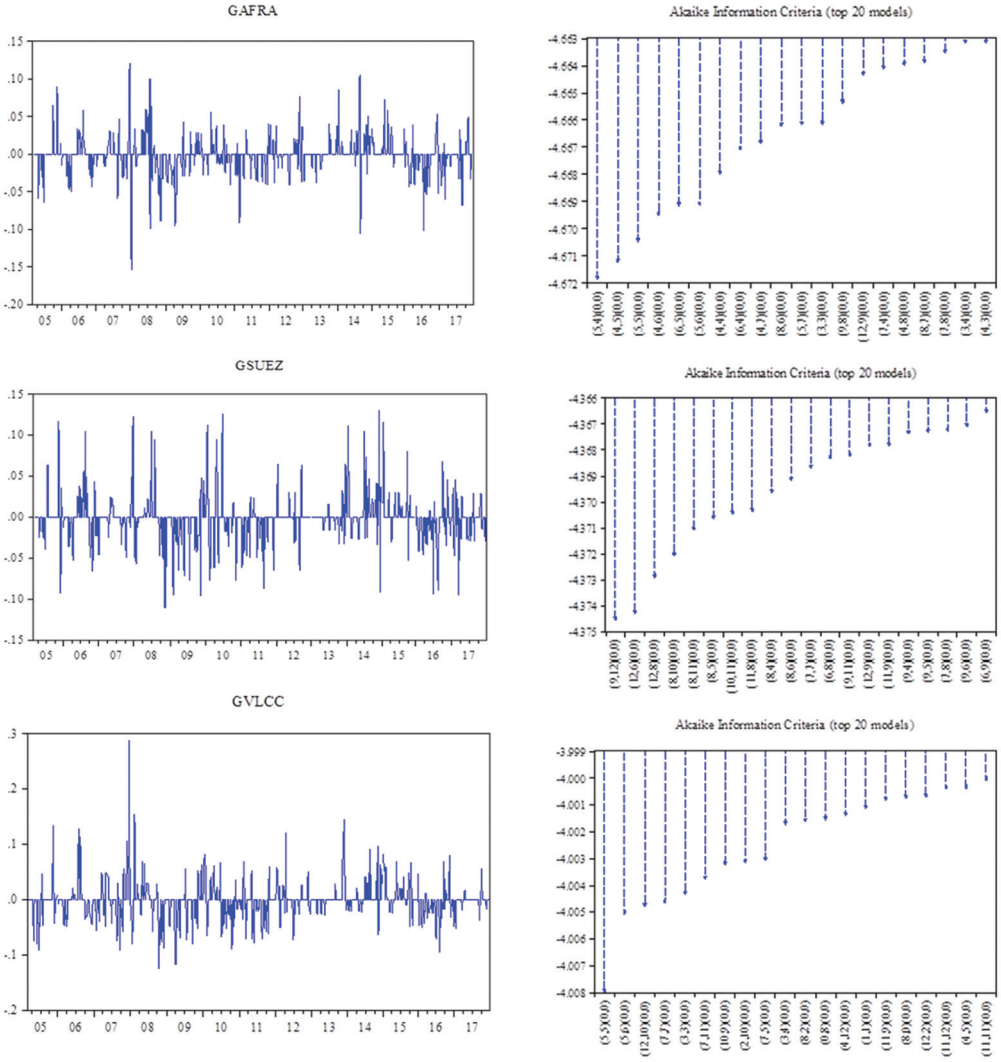
[16] Broock, W. A., Scheinkman, J. A., Dechert, W. D. and LeBaron, B.(1996). A Test for Independence Based on the Correlation Dimension.Econometric Reviews, August, 15(3): 197–235.

[17] Plunkett, J. W. (2010). Plunkett's Transportation, Supply Chain & Logistics Industry Almanac 2010. Plunkett Research, Ltd.

[18] McConville, J. (1999). Economics of Maritime Transport: Theory and Practice. Witherby, London

[19] Chen, Y. S and Wang, S. T. (2004). The Empirical Evidence of the Leverage Effect On Volatility in International Bulk Shipping Market. Maritime Policy Management, 31(2):109–124.

Attachment Figure 1. *Graphical Display of Return Series and Their Best ARMA Models*



Attachment Table 1. *ARMA (5, 4) Model Estimation Results of AFRAMAX*

Dependent Variable: R AFRA				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Sample: 3/02/2005 12/20/2017				
Included observations: 662				
Convergence achieved after 47 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.001298	0.001391	-0.933399	0.3510
AR(1)	0.768444	0.086444	8.889533	0.0000
AR(2)	0.342337	0.105220	3.253533	0.0012
AR(3)	0.430813	0.146578	2.939138	0.0034
AR(4)	-0.839491	0.070930	-11.83554	0.0000
AR(5)	0.098931	0.045485	2.175057	0.0300
MA(1)	-0.735464	0.088678	-8.293667	0.0000
MA(2)	-0.267561	0.106194	-2.519535	0.0120
MA(3)	-0.498695	0.138480	-3.601211	0.0003
MA(4)	0.789317	0.088074	8.961948	0.0000
SIGMASQ	0.000529	1.60E-05	33.17569	0.0000
R-squared	0.072036	**Mean dependent var**		-0.001280
Adjusted R-squared	0.057781	**S.D. dependent var**		0.023899
S.E. of regression	0.023199	**Akaike info criterion**		-4.671797
Sum squared resid	0.350354	**Schwarz criterion**		-4.597103
Log likelihood	1557.365	**Hannan-Quinn criter.**		-4.642849
F-statistic	5.053550	**Durbin-Watson stat**		2.004616
Prob(F-statistic)	0.000000			
Inverted AR Roots	.92-.26i	.92+.26i	.13	-.60+.71i
	-.60-.71i			
Inverted MA Roots	.92+.30i	.92-.30i	-.55+.73i	-.55-.73i

Attachment Table 2. *ARMA (9, 12) Model Estimation Results of SUEZMAX*

Dependent Variable: GSUEX				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Sample: 3/02/2005 12/20/2017				
Included observations: 662				
Convergence not achieved after 500 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.001352	0.001845	-0.732708	0.4640
AR(1)	-0.465084	0.348449	-1.334728	0.1824
AR(2)	0.014954	0.257982	0.057966	0.9538
AR(3)	-0.491476	0.275292	-1.785288	0.0747
AR(4)	-0.453668	0.275083	-1.649208	0.0996
AR(5)	-0.053469	0.296990	-0.180036	0.8572
AR(6)	0.199441	0.244852	0.814535	0.4156
AR(7)	-0.335028	0.215883	-1.551899	0.1212
AR(8)	0.341593	0.263525	1.296245	0.1954
AR(9)	0.620961	0.217514	2.854804	0.0044
MA(1)	0.523372	0.355471	1.472333	0.1414
MA(2)	0.091804	0.270238	0.339713	0.7342
MA(3)	0.560034	0.289507	1.934441	0.0535
MA(4)	0.617853	0.296872	2.081210	0.0378
MA(5)	0.176273	0.367831	0.479224	0.6319
MA(6)	-0.080770	0.309685	-0.260813	0.7943
MA(7)	0.441687	0.293895	1.502875	0.1334
MA(8)	-0.174786	0.346007	-0.505152	0.6136
MA(9)	-0.581559	0.234560	-2.479368	0.0134
MA(10)	-0.039891	0.084664	-0.471166	0.6377
MA(11)	0.043004	0.086279	0.498432	0.6184
MA(12)	-0.020099	0.070011	-0.287087	0.7741
SIGMASQ	0.000698	4.30E-05	16.25049	0.0000
R-squared	0.077456	**Mean dependent var**		-0.001330
Adjusted R-squared	0.045694	**S.D. dependent var**		0.027528
S.E. of regression	0.026892	**Akaike info criterion**		-4.352852
Sum squared resid	0.462106	**Schwarz criterion**		-4.196672
Log likelihood	1463.794	**Hannan-Quinn criter.**		-4.292324
F-statistic	2.438640	**Durbin-Watson stat**		1.999880
Prob(F-statistic)	0.000283			
Inverted AR Roots	.85	.69-.72i	.69+.72i	.19-.94i
	.19+.94i	-.64-.75i	-.64+.75i	-.90-.08i
	-.90+.08i			
Inverted MA Roots	.77	.70-.72i	.70+.72i	.20+.94i
	.20-.94i	.18+.22i	.18-.22i	-.54
	-.63+.76i	-.63-.76i	-.82-.06i	-.82+.06i

Attachment Table 3. *ARMA (5, 5) Model Estimation Results of VLCC*

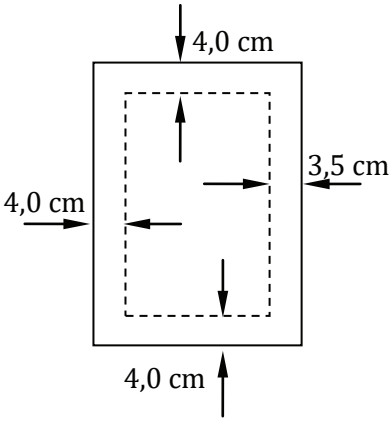
Dependent Variable: GVLCC				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Sample: 3/02/2005 12/20/2017				
Included observations: 662				
Failure to improve objective (singular hessian) after 423 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.001424	0.002445	-0.582681	0.5603
AR(1)	-0.157599	0.093441	-1.686613	0.0922
AR(2)	0.173959	0.086626	2.008151	0.0450
AR(3)	-0.433293	0.054600	-7.935761	0.0000
AR(4)	-0.162300	0.080549	-2.014917	0.0443
AR(5)	0.755225	0.080550	9.375833	0.0000
MA(1)	0.321178	6.156482	0.052169	0.9584
MA(2)	-0.011202	2.909526	-0.003850	0.9969
MA(3)	0.539599	0.187629	2.875884	0.0042
MA(4)	0.306491	7.197334	0.042584	0.9660
MA(5)	-0.687484	9.220220	-0.074563	0.9406
SIGMASQ	0.001013	0.002814	0.359803	0.7191
R-squared	0.098520	**Mean dependent var**		-0.001411
Adjusted R-squared	0.083264	**S.D. dependent var**		0.033541
S.E. of regression	0.032114	**Akaike info criterion**		-4.008003
Sum squared resid	0.670368	**Schwarz criterion**		-3.926518
Log likelihood	1338.649	**Hannan-Quinn criter.**		-3.976423
F-statistic	6.457874	**Durbin-Watson stat**		2.011635
Prob(F-statistic)	0.000000			
Inverted AR Roots	.82	.38+.91i	.38-.91i	-.86-.46i
	-.86+.46i			
Inverted MA Roots	.69	.37+.93i	.37-.93i	-.88-.48i
	-.88+.48i			

This Page Intentionally Left Blank

1. JEMS publishes studies conducted in English and Turkish.

2. Text are to be prepared with justified alignment , without indentation in the paragraph beginning, in "cambria" format with 10 point font size and with 1,0 line- spacing. There must be initially 6nk and then 3nk line-spacing between new launching paragraph and previous paragraph. Full text should not exceed 12 pages.

3. Worksheets must be on A4 paper size and margins should be 4 cm from top, 4 cm from bottom, 4 cm from left and 3,5 cm from right.



4. The text of abstract should be written fully justified, in italics and 10 pt. The section should be also no more than 150 words. The number of keywords should be between 3-5.

5. Studies must be submitted online from the journal's web address (http://www.jemsjournal.org). Articles printed or within CD, articles submitted by mail, fax etc. is not acceptable.

6. The main title of article must be written in Turkish and English respectively for Turkish studies, in English for English studies and should be set centered in 12 point-size. Initially 6nk and after 6nk space should be left before the main title.

7. The first letter of the primary headings in the article should be capital letter, and all headings and sub-headings should be designed 10 pt, bold and located to the left with numbering, and also navy blue color should be used for sub-headings.

1. OrcaFlex Program
1.1. Axis Team

8. The table heading should be placed above the table and the figure heading should be placed below the figure. 2 nk spaces should be added before the table heading and figure heading and also 3 nk space should be added after. The "table" and the "figure" should be written as bold and left aligned. First letters of table, figure and equation headings should be written with capital letters. The heading and the content should be written with "cambria" font and 10 point size. If tables, figures and equations in the study are cited, their references should be stated. 2 nk spaces should be added before references and 3 nk spaces should be added after. If tables and figures don't fit into a single column, they should be designed to include two columns. Tables and figures which include two columns should be stated at the top or bottom of the page. Total number of figures and tables should not exceed 10.

Table 1. *Sample Table*

Turkish Male Seafarers (n = 131.152)	BMI < 25,0	BMI 25 - 30	BMI ≥ 30	Number of Participants
16-24 Ages Group	74,1%	22,5%	3,4%	34.421
25-44 Ages Group	44,1%	43,3%	12,6%	68.038
45-66 Ages Group	25,6%	51,1%	23,4%	28.693
All Turkish Male Seafarers	47,9 %	39,6 %	12,5%	131.152
Turkish Male Population*1	47,3 %	39,0 %	13,7 %	-

9. In the article, decimal fractions should be separated with comma and numbers should be separated with dots.

   Average age: 28,624
   Number of participants: 1.044 people

10. Page numbers, headers and footers should not be added to the study. These adjustments will be made by the journal administration.

11. Authors are deemed to have accepted that they have transferred the copyright of their studies to the journal by submitting their studies to our journal. Submitting a study to two different journals simultaneously is not suitable within the frame of academic ethics.

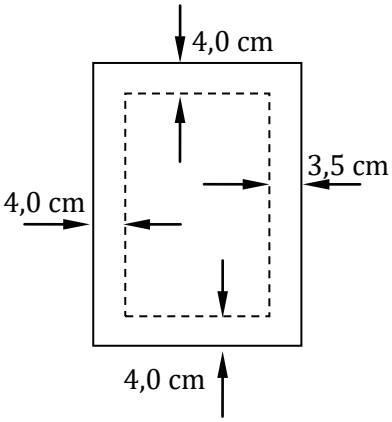
12. It is required that the studies are original and have not been published elsewhere before. If conference and symposium papers were published in a booklet, in this case they shall be published by JEMS on the condition that the copyright has not been transferred to the first publishing place. Information must be given to the journal editorship about the place where these kinds of papers were published before.

13. Citations in the study should be designed in brackets by numbering [1]. References also should be numbered in brackets as well. References should be prepared according to the APA format.

1. JEMS Türkçe ve İngilizce çalışmalar yayımlamaktadır.

2. Hazırlanan metinler; iki yana yaslanmış, paragraf başlarında girinti yapmadan, "cambria" formatında, 10 punto büyüklüğünde ve 1,0 satır aralıklı yazılmalıdır. Yeni başlanan paragraflar ile bir önceki paragraf arasında önce 6nk sonra 3nk satır aralığı olmalıdır. Tam metin toplam sayfa sayısı 12 sayfayı geçmemelidir.

3. Çalışma sayfaları A4 kağıt boyutunda ve üst 4 cm, alt 4 cm, sol 4 cm, sağ 3,5 cm olacak şekilde kenar boşlukları bırakılmalıdır.



4. Öz bölümünde çalışma ile ilgili kısa bilgilere ve temel bulgulara yer verilmelidir. Bu bölüm iki tarafa dayalı, italik ve 10 pt ile yazılmalı ve ayrıca 150 kelimeyi geçmemelidir. Bunun yanında anahtar kelimelerin sayısı ise 3-5 arasında olmalıdır.

5. Çalışmalar derginin web adresinden (http://www.jemsjournal.org) online olarak gönderilmelidir. Basılı ya da CD içerisinde veya posta, faks vb. yollarla gönderilen yazılar kabul edilmemektedir.

6. Makalenin ana başlığı, Türkçe çalışmalarda sırasıyla Türkçe ve İngilizce, İngilizce yazılmış makalelerde ise İngilizce olarak yazılmalı ve 12 punto büyüklüğünde ortalanmış olarak ayarlanmalıdır. Ana başlıktan önce 6nk sonra 6nk boşluk bırakılmalıdır.

7. Makalede yer alan birincil başlıkların ilk harfleri büyük olacak şekilde sola dayalı ve numara verilerek 10 punto ile kalın yazılmalıdır. Alt başlıklar ise aynı şekilde 10 punto ile kalın yazılmalıdır. Bütün başlıklarda ve alt başlıklarda lacivert renk kullanılmalıdır.

1. OrcaFlex Program
1.1. Axis Team

8. Tablo başlığı tablonun üstünde şekil başlığı şeklin altında yer almalıdır. Tablo başlığı ve şekil başlığından önce 2 nk sonra 3 nk boşluk bırakılmalı ve sola dayalı olarak sadece "tablo" ve "şekil" yazısı kalın olacak şekilde yazılmalıdır. Tablo, şekil ve denklem başlıklarındaki kelimelerin ilk harfleri büyük yazılmalıdır. Başlık ve içerik "cambria" formatında, 9 punto büyüklüğünde yazılmalıdır. Çalışma içinde yer alan tablo, şekil ve denklemler alıntı yapılmış ise kaynakları belirtilmelidir. Kaynaklardan önce 2 nk sonra 3 nk boşluk bırakılmalıdır. Tablo ve şekiller tek sütuna (burada ki sütun ifadesi makale yazımındakini ifade etmektedir) sığmayacak büyüklükte ise iki sütunu da kapsayacak şekilde verilmelidir. İki sütunu da kapsayan şekil ve tablolara sayfanın en üstünde veya en altında verilmelidir. Toplam şekil ve tablo sayısı 10 adeti geçmemelidir

Tablo 1. *Örnek Tablo*

Turkish Male Seafarers (n = 131.152)	BMI < 25,0	BMI 25 - 30	BMI ≥ 30	Number of Participants
16-24 Ages Group	74,1%	22,5%	3,4%	34.421
25-44 Ages Group	44,1%	43,3%	12,6%	68.038
45-66 Ages Group	25,6%	51,1%	23,4%	28.693
All Turkish Male Seafarers	47,9 %	39,6 %	12,5%	131.152
Turkish Male Population*1	47,3 %	39,0 %	13,7 %	-

9. Makale içerisinde ondalık kesirler virgül ile sayılar ise nokta ile ayrılmalıdır.

   Örnek:
   Ortalama yaş: 28,624
   Katılımcı sayısı: 1.044 kişi

10. Çalışmaya sayfa numaraları, alt bilgi ve üst bilgi eklenmemelidir. Bu düzenlemeler dergi yönetimi tarafından yapılacaktır.

11. Yazarlar çalışmalarını dergimize göndererek çalışmalarına ait telif hakkını dergiye devrettiklerini kabul etmiş sayılırlar. Bir çalışmanın aynı anda iki yere birden değerlendirme amaçlı gönderilmesi akademik etik çerçevesinde uygun değildir.

12. Çalışmaların orijinal olması, daha önce başka bir yerde yayımlanmamış olması gerekmektedir. Kongre ve sempozyum bildirileri bir kitapçıkta yayınlanmış ise, bu durumda, telif hakkı ilk yayınlanan yere devredilmemiş olması kaydı ile, JEMS tarafından yayınlanır. Bu tip bildirilerin daha önce yayınlandığı yer ile ilgili dergi editörlüğüne bilgi verilmelidir

13. Çalışma içinde yer alan atıflar parantez içinde numara verilerek yapılmalıdır [1]. Atıflarda olduğu gibi kaynaklar da parantez içinde numaralandırılmalıdır. Kaynaklar APA formatında gösterilmelidir.

Journal of ETA Maritime Science is an independent publication with regards to scientific research and the editor decide its publication policy. The statement signifies the ethical behavior of the publisher, the editor, the reviewers and the authors. The ethics statement for JEMS is based on COPE Code of Conduct and Best Practice Guidelines for Journal Editors and COPE Best Practice Guidelines for Journal Editors available at www.publicationethics.org.

A. DUTIES OF PUBLISHER:

Editorial Autonomy

JEMS is committed to ensure the autonomy of editorial decisions without influence from anyone or commercial partners.

Intellectual Property and Copyright

JEMS protects property and copyright of the articles published in the Journal and maintains each article's published version of record. JEMS provides the integrity and transparency of each published articles.

Scientific Misconduct

JEMS always takes all appropriate measures in respect to fraudulent publication or plagiarism the publisher.

B. DUTIES OF EDITORS:

Decision on Publication and Responsibility

The editor of JEMS keeps under control everything in the journal and strives to meet the needs of readers and authors. The editor also is responsible for deciding which articles submitted to journal ought to be published in the journal, and may be guided by the policies subjected to legal requirements regarding libel, copyright infringement and plagiarism. The editor might discuss with reviewers while making publication decision. Editor is responsible for the contents and overall quality of the publication. Editor ought to provide a fair and appropriate peer-review process.

Objectivity

Articles that submitted to journal are always evaluated without any prejudice.

Confidentiality

Any information about a submitted article must not be disclosed by editor to anyone other than editorial stuff, reviewers, and publisher.

Conflicts of Interest and Disclosure

The Editor of JEMS does not allow any conflicts of interest between the parties such as authors, reviewers and editors. Unpublished materials in a submitted article must not be used by anyone without the express written assent of the author.

C. DUTIES OF REVIEWERS:

Evaluation

Reviewers evaluate manuscripts without origin, gender, sexual orientation or political philosophy of the authors. Reviewers also ensure a fair blind peer review of the submitted manuscripts for evaluation.

Confidentiality

All the information relative to submitted articles is kept confidential. The reviewers must not be discussed with others except if authorized by the editor.

Disclosure and Conflict of Interest

The reviewers have no conflict of interest with regard to parties such as authors, funders, editors and etc.

Contribution to editor

Reviewers give helps the editor in making decisions and may also assist the author in improving the manuscript.

Objectivity

The objective judgment evaluation is always done by them. The reviewers express their views clearly with appropriate supporting arguments.

Acknowledgement of Sources

Reviewers ought to identify relevant published study that has not been cited by the authors. Reviewers also call to the editor's attention any substantial similarity or overlap between the manuscript and any other published paper of which they have personal knowledge.

D. DUTIES OF AUTHORS:

Reporting Standards

A submitted manuscript should be original and the authors ensure that the manuscript has never been published previously in any journal. Data of the research ought to be represented literally in the article. A manuscript ought to include adequate detail and references to allow others to replicate the study.

Originality

The authors who want to submit their study to the journal must ensure that their study entirely original and the words and sentences getting from literature should be appropriately cited.

Multiple Publications

Authors should not submit the same study for publishing any other journals. Simultaneous submission of the same study to more than one journal is unacceptable and constitutes unethical behavior.

Acknowledgment of Sources

Convenient acknowledgment of the study of others has to be given. Authors

ought to cite publications that have been efficient in determining the study. All of the sources that used process of the study should be remarked.

Authorship of a Paper

Authorship of a paper ought to be limited to those who have made a noteworthy contribution to study. If there are others who have participated process of the research, they should be listed as contributors. Authorship also includes a corresponding author who is in communication with editor of a journal. The corresponding author should ensure that all appropriate co-authors are included on a paper.

Disclosure and Conflict of Interest

All sources of financial support should be disclosed. All authors ought to disclose a meaningful conflict of interest in the process of forming their study.

Fundamental Errors in Published Works

If authors find out a remarkable error in their submitted study, they have to instantly inform it. Authors have a liability to cooperate with editor to provide corrections of errors.

ETA Denizcilik Bilimi Dergisi, bilimsel araştırma ile ilgili olarak yayımlanan bağımsız bir yayındır ve yayın politikasını editör belirlemektedir. Bu bildirge dergi imtiyaz sahibi, editör, hakemler ve yazarların etik davranışlarını içermektedir. JEMS'in etik beyanı, COPE Code of Conduct and Best Practice Guidelines for Journal Editors ve COPE Best Practice Guidelines for Journal Editors esaslarına dayanmaktadır ve bu kaynaklar www.publicationethics.org web adresinde ücretsiz olarak paylaşılmaktadır.

A. DERGİ İMTİYAZ SAHİBİNİN SORUMLULUKLARI:

Editoryal Bağımsızlık

JEMS, herhangi bir kimse veya ticari ortaklarının etkisi olmadan editoryal kararların bağımsızlığının sağlanmasını taahhüt etmektedir.

Fikri Mülkiyet ve Telif Hakkı

JEMS, dergide yayımlanan makalelerin mülkiyet ve telif haklarını korur ve her makalenin yayımlanmış versiyonunun kaydını sağlamaktadır. JEMS, yayımlanmış her makalenin bütünlüğünü ve şeffaflığını sağlamaktadır.

Bilimsel Suiistimal

JEMS, hileli yayın veya yayıncı intihali ile ilgili olarak daima uygun tedbirleri almaktadır.

B. EDİTÖRÜN SORUMLULUKLARI:

Yayın ve Sorumluluk Kararı

JEMS editörü, dergideki her şeyi kontrol altında tutmaktadır ve okuyucuların ile yazarların ihtiyaçlarına cevap vermek için çaba göstermektedir. Editör ayrıca,

dergiye gönderilen makalelerden hangilerinin dergide yayınlanacağının ve hangilerinin onur kırıcı yayın, telif hakkı ihlali ve intihal ile ilgili yasal gerekliliklere tabi politikalarla karar verilmesinden sorumludur. Editör, yayın kararı verilirken hakemler ile müzakere edebilir. Editör, içerik ve genel olarak yayın kalitesinden sorumludur. Editör adil ve uygun bir hakem süreci sağlamalıdır.

Tarafsızlık

Dergiye gönderilen makaleler daima, herhangi bir önyargı olmaksızın değerlendirilmektedir.

Gizlilik

Dergiye gönderilen bir makale ile ilgili herhangi bir bilgi, editör tarafından yayın kurulu, hakemler ve dergi sahibi dışında herhangi bir kimseye ifşa edilmemelidir.

Çıkar Çatışmaları ve İfşa Etme

JEMS editörü yazarlar, hakemler ve editörler gibi taraflar arasındaki herhangi çıkar çatışmalarına izin vermez. Dergiye gönderilen bir makaledeki yayınlanmamış materyaller, yazarın sarih bir yazılı onayı olmadan herhangi biri tarafından kullanılmamalıdır.

C. HAKEMLERİN SORUMLULUKLARI:

Değerlendirme

Hakemler yazarların kökeni, cinsiyeti, cinsel eğilimi veya siyasal felsefesine bakılmaksızın eserleri değerlendirmektedirler. Hakemler ayrıca, dergiye gönderilen metinlerin değerlendirilmesi için adil bir kör hakemlik süreci sağlamaktadırlar.

Gizlilik

Dergiye gönderilen makalelere ilişkin tüm bilgiler gizli tutulmaktadır. Hakemler, editör tarafından yetkilendirilmiş olanlar dışında başkaları müzakere etmemelidir.

İfşa Etme ve Çıkar Çatışması

Hakemlerin; yazarlar, fon sağlayıcılar, editörler vb. gibi taraflar ile menfaat çatışması bulunmamaktadır.

Editöre Destek

Hakemler, karar verme aşamasında editörlere yardım ederler ve ayrıca metinlerin iyileştirilmesinde yazarlara yardımcı olabilmektedirler.

Tarafsızlık

Objektif bir karar değerlendirmesi, daima hakemler tarafından yapılmaktadır. Hakemler, uygun destekleyici iddialarla, açık bir şekilde görüşlerini ifade etmektedirler.

Kaynakların Referansı

Hakemler ayrıca, kendi bilgileri dahilindeki yayınlanmış diğer herhangi bir makale ile dergiye gönderilen metin arasında herhangi önemli bir benzerlik veya örtüşme ile ilgili olarak editörü bilgilendirmelidir.

D. YAZARLARIN SORUMLULUKLARI:

Bildirme Standartları

Dergiye gönderilen bir metin özgün olmalıdır ve yazarlar, metnin daha önce herhangi bir dergide yayınlanmamış olmasını sağlamalıdırlar. Araştırmanın verileri, makalede tam olarak belirtilmelidir. Dergiye gönderilen bir metin, başkalarının çalışmayı türetmesine izin vermek üzere yeterli detay ve referansları içermelidir.

Özgünlük

Çalışmalarını dergiye göndermek isteyen yazarlar, çalışmalarının tamamen özgün olmasını sağlamalıdır ve literatürden elde edilen kelimeler ile cümleler uygun bir şekilde alıntılanmalıdır.

Birden Fazla Yerde Yayın

Yazarlar, aynı çalışmayı herhangi bir başka dergide yayınlanmak üzere

göndermemelidirler. Aynı çalışmanın birden fazla dergiye eş zamanlı gönderilmesi etik olmayan bir davranış teşkil etmektedir ve kabul edilemez.

Kaynakların Referansı

Başkalarının çalışmalarıyla ilgili olarak uygun referanslar verilmelidir. Yazarlar, çalışmalarının belirlenmesinde etkili olmuş yayınlara referans vermelidirler. Çalışma sürecinde kullanılan kaynakların tümü belirtilmelidir.

Makale Yazarlığı

Makale yazarlığı, çalışmaya kayda değer katkıda bulunan kişilerle sınırlı olmalıdır. Araştırma sürecine katılan başkaları var ise, bu kişiler katkıda bulunanlar olanlar listelenmelidir. Yazarlık ayrıca, derginin editörü ile iletişim halinde olan yazışmadan sorumlu olan bir yazar içermelidir. Yazışmadan sorumlu yazar, tüm yardımcı yazarların makaleye dahil olmasını sağlamalıdır.

İfşa Etme ve Çıkar Çatışması

Finansal destek ile ilgili tüm kaynaklar açıklanmalıdır. Tüm yazarlar, çalışmalarının oluşturulması sürecinde yer alan çıkar çatışmasını ortaya koymalıdırlar.

Yayınlanmış Çalışmalardaki Temel Hatalar

Yazarlar göndermiş oldukları çalışmalarında dikkat çekici bir hata bulduklarında, bu hata ile ilgili olarak derhal dergiyi bilgilendirmek zorundadırlar. Yazarların, hataların düzeltilmesini sağlamak üzere editör ile birlikte çalışma yükümlülükleri vardır.

Journal of ETA Maritime Science

JEMS JOURNAL

Reviewer List of Volume 6 Issue 3 (2018)

Owen NGUYEN	Tasmania University	Australia
Sadık Özlen BAŞER	Dokuz Eylül University	Turkey
Levent BİLGİLİ	Bandırma Onyedi Eylül University	Turkey
Elif KOÇ TEKİN	Bandırma Onyedi Eylül University	Turkey
Emre AKYÜZ	Bursa Technical University	Turkey
Mete EMİNAĞAOĞLU	Dokuz Eylül University	Turkey
Ünal ÖZDEMİR	Mersin University	Turkey
Duygu TÜRKER	Yaşar University	Turkey
Burak ÇAPRAZ	Ege University	Turkey
Ceren ALTUNTAŞ VURAL	Dokuz Eylül University	Turkey
Erdal ARLI	İstanbul University	Turkey
Serim PAKER	Dokuz Eylül University	Turkey
Bengü OFLAÇ	İzmir University of Economics	Turkey
Aysu GÖÇER	İzmir University of Economics	Turkey
Harun ŞİŞMANYAZICI	-	-
Hakan KAHYAOĞLU	Dokuz Eylül University	Turkey
Yusuf ZORBA	Dokuz Eylül University	Turkey
Haydar BAYAR	Yıldız Technical University	Turkey
Ferdiansyah INDRA	Politeknik Elektronika Negeri Surabaya	Indonesia

Journal of ETA Maritime Science

JEMS JOURNAL

Volume 6 Issue 3 (2018) is indexed in

This Page Intentionally Left Blank

Journal of ETA Maritime Science
Volume 6, Issue 3, (2018)

Contents

UCTEA - The Chamber of Marine Engineers