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Prikazi knjiga, doktorskih disertacija i magistarskih radova

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Reviews of Books, Ph.D. and M.Sc. Theses

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Review article
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ACCIDENT INVESTIGATIONS IN THE MERCHANT MARINE

A survey of total loss accidents in the merchant marine over a period of 30 years has shown that these accidents can be arranged in the following order: stranding, fire, water-leaks, gales and collision; other accidents have also been taken into consideration. The analysis covers ships over 500 GT flying different flags and plying any route of navigation.

At the beginning, a sample of 500 merchant ships - of different types and tonnage - and flying 15 different flags has been analyzed to determine the age and type of ship, as well as the causes of accidents.

In the second analysis, the same ships flying 15 flags are considered, but now over a wider range and on a sample totaling 1,500 merchant ships. The results of both the analyses have been compared. It resulted that all collisions, together with gales, amount to 25% of the maritime casualty returns -in the total loss lists- while stranding and collision take more than 40% of the toll.

Key words: *maritime casualty, safety at sea*

1. INTRODUCTION

Maritime accidents fall into one of the following groups due to several circumstances: those caused by weather conditions, such as gales, reduced visibility [1], ice, etc; or those due to pilot navigation error, narrow [2] and/or congested [3] waters, collision with unknown objects, ship lying at anchor or moored at buoys with strong currents, manoeuvring at close quarters or with limited space and adverse conditions in the port. Cargo related accidents occur through the carriage of dangerous goods, cargo on deck, heavy cargo, or cases relevant to the ship's seaworthiness. Failure in the steering system [4], main engine, different devices, war, terrorism, piracy, collision and misinterpretation in communications at sea, etc [5,6,7] can all lead to accidents.

Accidents by collision have significantly decreased, where a maritime traffic management service or, at least, a Traffic Separation Scheme (TSS) has been implemented. Currently, a worldwide maritime traffic management system is being contemplated [8].

The SOLAS (Safety of Life at Sea) convention rules the safety of navigation in sea

trade, in shipbuilding and fire-resistant bulkheads, life-saving appliances and facilities, radio communications, grain in bulk and dangerous goods transportation. These international provisions make it compulsory for sea-time training on board merchant ships, and for fire and abandon-ship drills.

Fire aboard merchant ships is serious, sometimes leading to total loss of the ship and/or her cargo, to gross damage, and to loss of life. In the past, when merchant ships were built out of wood and propulsion was achieved by wind action on the sails, lighting was achieved by means of oil or paraffin lanterns; tragic fires happened far too often, due mainly to the ship's rolling and the subsequent falling and breaking of the lanterns. In this day and age, flame lights are not allowed on board, or are prohibited by their inefficiency and danger. Nevertheless, fire still poses a high risk for several other reasons.

The stranding of merchant ships can result in fire and explosions, particularly when large tankers engaged in the crude oil trade are involved. Such was the case with the 'Torrey Canyon' in 1967, when a series of explosions and fires after her stranding in the Scilly Isles (Seven Stones, Pollard Rock) caused an all-time record in sea pollution. Probably petroleum products, shipped in bulk, present the highest risk, when errors occur, but we have other substances such as coal, a number of ores, feeding stuff, fertilizers, fish meal, etc. which are apparently harmless - when one is not acquainted with case histories - but which are liable to produce a spontaneous combustion.

Accident investigations show that fire leads to serious consequences not only in the carriage of dangerous goods, but also poses a risk to other goods which otherwise would not be dangerous and would not create a hazard during the sea passage - such as sugar, walnuts, cotton, and the like which can readily be stowed with no apparent fire risk. This kind of cargo burns easily and can become a risk if neighbouring hot work or a faulty mains line causes fire to break out in the cargo hold. Extinguishing this fire will prove difficult, once it has gained a hold and it will spread quickly if there is sufficient oxygen.

The paper aims at analyzing various maritime accidents during a 30-year period. On samples of 500 ships or more, it has been found that stranding and fire aboard, taken together, amounted to 50 % of the constructive total losses.

2. METHOD AND RESULTS

The method followed in this research on maritime casualties includes the analysis of the total losses of merchant ships flying different flags, with a gross tonnage of 500 GT or more, throughout 30 years. The accidents data were taken from the "Maritime Casualty 1963 - 1996" [6], which lists disasters alphabetically by the ship's name. To obtain useful or reliable results for a given flag, it is necessary to consider a group of 100 ships for each flag. To quantify causes, ages, and class-type under different flags, a sample of 500 ships [8, 9] is needed. A total of 500 merchant ship losses, flying 15 flags, was analyzed first, in order to establish the ship's age when lost and the trade she was on (class or type of goods transported). The number of ships and the total gross tonnage per flag was recorded, and the data obtained are shown in Table 1.

Whilst a sample of 500 accidents is sufficient to establish the causes of, it is not a large enough sample to discriminate the behavior between different flags. In the next two tables,

Table 3 and Table 5, the same particulars have been analyzed, but the number of ships has been increased to a total of 1,500.

The reasons for these accidents have been analyzed and quantified in Table 2, both as numbers and as a percentage of the total.

2.1 Age estimation

In the analysis of the "15 flags - 500 ships" (Table 1), the losses have been separated into four periods of a ship's active service – the first period covering 0-5 years, the second 6-12 years, the third 13-20 years, and the fourth overrunning 21 years of ship's service. In Table 1, the sum of the losses in the first two periods, 38+72, amounts to 110 ships, meaning 22% of the 500 ships analyzed. The losses in the third and fourth period, 185+205=390 ships, make 78% of the total number analyzed. The first particular to consider is that losses in ships over 13 years outnumber the others, and are 3.5 times more frequent than in new and middle-aged ships; but it is also true, that the over-ageing of the world shipping, in the 30 years under survey, is a trend to consider. The 205 ships in the table, aged over 21 year, amount to 41% of the 500 sampled ships flying 15 different flags, and only Japan looms as a younger fleet.

2.2 Trade

Regarding ships classified by trade, those carrying general cargo (break-bulk or conventional cargo) are the majority, making a total of 333 units, meaning 66.6% of the total; dry bulk cargo ships come to 51 ships with 10.2%; tankers number 55 with 11%; and the rest of the ships make a total of 61 units, coming to 12.2% of the 500 ships analyzed. The total gross tonnage amounts to 3,941,360 which, divided by the 500 ships, comes to a mean of 7,883 GT per ship.

2.3 Cause

Table 2 shows 15 different flags and 500 merchant ships, entering the nine most frequent circumstances in maritime accidents, resulting in total losses confirmed by the ships' classification societies. The results of the table place "stranding" as the leading maritime casualty - in fine weather, reason unspecified - followed by stranding in heavy weather, a total of 146 being entered with 29.2% of the 500 ships involved in accidents. Ranking second is "fire"; fire in the engine room is the most common cause, with 61 cases forming 55% of the total accidents caused by fire. The total number of accidents caused by fire amounts to 111 ships and represents 22.2% of the total. The third cause of a total loss is attached to "water-leaks" with 72 cases and 14.4% of the total. The fourth cause is represented by "gales", affecting 70 ships and a share of 14%. The fifth place is held by "collisions" with 48 cases and a 9.6% share.

The remainder of the total losses, having a less frequency impact in this table, stands in the following order: explosions, faults in cargo, war, and striking unknown floating objects.

2.4 Ship losses

In Table 3 the same 15 flags are analyzed, increasing the number of merchant ships - in total loss casualties - to 1,500 of 500 GT and over, the results being entered according to the ship's age, class of ship and gross tonnage. In the first nine flags with 100 or more ships, the ship's ages are analyzed separately, the type of ships involved in the casualties, on an average per flag and on a total average. For the analysis and quantifying of ships, the same four periods out of Table 1 are maintained.

Taking into consideration the first two periods - new and middle-aged ships on one hand - and the two second periods - too long in service and old ships on the other hand – and if the ratio of the former over the latter is greater than the unity, the flag of that merchant fleet can be assumed as being of a new construction. For a valid comparison in making the estimation, we need to have 100 or more ships per flag:

- Japan has a ratio greater than 2 [(39+50) / (31+7) = 2.342]
- Greece has the lowest ratio, [16/134 = 0.119], indicating the oldest fleet;
- Cyprus [19/131 = 0.145] turns out to be the second oldest flag, followed by Panama with 0.154, the Philippines with 0.174, Italy with 0.244, the U.K. with 0.250, Liberia with 0.363 and Spain with 0.887.

The whole 15 flags show an average ratio for the 1,500 ships of (140+251) / (483 + 626) = 0.352. From the total number of ships in casualty 9.3% are under 6 years and 41.7% are over 21 years old. These results do not mean that ships had a casualty for the reason of being very old, but, rather, that the world fleet in the 30 years under survey is quite old. It doesn't mean either that Japanese casualties occur mainly on board its new ships, but, rather, that its fleet is a new one.

As in Table 1, two letters have been entered at the head of the columns, for readily identifying the ship's class: GC = general cargo, BC = bulk carrier (dry-bulk carrier), etc. The total contribution of the GC ships is 1,034 units, a share of 69% of the total amount. The next column includes BC carriers with 121 ships and an 8.1% share, followed by 193 tankers or 12.9% of them employed in the carriage of crude oil or oil products. The rest of the ships (all columns to the right) entered in the same line (G total), amounting to 152 ships or 10% of the total. The average gross tonnage of the first four columns with 150 ships per flag is the highest for Liberia with 3,524,820 GT/150 = 23,499 GT. This figure, representing less GC ships and several BC and TA for the same number of ships, means a higher tonnage average. On the contrary, Panama, with a higher number of GC ships and few BC and TA, has the lowest tonnage average of the four analyzed with 874,780/150=5,832 GT. The total average (15 flags) amounts to 12,472,710 / 1,500 = 8,315 GT.

Comparing Table 1 and 3, the total tonnage average per ship is only of 8,315-7,883 = 432 GT. Ships' age in each table keeps a similar ratio, and only the 13-20 year column shows a difference as high as 4.8%. Regarding the types of ships, the highest difference between the tables does not surpass 2.4%. In Table 5 we have arranged the accidents of the 15 flags in 10 columns, for allocating 1,500 ships per flag and their casualties under their corresponding entries and headings. "Stranding" is still the first reason for accidents, totaling 455 cases and representing 30.3% of the total number. "Fire" ranks second involving 304 ships with 20.3% of the losses; fire in the engine room has the highest rate in this category, with 165 accidents.

The third position is occupied by "water-leaks", with 202 total losses or 13.4% of the total number. The fourth placed accident refers to "gales" with 157 ships and 10.5%. "Collisions", with 149 ships and 9.9%, are placed fifth. Finally, the remaining five casualty reasons come to 233 total losses or 15.6%.

Analyzing individually the first nine flags in this table, with 100 or more ships in casualty per flag, Greece and Spain have reached the highest rate in their total losses because of "fire aboard". On the contrary, Japan is the country with the lowest rate of losses by fire, with only five cases out of the 127 total losses, the most important accidents on record being "collisions".

3. CONCLUSIONS

While analyzing the total loss accidents, on a sample of 500 and 1,500 ships of over 500 GT flying 15 different flags, in a 30 year period, the following order for the leading maritime casualties in the merchant fleet has been registered: stranding; fire; water-leaks; gales; and collisions. Other five accident causes were entered, but had little impact. In the reckoning of the ships of both models, fire was the second most frequent cause of the accidents and, together with stranding, represents more than 50% of the maritime casualty returns and, if we include explosions in the column of fire, these latter items (explosion + fire) would add up to 25% of the casualties. Taking into consideration one by one flag that over 100 ships are flying, Greece and Spain are the flags where the highest number of accidents caused by fire is to be found, while Japan is the lowest one. In the latter case, "collision" is the leading accident cause, ending in a casualty eventually.

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Table 1. Ship's Age and Class of 500 Ships Flying 15 Different Flags

GC=General Cargo; BC=Bulk Carrier; TA=Tanker; OB=Ore Bulk Oil; GA=Liquefied Gas; CH=Chemical tanker; RR=Roll on, Roll off; CO=Container shipl; PF=Passenger or Ferry; OT=other ships

Flags	Years Old				Ships No	Class of Ships										DWT
	0-5	6-12	13-20	>21		GC	BC	TA	OB	GA	CH	RR	CO	PF	OT	
Greek			2		2	2					2					5,280
Panamanian	1	7	25	33	66	54	4	2			2	1		1	2	338,710
Liberian	7	12	37	29	85	36	21	17	6	1	3		1			1,680,190
Cyprus	1	8	23	32	64	53	4	2		1	1	1	1		1	234,880
UK	4	4	19	16	43	24	3	10	2	2				1	1	379,580
Japanese	6	9	11	1	27	16	2	4		1	1	1		1	1	146,850
Philippine	2	4	16	31	53	42		1					1	9		103,660
Italian	1	8	14	13	36	25	1	5		2	1		1	1		142,550
Spanish	6	6	6	11	29	17	2	6				1		1	2	310,630
Lebanese	1	1	5	17	24	20	2								2	65,750
Norwegian	4	4	8	1	17	11	2	2			1			1		200,470
Brazilian		6	5	6	17	14	3									80,240
USA	1	1	4	10	16	5	5	5						1		145,570
West German	4	1	7	3	15	11	1				1	1	1			53,920
Chilean		1	3	2	6	3	1	1							1	53,080
Total	38	72	185	205	500	333	51	55	8	7	10	5	6	15	10	3,941,360
%	7.6	14.4	37	41	100	66.6	10.2	11	12.2							100

Table 2. Causes of Maritime Casualties of 500 Ships Flying 15 Different Flags

S=Stranding, fine weather; SGF=Stranding in gale, fog or engine failure; FE=Fire in engine room; F=Fire, unspecified; FC=Fire in cargo; T =TOTAL; L= Leak; G=Gale; SC=Ship's collisions; E=explosion; MF=Machinery failure; T=Terrorism, piracy or war; CU=Collision with an unknown subject.

Flags	Stranding			Fire				L	G	SC	E	MF	T	CU	Ships No
	S	SGF	T	FE	F	FC	T								
Greek								1	1						2
Panamanian	15	5	20	5	5	1	11	14	10	2	2	3	2	2	66
Liberian	19	12	31	14	6	3	23	9	2	9	6	1	4		85
Cyprus	11	12	23	8	3	1	12	14	8	3		1	2	1	64
UK	8	4	12	7	2		9	3	8	3	2	1	2	3	43
Japanese	2	4	6					2	7	11	1				27
Philippine	7	6	13	6	5	4	15	7	11	14		3			53
Italian	7	4	11	5	2	2	9	5	5	2	1	1	1	1	36
Spanish	3		3	4	4	1	9	7	5	2	2	1			29
Lebanese	5	2	7	5	1	1	7	2	3	1			2	2	24
Norwegian	2	1	3	4	2		6	1	2	4	1				17
Brazilian	4	2	6	2	1	3	6	3	2						17
USA	3		3	1	1	1	3	2	3	3		1	1		16
West German	2	2	4			1	1	1	2	4		2		1	15
Chilean	4		4					1	1						6
Grand Total			146				111	72	70	48	15	14	14	10	500
%			29.2				22.2	14.4	14	9.6	3	2.8	2.8	2	100

Table 3. Ship's Age and Class of 500 Ships Flying 15 Different Flags

GC=General Cargo; BC=Bulk Carrier; TA=Tanker; OB=Ore Bulk Oil; GA=Liquefied Gas; CH=Chemical tanker; RR=Roll on, Roll off; CO=Container ships; PF=Passenger or Ferry; OT=other ships

Flags	Years Old				Ships No	Class of Ships										DWT
	0-5	6-12	13-20	>21		GC	BC	TA	OB	GA	CH	RR	CO	PF	OT	
Greek	4	12	63	71	150	104	13	24	2	1		1		4	1	1,608,720
Panamanian	2	18	53	77	150	117	14	7	1		2	1		2	6	874,780
Liberian	10	30	62	48	150	59	32	45	8	1	3		2			3,524,820
Cyprus	2	17	51	80	150	123	8	9	1	1	3	1	2	1	1	1,214,260
UK	11	14	50	50	125	71	9	22	4	2		5	1	5	6	1,013,070
Japanese	39	50	31	7	127	100	4	12		4	2	1		1	3	495,140
Philippine	3	13	33	59	108	79		8		3			1	17		285,280
Italian	7	13	35	47	102	67	5	18	1	2	3	1	1	3	1	597,010
Spanish	21	26	16	37	100	76	6	9			1	1	2	1	4	687,820
Lebanese	1	2	18	57	78	71	5								2	262,020
Norwegian	16	18	23	11	68	43	5	15		1	2			2		697,470
Brazilian	3	15	15	25	58	48	4	1	1	2				1	1	259,140
USA	2	3	13	40	58	18	12	20		1		1	2	2	2	608,510
West German	19	17	14	7	57	45	1	2			1	3	1		4	188,690
Chilean		3	6	10	19	13	3	1	1						1	155,980
Total	140	251	483	626	1,500	1,034	121	193	19	18	17	15	12	39	32	12,472,710
%	9.3	16.8	32.2	41.7	100	69	8.1	12.9	10							100

Table 4. Causes of Maritime Casualties of 500 Ships Flying 15 Different Flags

S=Stranding, fine weather; SGF=Stranding in gale, fog or engine failure; FE=Fire in engine room; F=Fire, unspecified; FC=Fire in cargo; T =TOTAL; L= Leak; G=Gale; SC=Ship's collision; E=explosion; MF=Machinery failure; T=Terrorism, piracy or war; CU=Collision with an unknown subject.

Flags	Stranding			Fire				L	G	SC	E	MF	T	CU	OT	Ships No
	S	SGF	T	FE	F	FC	T									
Greek	29	18	47	32	12	9	53	20	6	5	5	2	5	4	3	150
Panamanian	28	14	42	14	11	8	33	28	17	5	4	7	6	3	5	150
Liberian	29	19	48	21	11	4	36	17	8	15	10	2	9		5	150
Cyprus	26	20	46	23	9	4	36	30	12	5		3	12	1	5	150
UK	25	17	42	10	7	3	20	10	15	11	5	6	5	5	6	125
Japanese	14	17	31		2	3	5	16	26	38	7	4				127
Philippine	16	19	35	11	7	4	22	12	20	6	5	5	1	1	1	108
Italian	21	13	34	10	4	7	21	16	7	9	5	4	1	2	3	102
Spanish	11	9	20	9	10	4	23	15	10	14	4	9	2	2	1	100
Lebanese	22	12	34	10	1	2	13	9	6	3	2	3	4	2	2	78
Norwegian	7	6	13	9	6		15	7	7	12	5	6		1	2	68
Brazilian	14	11	25	3	1	5	9	9	3	6	2				4	58
USA	11	4	15	7	1	1	9	6	7	6	8	3	3		1	58
West German	9	5	14	5	1	1	7	5	9	14	1	5		2		57
Chilean	8	1	9	1	1		2	2	4		1			1		19
Grand Total			455	61	32	18	304	202	157	149	64	59	48	24	38	1,500
%			30.3				20.3	13.4	10.5	9.9	4.3	3.9	3.2	1.6	2.6	100

ISTRAŽIVANJA POMORSKIH NESREĆA

SAŽETAK

Na osnovi prikaza svih pomorskih nesreća s potpunim gubitkom broda, koje su se dogodile unutar 30 i više godina, proizlazi da se uzroci tih nesreća mogu svrstati prema sljedećem redoslijedu: nasukavanje, požar, vodopropusni otvori, vrlo jaki vjetrovi i sudar, te drugi uzroci nesreća koji su također razmatrani. Analizom su obrađeni brodovi od preko 500 BRT koji plove pod različitim zastavama i koriste sve plovidbene putove.

Na početku je analizom obuhvaćen uzorak od 500 trgovačkih brodova, različitog tipa i tonaže, koji su plovili pod 15 različitih zastava, kako bi se utvrdila starost i tip broda, kao i uzroci nesreća.

Sljedećom su analizom uzeti u obzir isti brodovi, s time što je uzorak proširen na ukupno 1500 trgovačkih brodova. Rezultati dobiveni na osnovi i jedne i druge analize su uspoređeni i došlo se do zaključka da svi sudari, zajedno s vrlo jakim vjetrovima, čine 25% od ukupnog broja gubitaka brodova, po popisu nesreća s potpunim gubitkom broda, dok je nasukavanjem i sudarom obuhvaćeno više od 40% gubitaka.

Ključne riječi: *gubitak broda uslijed pomorske nesreće, sigurnost na moru*

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DVOSTRUKI ZRCALNI GONIOGRAF

Dvostruki zrcalnui goniograf je navigacijski instrument za istovremeno mjerenje dvaju horizontalnih kutova. Konstruiran je pri Odjelu za nautičke instrumente Hidrografskog zavoda u Puli 1877. godine. Namjena mu je bila da navigatorima omogući određivanje pozicije broda neovisno o brodskom magnetskom kompasu u obalnoj navigaciji, a časnicima Carske i kraljevske mornarice koji su ga najviše koristili, pružao je najveću brzinu i točnost u određivanju pozicije broda među raspoloživim sredstvima i metodama krajem 19. i početkom 20. stoljeća.

Zahvaljujući optičkom principu dvostruke refleksije zrake svjetlosti i sustavu spojenih ravnala i zrcala, horizontalni kutovi se dobiju kada se dvije zrcalne slike smjeranih poznatih objekata dovedu u zajedničku vertikalu s izravno smjeranim objektom, pri čemu se optički pravci koji prolaze kroz smjerane objekte i pripadna tri ruba ravnala, sijeku u točki unutar instrumenta koja predstavlja opaženu i pravu poziciju broda. Zbog konstrukcije nalik dvokutomjeru, instrument se po završetku snimanja mogao položiti na navigacjsku kartu tako da rubovi ravnala tangiraju opažene objekte, a presjecište ravnala daje poziciju broda.

Zbog svoje praktičnosti i točnosti u mjerenju, instrument je bio rado korišten ne samo u navigaciji već i u geodetskim izmjerama.

U radu su prikazani opis i upotreba instrumenta, optički princip rada te ispravci pogrešaka instrumenta.

Ključne riječi: *mjerenje horizontalnih kutova, određivanje pozicije broda, Pothenotov problem, povijest pomorske navigacije*

1. UVOD

U navigaciji 19. stoljeća pozicija broda određivala se astronomskim i terestričkim metodama, a potonjim vrlo često mjerenjem dvaju ili triju azimuta istodobno. Izaberu se dva markantna i na karti ucrtana objekta, a presjecište njihovih dviju azimutnih crta, kojima kad god to prilike omogućuju treba pridružiti treću kontrolnu azimutnu crtu, daje opaženu poziciju broda. Budući da se ucrtavaju na navigacijsku kartu, izmjereni kompasni azimuti ispravljaju se u prave. Ovaj danas rutinski postupak navigatorima do kraja 19. stoljeća i nije bio toliko jednostavan.

Naime, premda su teorijske osnove o poremećajima u magnetskom polju Zemlje i utjecaju feromagnetske opreme broda na magnetski kompas bile poznate navigatorima 19. stoljeća, njihove točne vrijednosti nisu bile poznate, a mogućnost njihove kontrole bila je nepotpuna. Tek su godine 1889. i 1890. izvršene magnetske izmjere na području Istre i Dalmacije, a rezultate ovih istraživanja objavio je Hidrografski zavod Carske i kraljevske mornarice u knjizi predstojnika pulske Zvjezdarnice Franza Laschobera i kontraadmirala Wilhelma Kesslitza: *Magnetska promatranja na obalama Jadrana*, koja je objavljena u Puli 1892. Pet godina ranije zastavnik bojnog broda Heinrich Florian objavio je također u Puli djelo *Teorija i praksa devijacije i kompenzacije kompasa*. Ova dva datuma predstavljaju prekretnicu u praktičnoj navigaciji na Jadranu, te je od tada moguće odrediti točne vrijednosti varijacije i devijacije.

Do toga datuma vrijednosti zemaljskog i brodskog magnetskog polja bile su tek približno poznate, zahvaljujući dugogodišnjem eksperimentalnom promatranju tih pojava [1]. Tako se mjerenje azimuta na neki objekt u najboljem slučaju svodilo na procjenu njegove približne vrijednosti, zahvaljujući vještini i uvježbanosti navigatora i ukoliko su to dozvoljavale povoljne vremenske prilike i mirno more. Upečatljiva je i semantička opreznost koja se odnosi na nepovoljne magnetske utjecaje na brodski magnetski kompas: Constantin Pott, konsruktor dvostrukog zrcalnog goniografa u brošuri *Der doppelte Spiegel-goniograph* [5] umjesto devijacije koristi isključivo pojam *pogreška kompasa* (njem. Missweisung des Compass) i to najvjerojatnije zbog nepoznavanja njezinih točnih koeficijenata, budući da se ovaj konkretni izraz pojavljuje u izdanjima Hidrografskog zavoda otkada mu se mogu pridružiti određene brojčane vrijednosti.

Osim toga, vrlo često se događalo da u nedostatku prikladnog navigacijskog pomagala (npr. prijenosne smjerne ploče), dijelovi brodske konstrukcije (jarbol, čamci) onemogućuju smjeranje jednog ili više objekata, te bi jedino promjena kursa omogućila neometano smjeranje.

Kako bi se učinkovito izbjegle sve prije spomenute pogreške, a pozicija broda odredila brže i pouzdanije, te neovisno od brodskog magnetskog kompasa, poručnik bojnog broda Carske i kraljevske mornarice Constantin Pott konstruirao je pri Odjelu za nautičke instrumente Hidrografskog zavoda u Puli 1877. godine instrument, po principu sličan sekstantu, koji omogućuje istovremeno mjerenje dvaju horizontalnih kutova. Instrument se po završetku snimanja mogao položiti na navigacijsku kartu, a navigatori su ovim jednostavnim postupkom mogli s lakoćom odrediti četvrtu točku Pothenotovog problema – poziciju broda.

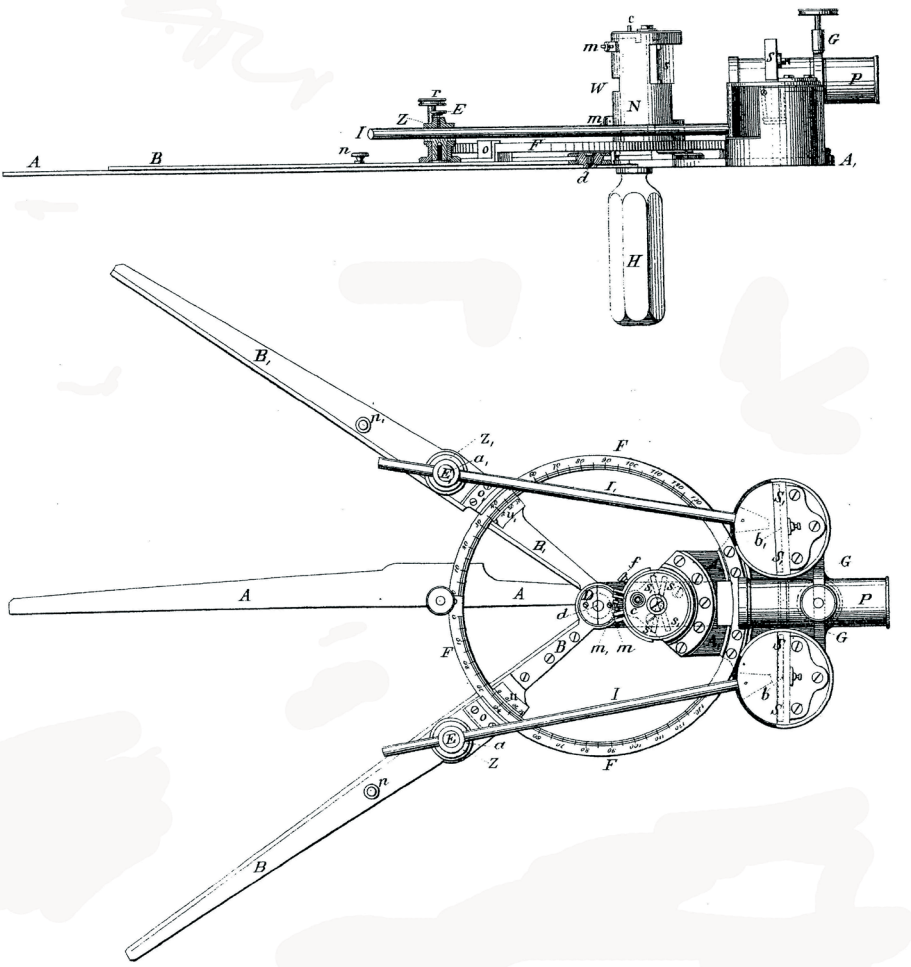
Dvostruki zrcalni goniograf dio je bogate, pet desetljeća duge znanstveno-tehničke djelatnosti Hidrografskog zavoda u Puli, a kao izum nagrađen je 1881. godine na izložbi Međunarodnog geografskog kongresa u Veneciji.

2. OPIS INSTRUMENTA

Ravnalo *A (Slika 1)*, središnje nepomično ravnalo instrumenta, nalazi se između dva okretna ravnala *B* i B_1, povezanih prstenom *D*, u čijem središtu se nalazi provrt *d*, zajedničko presjecište ravnog lijevog ruba središnjeg ravnala i unutarnjih ravnih rubova okretnih ravnala. Lijevo okretno ravnalo *B* i desno okretno ravnalo B_1, klizeći po gornjoj plohi središnjeg

ravnala *A*, mogu mjeriti horizontalne kutove od 0°, što označava ravni rub središnjeg ravnala i unutarnji rubovi okretnih ravnala kada se pokrivaju, do 130°. Osim toga, svako okretno ravnalo može se pomaknuti malo preko ravnog ruba središnjeg ravnala kako bi se izmjerio negativan kut, pri čemu drugo okretno ravnalo mora biti otvoreno.

Nakon završenog snimanja dvaju horizontalnih kutova, instrument se položi na navigacijsku kartu tako da ravni rubovi triju ravnala tangiraju poznate smjerane objekte, te kroz provrt prstena *d* olovkom označi opažena pozicija broda.



Slika 1. Dvostruki zrcalni goniograf
Izvor: [1, prilog 6]

Središnje ravnalo i kružnica sa stupanjskom podjelom *F* čvrsto su povezani, a središte kružnice je ujedno i središte prstena *d*. Okretna ravnala *B* i B_1 opremljena su vodilicama *O* i O_1 unutar kojih klizi vanjska strana stupanjske podjele, dok se s unutarnje strane stupanjske podjele na oba okretna ravnala nalaze noniji *u* i u_1 za očitavanje minuta.

Središnje ravnalo svojim se drugim dijelom nastavlja iza prstena, prošireno je i pojačano s lijeve i desne strane (A_1) i predstavlja konstrukcijsku kralježnicu instrumenta. Na tom stražnjem produžetku u uzdužnici instrumenta nalazi se nosač durbina *G*, koji omogućava da se prema potrebi pričvrsti durbin *P*.

S obje bočne strane durbina nalaze se zrcala *S* i S_1 u položaju okomitom na ravninu instrumenta, jednakih visina i okretna oko svojih središnjih vertikalnih osi *b* i b_1 koje se nalaze na jednakoj udaljenosti od središta prstena – provrta *d*. ($bd=b_1d$)

Na gornjoj površini oba okretna ravnala, otprilike na njihovoj sredini, nalaze se rukavci *Z* i Z_1, koji su okretni oko svojih osi *a* i a_1, okomitih na ravninu instrumenta. Udaljenost osi rukavaca *a* i a_1 od središta prstena *d* jednaka je udaljenosti okretnih osi *b* i b_1 prethodno spomenutih zrcala od središta prstena *d*. ($ad=bd=b_1d=a_1d$)

Oba rukavca *Z* i Z_1 imaju na odgovarajućoj visini provrt paralelan s ravninom instrumenta, kroz koji klizi cilindrična vodeća motka *I* i I_1 koja je svaka sa svoje strane instrumenta učvršćena za postolje na kojem se nalazi okretno zrcalo *S* i S_1. Vodeća motka posreduje u sinkroniziranom okretanju zrcala *S* ili S_1 s pomakom odnosnog ravnala.

Između nosača durbina *G* i prstena *D* nalaze se u kućištu *N*, u središnjici instrumenta, dva manja fiksna zrcala *s* i s_1, postavljena jedno iznad drugoga, na takav način da svako prima zrcalnu sliku svog pripadnog okretnog zrcala *S* ili S_1 i reflektira ju u smjeru paralelnom središnjici instrumenta prema promatraču. Razmak između zrcala *s* i s_1 iznosi 6 milimetara.

S prednje strane kućišta *N* nalazi se jedan isječak *W* koji odgovara razmaku između zrcala *s* i s_1, namijenjen izravnom smjeranju središnjeg objekta. Os durbina *P* nalazi se na visini jednakoj središtu isječka *W* iznad ravnine instrumenta, ali se prilikom snimanja objekata durbinom može promatrati dio gornjeg i donjeg zrcala *s* i s_1. Ukoliko se umjesto durbina koristio dvogled, tada se gornjim okularom promatrala zrcalna slika lijevog objekta, a donjim okularom desnog objekta.

Kada se okretna ravnala nalaze na nuli stupanjske podjele, odnosno kada su njihovi ravni rubovi u pokriću s ravnim rubom središnjeg ravnala, oba velika okretna zrcala paralelna su sa svojim pripadnim malim fiksnim zrcalima. Pri uporabi instrumenta, moguća su tokom vremena odstupanja od paralelnosti, te je potrebno izvršiti ispravak na sličan način kako se vrši kod sekstanta. U tu svrhu se na prednjem dijelu kućišta *N* nalaze dva korekcijska vijka *m* i m_1 koji se pomoću prikladnog ključa mogu fino zarotirati, pri čemu se malo zrcalo dovodi u paralelni položaj s velikim zrcalom, koje nije moguće korigirati.

Osim toga, povrh kućišta *N* nalazi se korekcijski vijak *c* za ispravak okomitosti gornjeg malog zrcala, dok se s donje strane instrumenta nalazi identični vijak za ispravak okomitosti donjeg malog zrcala, također uz pomoć odgovarajućeg ključa.

Na nosaču dalekozora *G* smještena je mala hvataljka u obliku dugmeta, te ista takva na spojnici stupanjske podjele sa središnjim ravnalom *r*. Obje hvataljke služe kako bi se instrumentom rukovalo pažljivo i sigurno prilikom vađenja i stavljanja u kutiju ili polaganja na navigacijsku kartu.

Za vrijeme snimanja s instrumentom, isti držimo u ruci za ručicu *H*. Ručica je utaknuta u četverokutni klin koji se nalazi ispod kućišta *N* i unutar kojeg se nalazi opruga čiji se vidljivi

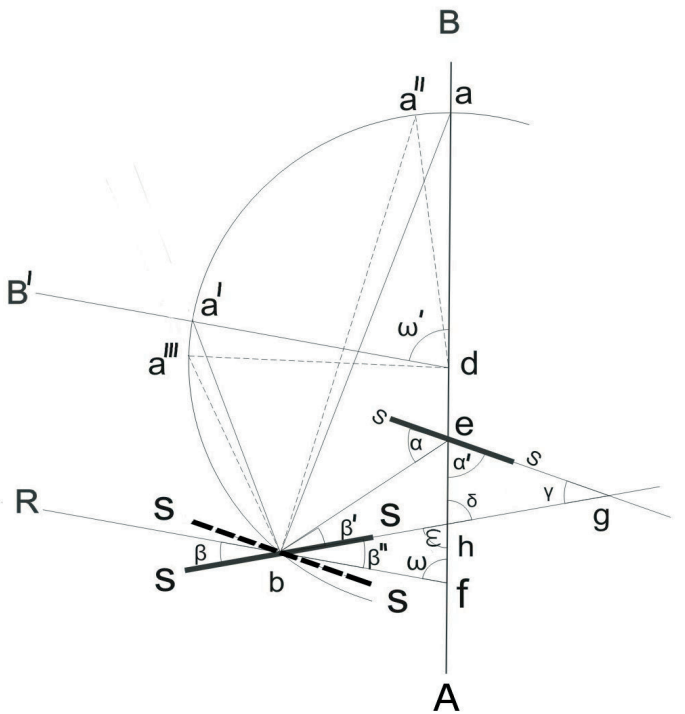
dio na oznaci *f* može odignuti i na taj način ukloniti ručica.

Kako okretna ravnala nakon završenog snimanja ne bi promijenila svoj kutni položaj, vodeće motke I i I_1 pričvrste se vijcima E i E_1 koji se nalaze na rukavcima Z i Z_1.

Okretna ravnala pomiču se duž stupanjske podjele pomoću hvataljki n i n_1 koje se nalaze na polovici dužine ravnala.

3. OPTIČKI PRINCIPI INSTRUMENTA

Na slici 2 pravac *AB* označava simetralu instrumenta. Promatramo lijevu polovicu instrumenta.



Slika 2. Optički princip dvostrukog zrcalnog goniografa - lijeva strana instrumenta
Izvor: [4, str.11]

Puna linija *ss* označava gornje fiksno zrcalo *s* u kućištu *N*, gdje je *e* središnja vertikala toga zrcala. Isprekidana linija *SS*, paralelna s gornjim malim fiksnim zrcalom *s* predstavlja pripadno veliko okretno zrcalo u nultom položaju. (Kada su veliko i malo zrcalo iste strane instrumenta paralelni, ravni rub pripadnog ravnala nalazi se u središnjici instrumenta, odnosno u pokriću je s lijevim rubom središnjeg ravnala.)

Puna linija *SS* predstavlja onaj položaj velikog zrcala pri kojemu upadna svjetlosna

zraka iz pravca *Rb*, refleksijom od okretnog i fiksnog zrcala prelazi optički put *RbeA*.

Točka *b* označava središnju vertikalu i os rotacije okretnog zrcala *SS*. Točka *d* označava središte prstena kroz koji prolazi vertikalna os oko koje se okreću okretna ravnala.

Prema Zakonu refleksije, upadni i odbijeni kut svjetlosne zrake na ravnoj površini moraju biti jednaki:

$$\alpha=\alpha' \text{ i } \beta=\beta'.$$

Također je i vršni kut $\beta=\beta''$.

Uzevši u obzir da je zbroj svih kutova u nekom trokutu 180°, tada je u trokutu *bge* vanjski kut pri *e,*

$$\alpha=\gamma+\beta',$$

odnosno

$$\gamma=\alpha-\beta',$$

ili također

$$\gamma=\alpha'-\beta''. \qquad \text{(I)}$$

Budući da su kutovi δ i ε kao vršni kutovi međusobno jednaki, zbroj preostalih kutova u trokutima *ehg* i *fhb* mora biti jednak:

$$\gamma+\alpha'=\omega+\beta''. \qquad \text{(II)}$$

Adicijom α' iz jednadžbe (I) u (II) dobijemo

$$\omega=2\gamma.$$

Riječima:

Kut između dva zrcala *SS* i *ss*, pri čemu se upadna zraka *Rb* reflektira u *eA*, jednak je polovici kuta koji ova zraka čini prije prve refleksije sa središnjicom instrumenta. Dakle, dvostruki zrcalni goniograf temelji se, poput suvremenog sekstanta, na optičkom principu dvostruke refleksije zrake svjetlosti.

Kada je okretno veliko zrcalo *SS* u nultom položaju (isprekidana linija *SS*), vodeća motka pripadne strane *I*, koja je čvrsto povezana sa svojim okretnim zrcalom, nalazi se u položaju *ba*. Vodeća motka prolazi kroz rukavac na pripadnom ravnalu, koji je okretan oko svoje vertikalne osi *a*.

Dužina *da* predstavlja ravni rub središnjeg ravnala, ali i ravne rubove okretnih ravnala kada su u pokriću s njim; drugim riječima, kada je kut između ravnog ruba središnjeg ravnala i ravnog ruba svakog okretnog ravnala jednak nuli.

Dužina *dB'*, odnosno dužina *da'*, označava položaj okretnog ravnala, kada on sa središnjim ravnalom zatvara kut ω'. U tom slučaju točka *a*, os rukavca, premjestila se u *a'*, pri čemu je vodeća motka promijenila položaj iz *ba* u *ba'*.

Prema konstrukcijskom principu instrumenta, udaljenost između osi okretnih zrcala i središta prstena jednaka je udaljenosti između osi rukavca i središta prstena, dakle $bd=ad=b_1d=a_1d$. Kao posljedica toga, može se opisati kružnica polumjera *da* sa središtem u točki *d*, koja prolazi i točkom *b*.

Kut ω' je kut koji odgovara otklonu okretnog ravnala iz nultog položaja, koji pritom opisuje luk *aa'*. Prilikom tog otklona vodeća motka se proporcionalno pomaknula duž luka *aa'*, čineći kut *aba'*. Primjećuje se kako je prvi kut u središnjoj točki instrumenta ω', odnosno *ada'* dvostruko veći od obodnog kuta *aba'* na kružnicu.

No, teorija dokazuje kako dolazi do izvjesnog odstupanja s obzirom na prethodnu činjenicu. Razlog tome je što se os rukavca kroz koji prolazi vodeća motka *I*, odnosno I_1, ne nalazi točno na rubu okretnog ravnala, već zbog konstrukcijskih razloga, nešto pokraj ruba,

točnije na sredini ravnala. Posljedica toga jest da će se točka *a* u nultom položaju okretnog ravnala nalaziti izvan središnjice instrumenta, u točki *a"*. Analogno, prilikom otklona okretnog ravnala iz nultog položaja, točka *a"* premjestit će se po kružnici sa središtem u točki *d* na mjesto *a'"*. Može se primijetiti da su unatoč ovom odstupanju kutovi *ada'* i *a"da'"*, te kutovi *aba'* i *a"ba'"* jednaki, a da je kut u središnjoj točki instrumenta *a"da'"* opet dvostruko veći od obodnog kuta *a"ba'"*.

Ovo odstupanje moglo bi definirati neznatnu indeksnu pogrešku, koja se može ispraviti korekcijom malog zrcala.

Kut otklona ravnala prema smjeranom objektu ω' jednak je kutu ω koji čini upadna zraka istog objekta prije prve refleksije sa središnjicom instrumenta, odnosno ω'=ω. Zahvaljujući toj činjenici dvostruki zrcalni goniograf može se koristiti kao instrument za mjerenje horizontalnih kutova i kao pribor za određivanje pozicije broda na navigacijskoj karti.

Sve što je opisano za lijevu stranu instrumenta, vrijedi i za desnu stranu.

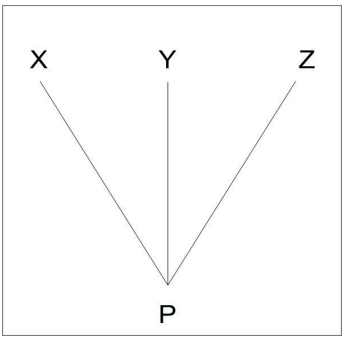
4. PRIMJENA INSTRUMENTA

4.1. Upotreba instrumenta u navigaciji

4.1.1. Određivanje pozicije broda mjerenjem dvaju horizontalnih kutova istodobno

Postupak za određivanje pozicije promatrača (broda) P na temelju poznatih objekata X,Y,Z pomoću dvostrukog zrcalnog goniografa (Slika 3.) može se podijeliti u dva koraka:

1.) Mjerenje horizontalnih kutova
2.) Određivanje pozicije na navigacijskoj karti



Slika 3. Položaj promatrača P definiran s tri poznata objekta X,Y,Z

Ad. 1.)

Nakon što oslobodi zatezne vijke vodeće motke E i E_1, navigator se s instrumentom postavi tako da kroz razmak između fiksnih zrcala s i s_1 izravno uoči središnji objekt Y. Tada se izmjeri horizontalni kut YPX tako da se instrument drži u desnoj ruci vodoravno ispred oka, a lijevom rukom se prihvati lijevo ravnalo B za dugme n i okrene toliko dok se zrcalna slika objekta X ne pojavi u malom zrcalu točno iznad izravno smjeranog objekta Y. Tada je potrebno laganim uzdizanjem i spuštanjem instrumenta duž optičkog pravca PY, dovesti izravno opaženi objekt Y u pokriće sa zrcalnom slikom objekta X u malom zrcalu s. Nakon što su objekti dovedeni u pokriće, pričvrsti se zatezni vijak E kako ne bi došlo do pomicanja ravnala i promjene kuta YPX.

Zatim, navigator prihvati instrument lijevom rukom, postavi instrument u ravninu oka i na jednak način kako je već opisano, izmjeri desni horizontalni kut YPZ. Potrebno je najprije izravno uočiti središnji objekt Y i potom motriti donje fiksno zrcalo s_1 u kojemu se mora reflektirati desni promatrani objekt Z. Kada se postigne pokriće zrcalne slike objekta Z s izravno opaženim objektom Y u pripadnom malom zrcalu, desno ravnalo pričvrsti se zateznim vijkom E_1.

Ukoliko se snimanje vrši durbinom, pokriće objekata može se bolje opaziti, a kutovi točnije izmjeriti.

U slučajevima kada se objekti X,Y,Z nalaze na znatno različitim visinama, konstruktor predlaže da se za smjeranje najvišeg objekta navigator posluži olovnicom.

Ad. 2.)

Prije svega, potrebno je ukloniti ručicu instrumenta, a potom se instrument, držeći za hvataljke G i r, pažljivo položi na navigacijsku kartu. Potrebno je postići da ravni rubovi triju ravnala tangiraju tri odnosna objekta na navigacijskoj karti.

Ravni rub središnjeg ravnala postavi se tako da tangira središnji objekt Y, lijevi objekt X ostavi se između središnjeg ravnala A i lijevog ravnala B, a desni objekt Z između ravnala B_1 i A, te se pomiče cijeli instrument po navigacijskoj karti u smjeru središnjeg ravnala kroz točku Y k sebi ili od sebe, dok objekte X i Z istovremeno ne dodirnu ravni rubovi odnosnih ravnala. Olovkom se označi pozicija broda kroz provrt prstena d.

Po uporabi instrumenta, zatvore se oba okretna ravnala i pričvrste zateznim vijcima, ukloni se eventualno korišteni durbin ili dvogled, te se pažljivo držeći za hvataljke G i r, pospremi u kutiju.

4.1.2. Primjena instrumenta u ostalim slučajevima na moru

Ukoliko je poziciju broda bilo moguće odrediti jedino pomoću dva objekta, instrumentom se snimio horizontalni kut između njih, a smjernom pločom kompasni azimut na jedan od objekata. Na navigacijsku kartu instrument se postavi tako da se ravni rub (obično središnjeg) ravnala kojim je smjeran objekt čiji je kompasni azimut snimljen, nalazi nad ucrtanim azimutom, te se pomiče duž njega dok ravni rub susjednog ravnala ne dodirne drugi objekt. Pozicija određena azimutom i horizontalnim kutom pouzdanija je od pozicije određene presjekom dviju azimutnih crta, naročito pri nepovoljnoj razlici azimuta, npr. kada dvije linije azimuta zatvaraju šiljati kut.

Instrument se mogao koristiti i u slučajevima kada Pothenotov problem nema rješenja. Snimanje horizontalnih kutova izvrši se na uobičajen način, te se istovremeno izmjeri i kompasni azimut na jedan od objekata. Slično kao u prethodnom slučaju, instrument se na navigacijsku kartu postavi tako da se ravni rub odgovarajućeg ravnala nalazi iznad linije azimuta onog objekta koji je njime smjeran, a cijeli se pomiče duž te linije dok preostala dva ravnala ne dodirnu *svoje* objekte. Pozicija broda određena na ovaj način pouzdanija je od pozicije dobivene presjekom triju azimutnih crta.

4.2. Upotreba instrumenta u zemaljskim radovima

Časnicima Carske i kraljevske mornarice koji su ga najviše koristili, dvostruki zrcalni goniograf znatno je olakšavao određivanje pozicije broda, a instrument prvobitno konstruiran u navigacijske svrhe našao je svoju široku primjenu također u zemljomjerstvu i geodetskim radovima. Koristio se pri katastarskim izmjerama, trasiranju željezničkih pruga i terenskim izmjerama potrebnim za izradu zemljovida. Značajna ušteda vremena ostvarena je u postupku triangulacije jer je instrumentom bilo moguće snimiti proizvoljan broj međutočaka između glavnih triangulacijskih točaka, bez zamornog postavljanja mjernog stola.

Točnost kutova izmjerenih dobro postavljenim instrumentom kretala se unutar jedne minute, što je značajno povećanje točnosti, budući da prilikom najfinijeg grafičkog rada (grafička triangulacija, grafičko rješenje Pothenotovog problema) točnost kuta iznosi tri minute.

5. POGREŠKE INSTRUMENTA

Dokaz da je izmjereni kut dotičnim ravnalom zaista jednak kutu između promatrana dva objekta i promatrača ($\omega'=\omega$), odnosno da se pravac od promatrača na smjerani objekt podudara s pravcem koji prolazi ravnim rubom odnosnog ravnala kada opažač ugleda reflektiranu zrcalnu sliku istog smjeranog objekta u malom zrcalu, ispravan je samo pod pretpostavkom da je:

1. udaljenost vertikalnih osi rukavaca i vertikalnih osi okretnih zrcala do središta prstena okretnih ravnala jednaka ($ad=bd=b_1d=a_1d$)
2. sjecište ravnih rubova svih triju ravnala u središtu prstena
3. svaki par fiksnih i okretnih zrcala međusobno paralelan u nultom položaju ravnala.

Što se prve dvije točke tiče, moguće su neispravljive greške u sustavu instrumenta uslijed nesavršene konstrukcije, no za dobro konstruiran instrument one su zanemarive. Ukoliko zrcalni parovi nisu u paralelnom položaju prema uvjetu iz treće točke, zadatak je navigatora da ispravi eventualne greške.

Na okomitost velikih zrcala S i S_1 na ravninu instrumenta ne može se utjecati, ona je definirana pri konstrukciji instrumenta, no općenito nikakva daljnja korekcija nije niti potrebna. Najčešća i najznačajnija korekcija koja se vrši jest ona zbog odstupanja od paralelnosti odnosnih parova velikih i malih zrcala, te se ona vrši isključivo korekcijom malih zrcala. Ova korekcija sastoji se od dva dijela s obzirom na ispravljanje položaja malog zrcala u

odnosu na njegovu horizontalnu ili vertikalnu os.

Odstupanje malog zrcala u odnosu na njegovu horizontalnu os, dakle pogreška okomitosti položaja malog zrcala utječe na točnost izmjerenog kuta samo u neznatnoj mjeri. Ova je korekcija ipak potrebna u slučajevima kada navigator primijeti kako reflektirana zrcalna slika promatranog objekta nije u ravnini sa svojim izravno promatranim objektom. Ako se neko okretno ravnalo nalazi u nultom položaju, dakle njegov zrcalni par je u paralelnosti, tada se izravno promatrana horizontalna ravnina (morski horizont) mora točno podudarati sa svojom zrcalnom slikom, ili se barem nalaziti jedna u produžetku druge, što je slučaj kod indeksne greške ukoliko ona postoji. Nalaze li se te dvije horizontale ipak jedna iznad druge, tada se malim okretom korekcijskog vijka c, odnosno c_1, ovisno radi li se o korekciji gornjeg ili donjeg malog zrcala, pomoću prikladnog ključa, zrcalna slika malog zrcala s ili s_1 dovede u ispravan položaj. Kako bi se navigator uvjerio u ispravnost okomitosti malog zrcala, bilo je dovoljno promatrati morski horizont, ili na obali dobro obilježen horizontalni rub.

Od velike je, pak, važnosti ispravak položaja malog zrcala oko njegove vertikalne osi. Naime, u tom pogledu umjesto paralelnosti velikog i malog zrcala u nultom položaju ravnala, postoji određeni kut među njima – indeksna greška. Ova greška može se vrlo lako i pouzdano ispraviti: postavi se ravnalo onog zrcalnog para koje se ispravlja točno na nulu stupanjske podjele, pri čemu se izravno promatrani objekt sa svojom zrcalnom slikom mora podudarati, ili se eventualno nalaziti točno u okomici jedan iznad drugoga, što je slučaj kada je vertikala malog zrcala malo otklonjena iz okomice na ravninu instrumenta. Ukoliko to nije slučaj, tada se vijčanim ključem izvrši korekcija gornjeg zrcala s pomoću vijka m, odnosno donjeg zrcala s_1 pomoću vijka m_1 tako da se primjerenim okretom zrcalna slika objekta dovede u pokriće sa svojom izravno promatranom slikom, ili eventualno u međusobno okomit uspravan položaj. Na moru ovaj se ispravak može najbolje izvršiti pomoću morskog horizonta pri čemu je potrebno instrument postaviti vertikalno, poput sekstanta.

Kada se ovi ispravci jednom izvrše, rijetko je potrebno njihovo ponavljanje budući da su mala zrcala zaštićena u svom kućištu.

6. ZAKLJUČAK

Povećanjem pomorskog prometa na istočnoj obali Jadrana u drugoj polovici 19. stoljeća nametnula se potreba za uspostavljanjem veće sigurnosti plovidbe. Vodeću ulogu u tom procesu imao je Hidrografski zavod Carske i kraljevske mornarice u Puli, koji je u pet desetljeća postojanja sve do 1918. godine, razmjenjivao iskustva s najznačajnijim svjetskim znanstvenim ustanovama, prateći i primjenjujući suvremena saznanja iz nautike, hidrografije, meteorologije, oceanografije, brodskog strojarstva, vojne tehnike i ostalih područja srodnih pomorstvu, ali i obogatio hrvatsko (tada austro-ugarsko) pomorstvo vlastitom znanstvenoistraživačkom i tehničkom djelatnošću. Dvostruki zrcalni goniograf dio je u nizu vrhunskih rezultata ostvarenih u doprinosu tom razvoju. Ovaj jedinstveni instrument u povijesti pomorske navigacije s obzirom na svoju dvostruku funkciju, čak i danas, 130 godina od patentiranja plijeni pažnju svojom originalnošću, jednostavnošću i preciznošću. Od mjerenja do definiranja prave pozicije na navigacijskoj karti, navigatorima je osiguravao brzinu, jednostavnost i točnost u postupku određivanja pozicije broda.

Najvažnije prednosti dvostrukog zrcalnog goniografa bile su:

a) Pouzdanost u određivanju pozicije broda jer
   - prava pozicija broda u obalnoj navigaciji se dobija mjerenjem dvaju horizontalnih kutova između tri objekta
   - neovisno o varijaciji i devijaciji čije točne vrijednosti nisu bile poznate još petnaest godina od početka korištenja instrumenta.

b) Brzina snimanja i određivanja pozicije na navigacijskoj karti jer
   - dva horizontalna kuta bilo je moguće snimiti gotovo istodobno, što je posebice bilo važno časnicima bržih brodova koji nisu trebali smanjivati brzinu kako bi se zanemarila pogreška zbog vremenskog razmaka i
   - pozicija broda određivala se jednostavnim polaganjem instrumenta na navigacijsku kartu.

c) Praktičnost instrumenta se ogledala u
   - dvojakoj naravi instrumenta u obliku navigacijskog instrumenta za opažanje i pribora za unošenje pozicije na navigacijsku kartu
   - prenosivosti u slučajevima kada su dijelovi brodske konstrukcije onemogućavali neometano snimanje.

Također, navigator je bio oslobođen iscrpnog grafičkog, odnosno trigonometrijskog rješavanja Pothenotovog problema.

Isto tako, mogućnost određivanja pozicije broda pomoću dva objekta, na temelju horizontalnog kuta i jednog azimuta, te mogućnost korištenja instrumenta u slučajevima kada Pothenotov problem nema rješenja.

Područja primjene instumenta je bila osim u navigaciji i u zemljomjerstvu.

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THE DUAL MIRROR GONIOGRAPH

SUMMARY

The dual mirror goniograph is a nautical instrument for the simultaneous taking of two bearings between three objects or marks. The instrument was constructed in 1877 at the Hydrographic Institute, Pula at the Department for Nautical Instruments.

It was used to enable navigators to determine the position of a ship when in sight of land, independently from the magnetic compass. The instrument was mostly used by the officers of the Austro – Hungarian Navy providing them with the means to effeiciently and accurately determine the position of a ship. Of all the means available at the time, it was the preffered instrument at the end of the 19th and the beginning of the 20th century.

The dual reflection of a beam of light and a system of connected rulers and mirrors, create bearings when the two mirror images of the observed known objects become vertical together with directly observed object. It is then, that the optical straight lines which are running through the observed objects and the three edge rulers, intersect at the point inside the instrument revieling the position of the ship. Due to it's shape (resembling a station- pointer), the instrument is placed on the navigation chart after the bearings are taken, so the edges of the ruler adjoin the observed objects. The point of the intersection of the edge rulers provides a ship's position.

The instrument was used not only in navigation but also in land surveying, due to its practical and accurate measuring abilities.

The description and the usage of the instrument, it's optical principle and the rectification of the instrument's inaccuracies are all included in this work.

Key words: *taking bearings of objects, obtaining a ship's position, Pothenot's problem, history of navigation*

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SAMOODRŽAVANJE BRODSKIH SUSTAVA

U radu je prikazan koncept samoodržavanja kod tehničkih brodskih sustava. Samoodržavajući sustavi su oni sustavi koji su tolerantni na greške te će i u slučaju pojave greške sami izvršiti održavanje te nastaviti s ispravnim radom. Pri tome se pod održavanjem ne misli na popravak ili fizičku zamjenu neispravne komponentne sustava. Samoodržavanje podrazumijeva vraćanje sustava, kod kojeg se pojavila greška, u njegovo ispravno funkcionalno stanje. Ovime se povećava raspoloživost sustava te smanjuju troškovi održavanja. U radu se razmatraju dva tipa samoodržavanja, kontrolni i funkcijsko-redundantni. Kod kontrolnog tipa, popravak se vrši podešavanjem različitih parametara koji utječu na rad sustava, dok se kod funkcijsko-redundantnog tipa povratak u ispravno radno stanje vrši reorganizacijom strukture sustava.

Ključne riječi: *samoodržavanje, kontrolni tip, funkcijsko-redundantni tip*

1. UVOD

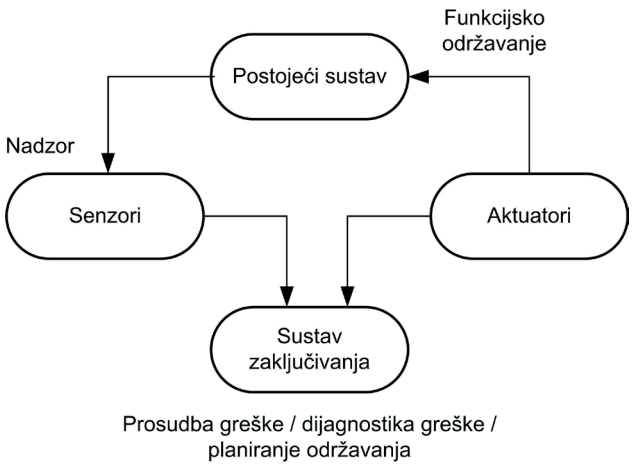
Kako bi se kod vitalnih sustava spriječilo da njihov ispad zbog pojave kvara na nekom uređaju uzrokuje nemogućnost broda da obavlja svoju zadaću, proizvođači takve uređaje nastoje dizajnirati ne samo da su tolerantni na pojavu greške [1], nego da je mogu i otkloniti. Uređaj s ugrađenim samoodržavanjem je uređaj koji može funkcionirati i u slučaju pojave greške. Pod tim pojmom se ne misli na popravak ili zamjenu neispravnih fizičkih dijelova nego na popravak funkcionalnosti sustava. To znači da se u slučaju greške, tj. primijećene razlike u funkciji uređaja, uređaj mora samoodržavanjem vratiti u ispravno funkcionalno stanje. Ovakvo održavanje se zove funkcijsko održavanje te je mnogo kompleksnije od fizičkog održavanja. Njegovom primjenom ne samo da se povećava raspoloživost sustava, poboljšava tolerantnost na greške, nego i smanjuju troškovi održavanja.

2. OSNOVE SAMOODRŽAVANIH SUSTAVA

Pretpostavka za implementiranje samoodržavanja na nekom sustavu je da je na njemu ugrađen sustav nadzora [2] i samodijagnostike. Stoga sustav s implementiranim samoodržavanjem mora imati ugrađenu sposobnost izvršavanja:

- nadzora
- prosudbe (procjene) greške
- dijagnosticiranja
- planiranja održavanja
- održavanja.

Na slici 1. prikazana je arhitektura sustava samoodržavanja. Preko senzora se nadziru zahtijevane funkcije sustava, dok se održavanje provodi preko aktuatora.



Slika 1. Arhitektura sustava samoodržavanja

Ugrađen sustav zaključivanja omogućuje izvršavanje prosuđivanja greške, dijagnosticiranja [3] i planiranja održavanja.

Ograničenja ovoga sustava je da su operacije održavanja ograničene na one koje ne zahtijevaju pričuvne dijelove. Ovo ograničava vrstu grešaka koja se može popraviti. Drugo ograničenje je da je izvršeno održavanje više ili manje privremena mjera. Samoodržavanje će samo odgoditi fizičko održavanje, neće ukloniti stvarne fizičke uzroke kvara što znači da se oni moraju naknadno ukloniti fizičkim održavanjem.

Uzimajući u obzir gornja ograničenja razlikuju se dva pristupa, kontrolni i funkcijsko-redundantni.

Kontrolni tip

Određena vrsta popravka na sustavu se može izvršiti samopodešavanjem radnog stanja bez mijenjanja ili reorganizacije strukture sustava. Ovaj tip održavanja je ostvariv na način da se preko aktuatora obnavlja cijela ili jedan dio zahtijevane funkcije.

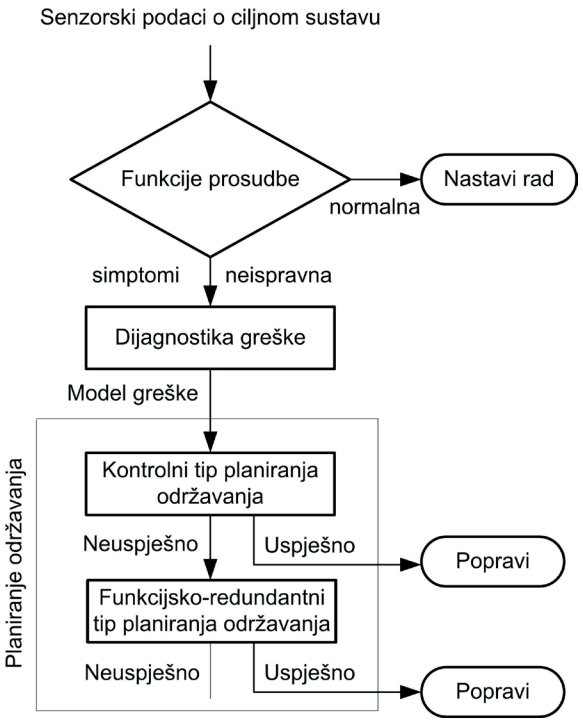
Funkcijsko-redundantni tip

Ukoliko sustav može rekonfigurirati svoje ponašanje kako bi održao obavljanje zahtijevane funkcije bit će tolerantniji na greške. Tradicionalnim načinom ovo se ostvaruje redundantnošću komponenti [4]. Međutim, redundantnost komponenti često rezultira neželjenim troškovima, utječe na fizičke karakteristike (težina, visina, itd.) i kompleksnost sustava. Kod funkcijsko-redundantnog tipa koriste se mogućnosti funkcija komponenti na malo drukčiji način od originalnog dizajna kako bi se povratila i održavala zahtijevana funkcionalnost sustava [5].

3. OSNOVNE METODE ZAKLJUČIVANJA

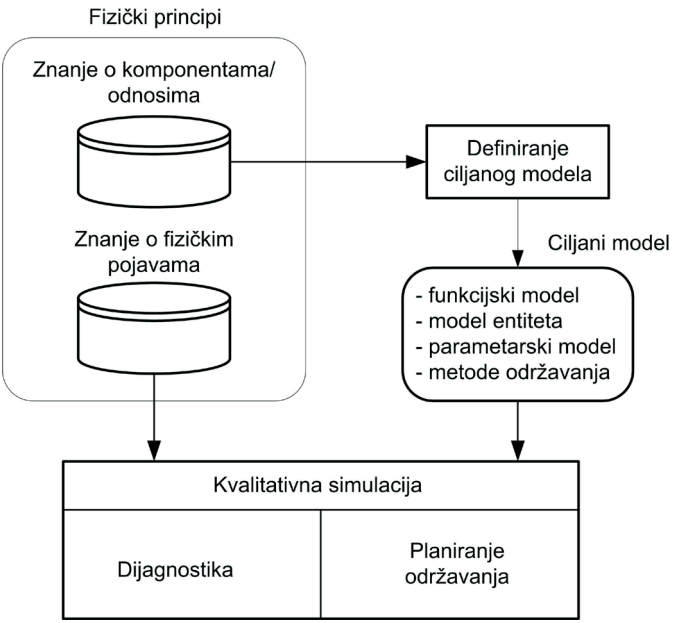
Metode koje se koriste kod realizacije samoodržavanih sustava [6] su:
- prosudba o grešci
- dijagnostika greške
- planiranje održavanja.

Algoritam zaključivanja kod sustava s implementiranim samoodržavanjem prikazan je na slici 2.



Slika 2. Algoritam zaključivanja

Arhitektura sustava zaključivanja prikazana na slici 3. zasniva se na pristupu definiranja i uporabe ciljanog modela [7].



Slika 3. Arhitektura sustava zaključivanja

4. PREDSTAVLJANJE ZNANJA

Kako bi se moglo izvršiti samoodržavanje u bazi podataka sustava potrebno je pohraniti različite informacije. U to su uključene informacije o zahtijevanim funkcijama sustava, strukturi sustava, fizičkim karakteristikama, metodama popravka, te greškama koje se mogu pojaviti kod sustava [8]. Ove informacije koje predstavljaju znanje o sustavu mogu se podijeliti u dvije kategorije. Jedna predstavlja znanje o ciljanom modelu, a druga znanje o fizičkim principima koja definiraju ponašanje sustava.

Znanje o ciljanom modelu obuhvaća:

- Funkcijski model koji predstavlja funkcijsku hijerarhiju ciljanog sustava. Svaka funkcija u funkcijskoj hijerarhiji određena je prosudbenim parametrima o tome da li je funkcija izvršena ili ne.
- Model entiteta koji predstavlja topologijsku strukturu komponenti ciljanog sustava.
- Parametarski model koji sadrži informacije o fizičkim karakteristikama ciljanog sustava.

Parametarski model, odnosno mreža parametara sustava generira se na temelju znanja o komponentama i relacijama između njima primijenjenog na modelu entiteta.

– Metode održavanja koje opisuju metode popravka koje se mogu izvršiti na sustavu. Dok se kod kontrolnog tipa pod metodom održavanja misli na podešavanje aktuatora, kod funkcijsko-redundantnog tipa, metode održavanja obuhvaćaju aktiviranje redundantnog funkcijskog moda predstavljenog s alternativnim modelom u kojem je ponašanje sustava različito nego kod normalnog modela.

Znanje o fizičkim principima obuhvaća:

– Znanje o komponentama i relacijama između njih. Ovo znanje opisuje karakteristike komponenti i relacije između njih u formi kvalitativnih rješenja diferencijalnih jednadžbi. Na temelju njih može se konstruirati ciljani model sustava.
– Znanje o fizičkim pojavama. Razlikuju se pojave pridružene greškama zbog strukturalnih promjena ciljanog sustava i one koje se odnose samo na promjenu parametara diferencijalnih jednadžbi koje opisuju ponašanje sustava.

5. METODE ZAKLJUČIVANJA KOD DIJAGNOSTIKE GREŠKE

Postupak zaključivanja kod samoodržavanja sastoji se iz dva koraka, dijagnostike i planiranja održavanja. Cilj dijagnostike [9] je otkriti fizički uzrok greške. Mogu se dijagnosticirati višestruke greške čiji su uzroci povezani. Postupak dijagnostike sastoji se iz četiri koraka:

– Identifikacija simptoma o grešci. Simptomi se identificiraju uspoređivanjem podataka iz senzora s funkcijskim modelom.
– Traženje mogućih uzroka greške. Prvo se traže sve promjene parametara kao i jednakosti koje su povezane sa simptomom. Nakon toga se sve pojave čiji efekti uključuju promjene parametara pronalaze pretraživanjem u bazi podataka o fizičkim pojavama.
– Simulacija greške. Za svaki mogući uzrok greške, sustav mora simulirati ponašanje uređaja i izgraditi njegov model greške. Model greške može se dobiti korištenjem kvalitativnih simulacija [10]. Model greške omogućuje planiranje održavanja s informacijama o strukturi i stanju neispravnosti uređaja.
– Identifikacija uzroka greške. Sustav identificira najvjerojatniji uzrok greške odabirući model greške koji se najviše slaže i nije proturječan sa senzorskim podacima.

6. METODE ZAKLJUČIVANJA KOD PLANIRANJA ODRŽAVANJA

Kod kontrolnog tipa sustav prvo pokušava obnoviti funkcije primjenom metoda kontrolnog tipa popravka. Ukoliko ovaj pristup nije uspio primjenjuju se metode funkcijsko-redundantnog tipa. Planiranje održavanja kod kontrolnog tipa sastoji se iz sljedećih koraka:

– Donošenje odluke o cilju popravka

Nakon što je dijagnosticirana greška sustav zaključivanja donosi odluku o smjeru promjene funkcijskih parametara (npr. ukoliko neki funkcijski parametar trenutno raste, cilj popravka je njegovo smanjivanje).

– Generiranje kandidata

Sustav izabire moguće metode popravka koje mogu ispuniti zadovoljavanje cilja popravka. Ovo se ostvaruje pretraživanjem baze podataka o modelima greški.

– Simulacija popravka

Simulira se ponašanje ciljanog sustava za svakog odabranog kandidata iz prijašnjeg koraka. Pri tome se koriste odabrani modeli greški pri čemu se povećavaju ili smanjuju parametri odabranih kandidata. Kao rezultat, sustav zaključivanja provjerava za svakog kandidata može li obnoviti ciljanu funkciju. Kandidat kod kojeg je to nemoguće se isključuje. Također sustav zaključivanja pri tome provjerava imaju li kandidati i popratne efekte.

– Odabir metode popravka

Od mogućih kandidata sustav zaključivanja odabire metodu popravka koja može popraviti ili poboljšati ciljanu funkciju.

Ukoliko kontrolni tip održavanja nije uspio, odnosno nije se mogao definirati odgovarajući plan održavanja, pristupa se funkcijsko-redundantnom tipu planiranja održavanja. On se sastoji iz sljedećih koraka:

– Odabir metode popravka

Prvo sustav selektira funkcijsko-redundantnu metodu popravka čija je ciljana funkcija jednaka onoj koja je zahtijevana te čiji alternativni model ne upotrebljava komponente u kvaru. To se postiže uspoređivanjem alternativnog modela s modelom greške.

– Rekonstrukcije ciljanog modela

Sustav rekonstruira novi model uporabljujući alternativni model iz prijašnje točke. Ovo se radi iz razloga što ovaj tip potiče strukturalne promjene.

– Izvršavanje kontrolnog tipa planiranja održavanja

Sustav provodi kontrolni tip planiranja održavanja s ponovno konstruiranim ciljanim modelom.

7. ZAKLJUČAK

Mogućnost broda da izvršava svoju osnovnu funkciju i donosi profit usko je povezana s održavanjem. Troškovi održavanja predstavljaju znatnu stavku u poslovanju brodara. Na brodovima se nastoje implementirati takva rješenja da su vitalni sustavi tolerantni na greške, odnosno da pojave greške ne uzrokuje i zastoj u njihovom radu. Tradicionalnim načinom ovo se postiže redundantnošću komponenti sustava. Redundantnost komponenti utječe na fizičke karakteristike sustava, pa se u slučaju gdje je to ograničavajući faktor moraju primijeniti druga rješenja. Jedno od rješenja je implementiranje samoodržavanja. Samoodržavanje omogućuje da u slučaju pojave greške na nekoj komponenti sustava, ta greška bude prevaziđena na način da se sustav vrati u ispravno funkcionalno stanje. Razlikuju se dva tipa samoodržavanja. Kod kontrolnog tipa sustav će se nastojati vratiti u ispravno funkcionalno stanje podešavanjima

radnih parametara. Ukoliko je to nemoguće onda će se pristupiti funkcijsko-redundantnom tipu samoodržavanja gdje se vraćanje u ispravno stanje nastoji postići rekonfiguriranjem strukture sustava. Ograničenje samoodržavanja je da se ne može primijeniti kod kvarova gdje se za popravak zahtijevaju rezervni dijelovi. Samoodržavanjem će se sustav vratiti u ispravno funkcionalno stanje, ali se neće izvršiti fizičko održavanje, odnosno zamjena komponenta na kojoj je detektirana greška. Fizičko održavanje se samo odlaže na način da se popravak može izvršiti za brodara u najpovoljnijem trenutku (npr. brod u luci) kad su i troškovi održavanja najmanji.

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SELF-MAINTANENCE OF SHIP'S SYSTEMS

SUMMARY

The paper aims at presenting the self-maintenance concept of the ship's systems. The self-maintenance systems are fault tolerant systems that, in case of failure detection, will perform the self-maintenance procedure and continue with normal operation. But the term maintenance does not refer here to the repair or manual replacement of the faulty part in the system. Self-maintenance includes getting back the failure detected system into normal function, thus increasing the functional redundancy of a system and, at the same time, reducing the maintenance costs. Two types of self-maintenance are analyzed in this paper: the controlling and functionally-redundant one. When the controlling type is in question, repairs are undertaken by adjusting different paramenters that have an impact on the ship's operation, while in the functionally- redundant one, the ship's system is returned into normal working condition by restructuring the system.

Key words: *self-maintenance, controlling type, functionally-redundant type*

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NEW POTENTIALS OF LINER SERVICE IN MARITIME TRADE

Liner shipping, with all its specific features, plays an important role in the economic development of a country whose ports liner ships are calling at. Under classical liner shipping we understand the carriage of cargoes or passengers over long distances and by large vessels. However, it should be considered that a cargo, which has been discharged at the port of destination and has not yet reached the customer, has to be further transhipped onto a road vehicle. Likewise, a road vehicle carries cargo intended for sea transport to a port of shipment.

The article aims at presenting a detailed analysis of the weaknesses of the present-day cargo traffic from the shipper to the consignee involving sea and inland transport. It deals with the relation between sea and land transport, favouring the former to the latter. Organizational changes required to abandon the classical transport of cargo are based on the White Paper regarding the European transport policy up to the year 2010.

Key words: *liner shipping, motorways of the sea, traffic accidents*

1. INTRODUCTION

Europe has experienced great political and economic changes. Barriers represented by state frontiers have been pulled down thus offering the possibilities for a new economic development. This requires a conformation of the shipping and maritime economy in general. Time conformation to economic changes is crucial. The classical liner shipping, with all its peculiarities, still remains one of the three basic types of shipping. However, changes in the European economy have point out to a new understanding of the liner shipping development.

Liner shipping, with all its specific features, plays an important role in the economic development of a country whose ports liner ships are calling at. Under classical liner shipping we understand the carriage of cargoes or passengers over long distances and by large vessels. However, it should be considered that a cargo, which has been discharged at the port of

destination and has not yet reached the customer, has to be further transhipped onto a road vehicle. Likewise, a road vehicle carries cargo intended for sea transport to a port of shipment.

Shipping is still one of those fields which do not easily change the already established and generally accepted rules. These give shipping a patina, a special attraction and, perhaps, a particular safety. Only those who are born for a maritime profession can live the Sisyphus' life and survive.

2. GEOGRAPHICAL POSITION OF A SEAPORT

The geographical position of a seaport, its economic power and the political system of its hinterland represent the decisive impact on the development of liner shipping. It can be anticipated that the choice of liner shipping ports is wider than is commonly believed. Up to now, the main factor in the choice of these ports has been the amount of liner cargo handled. However, the very latter factor has been the limiting factor for small countries with a relatively minor economic power. In such countries the way in which a liner ship operates should be taken into account. Considering the necessary amount of liner cargo, the paper further confines itself to the importance of the geographic position of the Mediterranean ports, particularly of the ports of the Adriatic Sea.

The Mediterranean area is considered to be the South door of the EU, expanding on 19.5 million km^2 with more than 400 million consumers. The area includes the countries which will in the near future become members of the great European and world economic integration as well. Yearly, and already at this very moment, they export and import more than 1.030 billion EUROS of various goods. They have high rates of economic growth and a rapid rise of living standards. The Adriatic ports are located along the shortest transport route, connecting Middle and Eastern Europe with the Mediterranean countries and those beyond the Suez Canal. The sea route is more than 2000 nautical miles shorter as compared to the North European ports, and the inland route to the main Middle European market centers is on average 500 km shorter. All the above mentioned facts have already pointed to the important cargo traffic, which, however, has yet to be directed and organized. However, several main conditions have to be fulfilled. The minimum conditions required to reach the economic justification are as follows:

1. It is necessary to direct and augment the cargo traffic through ports.
2. The ports should be organised, so as to speed up the cargo transhipment. In other words not to keep cargo in ports too long. Fast and good environmental infrastructure should be provided from sea ports to consumers.
3. Fast and modern information system should be introduced.
4. Simplified and unified customs procedure should be achieved.
5. More efficient standardization of cargo transport should be developed.

A seaport is successful when it permanently contributes to a positive GDP of a state and its basic product enables additional positive effect to a state GDP and, at the same time, preserves the required clean environment.

2.1. Increase of Cargo Traffic through Ports

While speaking about the increase of cargo traffic through seaports we mostly think about new contracts of the carriage of goods by sea. This is a classical approach with its characteristics and limitations. The amount of the expected cargo to be handled and the port fees are certainly one of them. Furthermore, we shall focus on the expected amount of cargo handled.

One of the characteristics of liner shipping is the susceptibility to the cost of a liner ship. And this is frequently crucial for the liner ship carrier in selecting the seaport. Consequently, small countries with a relatively poorely developed economy will have then less chances that their port will be chosen as the port of call for liner ships. Therefore, solutions should be sought to develop liner shipping in order to be useful even there, where, for the said reasons, it has not been employed so far..

3. LINER SHIPPING

Classical liner shipping is based on the following presumptions:

1. The voyage of a liner ship is predetermined, i.e. the ports of call are known in advance, as well as the schedule. Liner ships are different from bulk carriers in construction and equipment.
2. Liner ships generally do not offer the whole cargo space but only a part of it in the port of shipment. The cargo loaded in the port of shipment is usually different. The same route mainly employs several liner ships.
3. Cargo holds are rarely 100% utilised and cargo is loaded and discharged at the same ports.
4. The relation between the supply and demand of cargo space and the oscillation of this relation do not have such impact on freight rates as is the case in tramp shipping.
5. More than to the relation between the supply and demand of cargo space, liner shipping is susceptible to the changes in the expenses of liner shipping operations. The organization of liner shipping companies is complex and more expensive than the organisation of tramp shipping companies.

Each country, having a direct exit to the open sea via its own seaport, has a natural advantage over countries which do not have it. Unlike land traffic infrastructure, which has to be built, sea routes are already there, only the access to them, i.e. ports, has to be bult and equipped. The possibilities of exploiting seaports vary of course, depending on natural circumstances.

3.1. Liner Ship Service

Large liner ships increasingly reduce the number of ports of call. The reason for this trend lies in the cost of liner ship operations. The second reason is the size of liner ships.

Container ships, for example, are so large that they cannot call at all ports. The third reason is the incapability of certain ports to meet the modern lay day standards, in other words, they cannot tranship cargo within the acceptable loading or discharging time The question arises how to provide conditions for minor ports to take part in the distribution of such a cargo?

Before answering this question, we should distinguish two types of cargo. The first type comprises the ship cargo waiting in collecting ports to be shipped to the port of destination. This cargo is not delivered to the port of destination due to one of the said reasons in the first paragraph of this chapter. The second type of cargo is available in the port of shipment, but its amount is so small that it is not worth carrying it by a tramp ship. Both types of cargo can be shipped to the port of destination by a smaller liner ship.

In te first case, the cargo is most frequently carried by an alternative means of transport to the buyer, either by road or by rail. In both cases the »door to door« service is applied. The time factor is often favourable. In the second case, there are two options. When the use of the landside infrastructure is impossible and considering that the sea lies between the shipper and the consignee, the cargo is carried by sea, but only as far as the appropriate seaport from where the landwise infrastructure is to be used again. The time factor of such a transport is frequently unfavourable. However, when the use of the landwise infrastructure is possible, considering that there is no sea between the shipper and the consignee, the option offered by the landwise infrastructure is used.

Based on the above mentioned facts, we should aim at the following goals:

1. Sea transport should be used to the user's nearest point.
2. Inland transport from the seaport to the user should be carried out by the means of transport which pollute environment the least.

Both goals should meet two requirements. First, the carriage by sea is the cheapest way of transport and it pollutes the environment the least. Second, rail transport should have advantages over road transport. Both goals are in compliance with the implementation of the Kyoto agreement, ratified by the EU on May 31, 2002. They also follow the directives of the European White Paper about the transport policy up to 2010 [3]. Yet, the above goals require adequate organization and newly set business regulations. Besides, they introduce new elements in the classical liner shipping operations.

4. SHORT SEA SHIPPING

Based on what is said so far, the conception of the liner shipping development should change essentially. This is particularly due to the environmental protection and safety of lives. The globalisation of the world economy has made us realize that the transport of goods must also meet the requirements of the environmental protection. Although liner shipping tends to preserve the tradition, it is now faced with new tasks in the transportation chain. Therefore, on its way from the shipper to the consignee the following conditions must be provided:

1. Transport means must be selected in order to pollute environment the least.
2. Duration of transport must be short.
3. Transport must be safe.
4. Transportmust be cost efficient and competitive.

According to the analysis in chapter 3.2 and considering the above four conditions the order of the choice of transport should be as follows:

1. Sea or other waterway transport.
2. Railway transport.
3. Road transport.

As sea transport meets the most of the required conditions, the development of short sea liner shipping should be encouraged in the future.

4.1. Organization of Short Sea Liner Shipping

The organization of short-sea liner shipping requires a completely new approach. Before setting the conditions for the economical liner cargo transport, we should define the range of the operation of the whole transport chain:

1. Short-sea liner shipping should involve the coastal member states of the EU as well as other coastal candidate-members for the EU.
2. Short-sea liner shipping should be economical and more cost effective than road or rail transport.
3. Short-sea liner ships are usually smaller than classical liner ships.
4. The choice of seaports must provide the shortest landwise transport to the users of goods.
5. The chosen seaports must have a good connection with the hinterland.
6. The chosen seaports must provide fast and safe cargo transhipment.
7. Customs operations must be simplified so as not to delay cargo delivery on its way to the consignee.
8. It is necessary to standardise loading units to enable the development of intermodal transport.

A successful short-sea transport along the motorways of the sea depends on its organization and it involves promotion centers on the managerial and practical level [11].

The managerial level is represented by the National Focal Points. These are managed by highly qualified officials in charge of liner shipping in national administrations. Their activity is harmonized with the European Commission and the policy of the EU. On the initiative of the Commission the focal points are related on the European level, experience is exchanged and the way of encouraging short sea shipping is analysed. Their task is to reduce bottlenecks, which obstruct the development of such transport, and to provide new strategies to make liner shipping more attractive. The Maritime Industries Forum branches take part in yearly observers meetings. Thus the necessary relation is achieved between planning (National Focal

Points) and implementation (Maritime Industries Forum).

Short Sea Promotion Centers are organized and operate on the national level but in accordance with the EU Commission. Their task is to promote short sea shipping and give information to potential users. Promotion includes virtual meetings, creation of electronic network, data bank etc.. The sea carriers and road hauliers represent a special target group. The centers are united in the network all over Europe with customers on both sides of the short distance. Thus they can take advantages of all opportunities offered by their geographical locations.

The organization of short sea liner shipping calls for the interconnection of the Mediterranean states in the field of cargo traffic. That is to say, the organization of cargo traffic in the Mediterranean must comply with the set rules. This will enable the right choice of seaports and the financial aid by the EU. The Masterplan of the Mediterranean motorways of the sea includes the basic rules for the choice of maritime seaports connected in the Mediterranean sea motorways. However, we must be aware that some cargo traffic has already been established in the Mediterranean Sea. Given that the Masterplan is in its initial stage, such individual established flows of freight have to be somehow incorporated in the plan. The working group, established by the Mediterranean member states, decided in June and July 2004 that the Masterplan should consider the existing sea routes. [12]. Such decision was taken on the basis of previous meetings of the said working group on Malta and in Ljubljana.

5. MOTORWAYS OF THE SEA

The European Commission on July 2, 2004 in its final report about short sea shipping reported to the European Parliament the following [9]:

The White Paper about the European traffic policy up to 2010 stressed the concept of » motorways of the sea «. This should become the constituent part of the Trans - European Network (TEN-T). The sea motorways should reduce the overburdening of roads and improve the access to peripheral and island countries. Apart from reducing the number of lorries on roads, they could, in some cases, also contribute to the development of the sea passenger traffic, as some ships can simultaneously carry both cargo and passengers.

The motorways of the sea should become the constituent part of the logistic chain »port to port« and offer efficient, regular and reliable services, which could compete with road traffic in terms of transit time and cost efficiency. Ports connected with these motorways must have good hinterland connections, fast administrative procedures and high quality short sea shipping services.

The future development of liner shipping should spread to all suitable seaports. The definition of the new term » motorways of the sea « more precisely explains the tasks of short sea shipping [10]: *"The trans – European network of motorways of the sea is intended to concentrate flows of freight on sea-based logistical intermodal routes in such ways as to improve existing maritime links or to establish new viable, regular and frequent maritime links for the transport of the goods between Member States so as to reduce road congestion and/or improve access to peripheral and island regions and States. Motorways of the sea should not exclude the combined transport of persons and goods, provided that freight is predominant".*

The definition gives new dimensions to the classical operation of short sea liner shipping. Unlike the classical understanding of the choice of liner shipping ports, the new definition gives precedence to the geographical position of a seaport. In other words it is not crucial anymore whether a seaport can receive a liner ship with respect to access circumstances or the amount of cargo. But the geographical position of a port with respect to the logistic route has become more important. Further, a principle should be applied to select such port to minimize the length of road transport in favour of railway transport.

Motorways of the sea, therefore, do not exclude the criteria of the classical liner shipping but add a new important criterion. In Octobre 2003, the European Commission suggested changes of the European Guidelines about the development of the Trans-European Transport Network (TEN-T), including the implementation of 29 priority projects, which are in the »European interest«, accordingly they would be preferentially financed from adequate sources of the Community. The project no. 21 is a priority project about the development of motorways of the sea. Within this priority project four motorways of the sea were recommended [9]:

- Motorway of the Baltic Sea (linking the Baltic Sea Member States with the Member States in Central and Western Europe, including the route through the North Sea/ Baltic Sea canal);
- Motorway of the Sea of Western Europe (leading from Portugal and Spain via the Atlantic Arc to the North Sea and the Irish Sea);
- Motorway of the Sea of South-east (connecting the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean, including Cyprus);
- Motorway of the Sea of South-west Europe (western Mediterranean, connecting Spain, France, Italy and including Malta and linking with the Motorway of the Sea of South-east Europe and including links to the Black Sea).

The European Parliament confirmed the proposal of the Commission. So there is a possibility now for the financial assistance to the Trans-European Network (New article 12a on the motorways of the sea).

6. PROTECTION OF THE ENVIRONMENT AND THE SAFETY OF TRANSPORT

The European White Paper about the transport policy up to 2010 significantly reverses negative trends, which are the result of current practices to transport goods from the shipper to the consignee, using the landwise traffic infrastructure. The policy gives a special priority to all waterway routes, sea and river. The landwise routes should be as short as possible and environmental friendly.

The situation in the field of environmental protection from pollution with greenhouse gases, resulting mostly from road transport, is insufficient in the EU. The research into the amount of landwise transport of goods already shows, for the countries EU-15, a significant rise. [4] The growth index in road transport between 1990 and 1997 was over 26%, unlike rail transport, which fell in the same period for 7%. Although new statistical data for the year 2004 for the countries EU-25 is not yet available, we can anticipate even worse indicators, as

the statistical data for the year 2000 show the rise in the number of road transport vehicles and the growth of CO_2 emissions in all European countries (the only exception is the Former Yugoslav Republic of Macedonia) [5].

Table 1 shows the rise of the number of road vehicles between 1985 and 2001 and the pollution of environment with CO_2 for a few selected states, which, with the exception of Macedonia, border with Slovenia [6]. As seen from the table, all states, including Slovenia, should reduce the existing burdening of environment with the greenhouse gases.

Table 1. The rise in the number of road transport vehicles between 1985 and 2001

Country	The number of lorries per 1000 inhabitants		CO_2 emissions in million tons per year		Required reduction according to the Kyoto agreement.
	1985	2001	1990	2000	until 2012
Austria	27	41	56,9	62,8	- 13%
Italy	31	56	400,1	425,7	- 6,5%
Croatia	9	28	No data	17,8	- 5%
Hungary	14	35	70,5	55,2	- 6%
Slovenia	17	26	12,5	14,5	- 8%
Macedonia	11	10	9,2	8,4	No requirement

Table 2 shows the amount of consumed fuel and the amount of greenhouse gases with which environment is burdened by individual transport [4]. The average fuel consumption and the emission of gases in the environment is calculated with g/km.

Table 2 shows that road transport most severely pollutes the environment. Since it is realistically expected that road transport of goods will grow even more in the future due to the fast development of the road infrastructure, a deviation of the latter to railway and waterway routes should follow. It is believed that road transport will increase in the EU for 50% by the year 2010 unless the said deviation takes place. This would then result in the increase of the road infrastructure burdening for 12 billion tons-kilometres per year. [7] The General Directorate for Energy and Transport of the EU finds that, considering the said increase, the share of CO_2 would rise to 84%. [3]

Given the above mentioned, the transport policy supported by the relative directives is self evident. In the transport of goods the traffic infrastructure which pollutes the environment the least should be used. In doing this the said transport should be redirected from roads to railway or waterways wherever possible. The condition of the safety of lives in the field of transport is insufficient. The European Commission was presented with the following data [8]:

In the EU 96% of all accidents take place on roads, causing about 40.000 losses of lives. In the rail traffic the loss is 115 people (information refers to the years 1990-96), and in the European part of the sea 140 people.

Table 2. The analysis of the amount of the consumed fuel and the emission of greenhouse gases

	Fuel consumption (g/km)	CO_2	CO	HC	NO_x	SO_2	Solid particles
Roads	31,330	98,301	0,479	0,227	0,978	0,031	0,078
Railways	8,911	28,338	0,196	0,098	0,472	0,036	0,027
Sea	4,828	15,45	0,036	0,012	0,311	0,29	0,006

The death toll, considering the above data and calculated per 100 million km covered, is as follows:

- Sea transport 1,4 deaths
- Road transport 100 deaths
- Railway transport 40 deaths.

Table 3 shows the number of deaths in 2001 in road traffic accidents in Slovenia and the neighbouring countries [5]:

Table 3. Number of deaths in road traffic accidents in 2001

	Overall deaths	Those under 25 years of age
Austria	958	246
Italy *	6410	1435
Croatia	647	174
Hungary	958	226
Slovenia	278	76

** Valid for the year 2000.*

The White Paper about the transport policy up to 2010 represents also the calculated costs structure for lorries using European motorways. Table 4 shows the structure of costs in EUROs per 100 km of Motorways.

Table 4. Costs structure for lorries using European motorways

Costs structure	Range (EUROs)
Air pollution (medical treatment expenses and the loss of harvest)	2,3 – 15
Consequences of climate changes (changes in precipitation and the harvest)	0,2 – 1,54
Use of infrastructure (return from investments)	2,1 – 3,3
Noise (costs of medical treatment)	0,7 – 4
Accidents (costs of medical treatment)	0,2 – 2,6
Traffic congestions (loss of time)	2,7 – 9,3
Overall	8,0 – 36,0

Considering the said goals of the European transport policy up to 2010, it is realistically expected that fees for the use of roads will considerably increase. Such policy will encourage the use of railways and waterways.

6. CONCLUSION

Considering all the above mentioned facts, the following conclusions can be made:

1. Long distance liner shipping preserves all its basic characteristics, however the liner carrier should also take into account the smaller amount of cargo which he would normally not load or discharge in the port of call. Short sea shipping can now solve these problems, provided new approach has been adopted, based on fast and accurate information. The logistics operators are faced with new challenges. The evil anticipated by Prof. Stromme Svendsen seems to be the consequence of the unstoppable development of liner trade.
2. The geographical position of the seaports in the Mediterranean is of crucial importance. Those seaports, from wher the landwise transport to consumers is the shortest one, have the most advantageous position, considering they are also located near the main European transport routes. The possibility of fast transport by railway to the user is of utmost importance as it is most cost efficient. The fact that the use of road infrastructure will become even more expensive should be taken into consideration
3. Seaports having good geographical position must also have enough land space so as to be able to locate and eventually process goods. The development of seaports should take into account that some goods will always have to be kept in stock. However, these trends require new technology and organization of work resulting in the added value.
4. A successful development of short sea shipping is expected to necessitate the organization of oligopoly in the field, but only when the development has reached a relatively high level.

7. Logistics operators are expected to gain in importance, as they will have to become part of the promotion network on the practical level. Anyway, the future role of logistics operators needs special consideration.
8. Short sea seaports will provide additional multiplicative effect on the national landwise transport budget. The investment in the short sea shipping should, therefore, be also in the national interest of each member state.

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NOVE MOGUĆNOSTI BRODOVA LINIJSKE PLOVIDBE

SAŽETAK

Linijsko brodarstvo, sa svim svojim specifičnostima, igra značajnu ulogu u gospodarstvenom razvoju zemlje u čije luke uplovljavaju brodovi linijske plovidbe. Pod klasičnim pojmom linijskog brodarstva podrazumijeva se prijevoz tereta i putnika velikim brodovima na velike udaljenosti. Međutim, treba se uzeti u obzir činjenicu da se teret, koji se iskrcao u odredišnoj luci i koji još nije stigao do kupca, mora još prekrcati u cestovno vozilo. Na isti se način doprema teret, namijenjen prijevozu brodom, cestovnim vozilom do otpremne luke.

U članku se detaljno analiziraju slabosti postojećeg prometa tereta od krcatelja do primatelja, a koji uključuje i pomorski i kopneni prijevoz. Analizira se i veza koja postoji između pomorskog i kopnenog prijevoza, dajući pri tome prednost pomorskom nad kopnenim prijevozom. Promjene u samoj organizaciji prijevoza, koje je potrebno izvršiti ukoliko se želi napustiti klasični način prijevoza tereta, temelje se na Bijeloj knjizi o europskoj prijevoznoj politici do 2010. godine.

Ključne riječi: *linijsko brodarstvo, morske autoceste, prometne nesreće*

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NEW CONCEPT OF THE CONTAINER TERMINAL IN THE PORT OF RIJEKA

The port of Rijeka is a port of national interest open to national and international public traffic. It is mostly intended for the movement of goods with the container traffic playing an important role. As laid down in the Port Classification and Physical Plan of the Primorsko-goranska County, Rijeka is a port of a special international economic importance for the Republic of Croatia.

The largest part of the Croatian imports and exports of goods is realized through the port of Rijeka which is also a major transit port in Croatia for the goods from Hungary, Slovakia, the Czech Republic, Austria, Italy and Serbia. The essential factors of the port of Rijeka geotraffic position are the physical characteristics of its location and its connection with the hinterland.

The construction of the new leveled rail line from Zagreb to Rijeka, the reconstruction of the Rijeka-Zagreb motorway to a full profile highway, the canalization of the river Sava from Šamac to Sisak and the construction of the Vukovar – Šamac Canal will make Rijeka an important seaport for the flows of goods from the Danube basin to the Adriatic. In the future period, the structure of the goods flow will be marked by the growth of the container traffic which has, by today, reached the upper limit of the container terminal storage and handling capacity. If the port of Rijeka wishes to maintain its competitive ability in the North Adriatic ports catchment area, it should meet such increased transport needs by adequate expansion and new investments to be made in a short-time period.

This paper aims at focusing particularly on the container terminal Brajdica and its expansion possibilities which, contrary to other projects requiring a longer period of time for their realization and for bringing corresponding traffic solutions, include specific space and traffic predispositions.

Key words: *port, port authority, container traffic, container terminal Brajdica, Gateway project.*

1. INTRODUCTION

The essential factors of the traffic system of every maritime country are its sea ports which are a central point and main gateway for all traffic routes and transportation facilities. They are not only the key subsystem of every maritime and traffic systems, but also an accelerator of traffic, acting as magnet for industrial installation and other economic activities. Present-day ports are characterized by a number of distinctive features which, as a general development tendency, can be seen in almost all world ports. These are: concentration of traffic to a smaller number of larger ports, concentration of different combined economic functions in a port, efforts to generate a bigger added value (finishing operations and job processing), modern traffic connections with the hinterland and a higher degree of autonomy in the port management and control.[1]

With the European market tending to expand toward Asia and Africa, the North Adriatic route, 2300 nm shorter than the North European and Baltic ports, regained its importance.

It was its geographical position, maritime tradition and nearness of the European market with traditionally strong overseas trade that helped the port of Rijeka and the associated overland -maritime traffic route, to outgrow its national context. Good traffic and infrastructure links, especially the road network and shipping lines, are essential for Rijeka to become recognized as the main transit port for the neighboring countries on the trade route towards the Mediterranean, Near and Far East and Africa. The maximum volume of dry (general and bulk) cargo passing through the port of Rijeka was realized 17 years ago when it reached the tonnage of 7.5 million. The evident come back of these cargoes with an outstanding increase of the container traffic leads us to believe that a considerable growth of the containerized and other dry cargo is to be expected in the near future.

In terms of transport, the shortage of adequate roads linking the port, situated in the very centre of the city, with the major highway network, is a considerable handicap of Rijeka. There is also a problem of the railroad connections and their inadequate capacities whose upgrading is falling behind schedule. Therefore, any serious attempt to increase the port competitive ability and help maintaining the existing traffic efficiency growth in the following period calls for such government measures which shall not only speed up the road upgrading process but also ensure the modernization of the port system, including the construction of a new and the updating of old terminals.

1 Dundović, Č., Pomorski sustav i pomorska politika, Rijeka, Pomorski fakultet, 2003., str.. 83

2. IMPACT OF THE EUROPEAN TRAFFIC POLICY AND TRAFFIC ROUTES ON THE DEVELOPMENT OF THE CONTAINER TERMINAL IN THE PORT OF RIJEKA

The Pan-European Transport Areas – PETRA encompass the most important seaports and transport routes and are an extension of the existing overland corridors.[2] There are four established PETRA areas: in the north – the area comprising the North Sea, the Barents Sea and North Baltic; in the south-east – the Black Sea basin; in the south – the Adriatic and Ionian Sea and, the Mediterranean as the fourth area.

With the integration of these Pan-European seas and overland transport areas, the whole Europe from the Atlantic Ocean to the Urals, the Mediterranean countries included, will be united into one integral economic and transport zone with more than thousand million inhabitants. There are three Pan-European corridors passing through Croatia: the B and C branches of the Corridor V, and Corridors VII and X. The North East Adriatic Range – NEAR, is dominated by three important ports: Trieste, Koper and Rijeka. On the North Adriatic route, the maritime traffic grows at the annual average rate of o 2.8%. Until 1990, Rijeka was an exceptionally important port within the NEAR market whose share in the market loading/discharge volume amounted to around 35%. However, with the developments taking place in the nineteen nineties, the situation changed and the port of Rijeka share was reduced to some 12%. The recovery of the port, which had started with the modernization of its infrastructure and the establishment of more favorable operating conditions, led to the gradual increase of this share which, by the year 2006, amounted to some 18.5%. [3]

The long term development concept of the port of Rijeka landside is closely connected with the development strategy of the traffic system in Croatia and the role which Croatia may have in connecting the Central Europe and Danube-Region with the Mediterranean and the world.

3. CONSTRUCTION OF NEW ROADS PROMOTING THE CONTAINER TERMINAL DEVELOPMENT

In terms of traffic, the port of Rijeka has a very convenient position nearby the European market and the countries with traditionally intensive overseas trade. The transport routes, foreseen in the long terms traffic development projection, start mostly in Rijeka or pass through it. Thus, no increase of the competitive ability of the port of Rijeka will be possible without the modernization of the Corridors V and X branches, both road and rail (table 1).

2 Dundović, Č., D. Rudić, Seaports and maritime shipping trade in the Primorsko-goranska County-actual situation and development concepts, Naše more, 52(2005), 3-4, str. 136.
3 Data supplied by Port of Rijeka Authority

Table 1. - Road and rail corridors passing through Rijeka

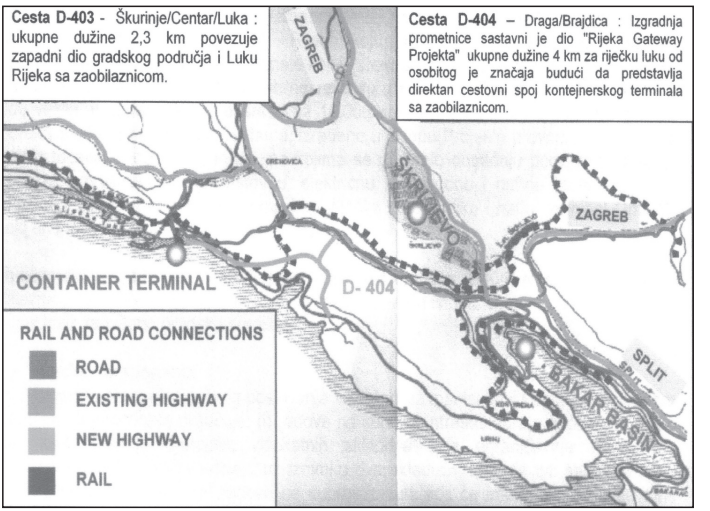
V corridor						
Main direction	Venezia	Trieste/Koper	Ljubljana	Budapest	Uzgorod	Lvov
Vb Branch	Rijeka		Zagreb		Budapest	
X Corridor						
Main direction	Salzburg	Ljubljana	Zagreb	Beograd	Skopje	Thessaloniki
Branch Vb	Rijeka			Zagreb		

Source: Luka Rijeka d.d

The highway Rijeka-Zagreb, as skeleton of the Croatian road traffic network, is of vital importance for the port of Rijeka and its performance. The construction of the Rijeka road traffic junction, defined as priority of the local administration, is planned to be completed by 2009 (Fig. 1). The beltway, 28.4 km long, is foreseen to spread from Jušići, through Orehovica to Križišće.. The ultimate objective of the road construction activity, being under way in Rijeka and around it, is to integrate all the key towns, outlaying housing, industrial and port areas. The completion of the Rijeka road traffic junction known as the Rijeka Gateway Project is a precondition for the further development of Rijeka, its port and economic resources as a whole.

By the link-roads D-404 and D-403, "leaning against" the Rijeka beltway, the port of Rijeka gets a direct connection to the important transport routes leading to central and eastern Europe. At the same time, these new traffic arteries will make it possible for the city of Rijeka to solve the serious problem of its traffic congestion, and the port operational quays will get a direct link to the highway network.

Fig.1. The port of Rijeka road links D-404 and D-403



Source: Luka Rijeka d.d.

The Rijeka – Rupa Higway, 14.5 km long, is an important road linking the Croatian road network, with either the Rijeka – Zagreb Highway through the Orehovica junction, or the Istrian arterial road through the Matulji junction. In the future, once the Rijeka – Žuta Lokva Highway is finished, this road will provide not only for the connection to the Zagreb – Split Highway, but also to the Adriatic Highway via Maslenica. The Adriatic – Ionian Highway, from Trieste to Kalamate, 1200 km long, running along the Adriatic Coast, will provide for a direct road connection between Italy and Greece. The preparations and plans for the construction of this important international highway, known as the Adriatic –Ionian Initiative, call for a close regional economic cooperation of at least eight countries. This space and economic area stretching from the Adriatic to the Ionian Sea with some 50 million inhabitants, is of the greatest importance for Rijeka, providing its port with the opportunity to participate actively in the transport system of the European Union member countries.

The construction of the new railway bears an equal importance for the port Rijeka. In the nineteen seventies already, the existing rail line was considered as the bottleneck of the Rijeka traffic route and a limiting factor in the port development. By its technical characteristic, the railroad from Moravice to Rijeka, belongs to the category of heavy mountain- rail with no possibility to meet the needs of the growing traffic in transit. This problem and the possible solutions were dealt with by traffic experts, whereupon the two options, known as "Kupska" and "Drežnička" routes, were advanced. These are both considered as levelled rail lines, with two electric-powered tracks (25 kV, 50 Hz, AC). Although the variant called "Kupska trasa" is, in terms of construction works, more favorable (spreading through the river Kupa valley), it was decided to accept the other variant, known as "Drežnička trasa", stretching from Karlovac to Josipdol and reaching Rijeka via Drežnice, Krasica and Škrljevo. There are three tunnels planned along this route, the longest one being 13 km long.

It is 24 km longer than the "Kupska trasa" route, with the highest elevation point higher for as much as 198 m. What's more, its rising grounds are slightly bigger. The reason for choosing the "Drežnička trasa" route lies in its better position with respect to the future network of the fast railway service. Namely, Drežnica is the place where the section going to Dalmatia, so called Adriatic Section, is planned to branch off. The Rijeka –railroad would be longer as compared to the "Kupska Trasa" variant, but the other sections whose construction is also planned, would be shorter. As for the speeds, there would be no difference between the two routes, i.e. "Drežnička" and "Kupska Trasa."

The second track from Karlovac to Zagreb and from Dugo selo to Botovo, would be built on the existing route, with the necessary reconstruction in terms of direction and altitude, which would make it possible to attain the speeds up to 160 km/h. With the freight train speeds, which would be almost doubled (55 km/h) and the maximum driving speed of 120 km/h, the leveled rail line will provide for a substantial increase of the annual capacity, from the actual 5 mil. to 25 mil. tons of cargo. In fact, it's the Vb leg Botovo – Zagreb – Rijeka where the largest growth of freight traffic is expected.

The estimate ranges from 9.5 to 12.5 mil tons per year. According to the current estimates, the total value of the investments required for the construction of the leveled rail line, amounts to 8 thousand million kuna.

4. COMPATIBILITY OF THE URBAN DEVELOPMENT PLANS AND THE PORT OF RIJEKA DEVELOPMENT PLANS

There are many limiting factors both in the town itself and the larger Rijeka area, which had to be taken into consideration when deciding on the assignment of individual town districts to a specific purpose. It is possible to identify three town areas of such kind:

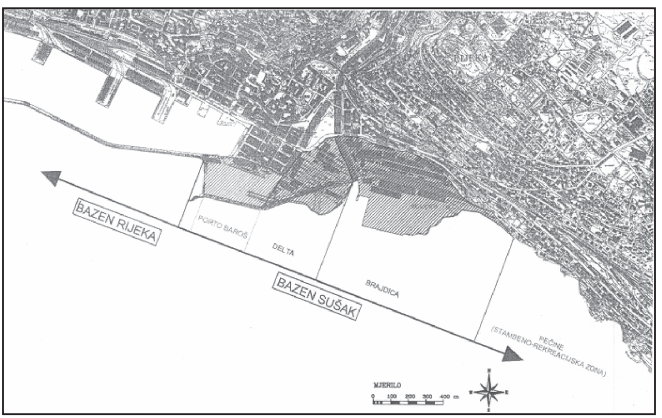
- working area along the coastal strip
- residential districts on the hills
- recreational zones along the coast

The main city-establishments and objects are located in the central town area, in the contact zone of the river Rječina delta and the residential districts. This is also the area which, full of places and city spots of historic and architectural interest, has given Rijeka its urban character. With almost entire productive sectors situated within the working area along the city coastal strip, a serious problem arises related to the technological processes lacking in rationality and adequate traffic links.

The Sušak basin of the port of Rijeka (fig.2) comprises the port –industrial complex with the container terminal Brajdica as an important part of it. It is located to the south, below the residential district, in a separated port-operational zone. The port industrial complex of the Sušak basin covers an area of 18 ha and includes the following facilities:

- part of the port "Porto Baroš" (operating on a restricted scale)
-oil terminal in the "Delta" area (out of operation)
-timber warehouse in the "Delta" area
-shunting yards
-office buildings
-container terminal Brajdica
-timber warehouse Brajdica
-covered storage in the Brajdica area

Fig. 2. The Sušak basin and its parts



There are no plans for the expansion of the port area in the Sušak basin. What is more, the town planners have in mind to have the whole area redesigned. This transformation is planned to include particularly the parts of:

-Porto Baroš
-Delta
-Brajdica terminal

As envisaged in the Project, the larger part of this area would be differently planned in terms of space and urbanization, with the aim of transforming this part of Rijeka into new and attractive city spots.

5. THE GATEWAY PROJECT AND ITS IMPORTANCE FOR THE PORT OF RIJEKA

A Loan contract was signed in 2003, by which the World Bank granted a loan of 155 mil. US$ to the Republic of Croatia, where the Port of Rijeka Authority, Luka Rijeka d.d. and the City of Rijeka are partners aiming to realize the planned investments (the Gateway Project). The projects regarding the modernization of the existing and the extension of the new port terminals are extremely vital. However, the so called Waterfront Project is of actual importance for the City of Rijeka. As this project envisages to open the middle part of the port basin for commercial purposes and to give the citizens the chance to have access to this part of the shore, the passenger terminal, the southern Delta and Porto Baroš will be differently planned with the aim of enabling citizens to visit and use these parts of the harbour around the clock, thus creating new and attractive places in the city, more appropriate for an urban development at the Mediterranean.

In this effect, the City of Rijeka, the Port of Rijeka Authority and Luka Rijeka d.d. have signed a Cooperation Agreement with the aim of defining their collaboration in the realization of the Rijeka Gateway Project. This Agreement lays down the terms and conditions as well as the sources of financing the preliminary preparatory stage in the Delta and Porto Baroš and the construction of the passenger terminal at the Rijeka breakwater. The contracting parties have undertaken the obligation to cooperate closely, rendering each other every possible assistance and support in the project implementation activities.

The project is a complex one: besides the modernization of the port of Rijeka and the reconstruction of the traffic route, it ensures an appropriate urban development of the city of Rijeka, creating new city spots and public infrastructures.

The Project also provides the financing of the consultants' services related to the improvement of management, to the working out of draft contracts for the building construction works, to the preparation of the BOT –based contract for the extension of the pier "Zagrebačka obala", to the construction of the new D-404 road and to the supervision of construction works under the Project. Thanks to the increased efficiency and safety of the port operations, the offering of the port services will be considerably improved by the application of the new Electronic Data Interchange System (EDI), linking up the port administration

and the port service users. Incorporated in the Project is also the financing of the worker care program, i.e. severance wages. The introduction of an adequate financial management system and training for its application will be also financed under the Project (table 2).

Table 2. Financial structure of the port of Rijeka development components

Component	Indicative costs (in mil. US$)	Bank financing (in mil. US$)
A – Restructuring and modernization of the port	75.10	50.20
B - Development of a border area between the port and the city	43.20	24.60
C- International road upgrading	144.80	78.70
D – Funds allocation for the pre-investment activity	1.50	1.50
Total funds	264.60	155.00

Source: Port of Rijeka Authority

The project is expected to yield direct economic benefits with numerous positive effects in terms of traffic, social welfare and ecology.

These direct economic effects will lead to:

- growth in the port turnover and income
- reduction in operating cost and road traffic based delays
- growth in the transport service-based trade as well as other economic activities induced by the increased traffic in transit
- reduction in the long term state grants to the port of Rijeka
- improved port management
- rise in labour productivity
- improved operating and environmental conditions (reduced traffic jams, air pollution and noise level)
- improved traffic connections between the port of Rijeka and the Trans-European road network via the Vb corridor.

6. CONTAINER TERMINAL AND ITS ROLE IN THE DEVELOPMENT OF THE PORT OF RIJEKA

There is a constant upward trend of the container traffic share in the total traffic structure of the port of Rijeka (table 4) which is now estimated to amount to some 7%. The role of the container terminal Brajdica is particularly important for the development of the container traffic. It constitutes a separate company of the port of Rijeka named Jadranska vrata. In the past, there were considerable oscillations in the traffic volume of the terminal Brajdica which was built in 1979. The peak-traffic in the past century was realized in 1989 when it reached the volume of 52,031 TEU. However, as a result of the changed political,

economic and safety situation (the split of the former Yugoslavia and the state of war) it was drastically reduced to only 6,866 TEU in 1999 (table 3).

This overall stagnation and decline in the traffic of the container terminal Brajdica in the above stated ten-year period (1990 – 2000) led to a technical and technological setback and loss of the market. In that period the container terminal was not deficient in the cargo handling capacities but there were no investment projects and the regular maintenance was reduced to a minimum. Such drastically reduced traffic volume was the reason for a limited operational and technological use of the stacking cranes – transtainers, which were put into operation in 1991, but were never made completely functional, neither technically nor operationally. Namely, with the traffic decreased to such a low degree, that type of the cargo handling equipment would not be profitable.

However, as from the year 2000, there has been a constant growth of the traffic at the terminal Brajdica, thanks to the considerable investments in the cargo handling capacities and improved port services, in which process the following is particularly worth mentioning (table 3, graph 1):

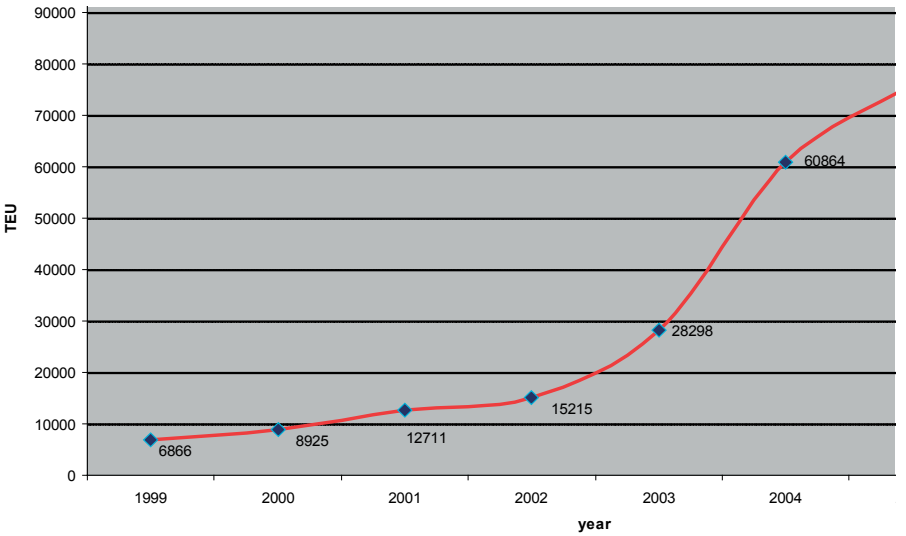
1. Purchase and installation of two new container gantries Samsung which together with the existing ones, type "Metalna" and "Liebherr", made it possible for the port of Rijeka to have the port mechanical equipment able to handle larger vessels and bring the terminal productivity up to the competing North Adriatic ports.
2. Setting up of the feeder service with the most important Mediterranean ports (Gioia Tauro, Malta), with regular weekly services agreed upon with the world container liners (ZimLine, CMA-CGM).
3. Container throughput in 2006 was increased and totalled 94,390 TEU showing a tendency toward further growth.
4. Purchase of two "Belotti Triton" stockyard mobile cranes.
5. The D404 road linked Brajdica directly with the Rijeka – Zagreb highway.
6. The purchase of new stockyard equipments (Ro-Ro tractors, various types of trailers, empty and full container lifters) is under way.

Table 3. Total container throughput (TEU) realized in the port of Rijeka from 1999 to 2006

Year	Throughput (TEU)
1999	6,866
2000	8,925
2001	12,711
2002	15,215
2003	28,298
2004	60,684
2005	76,258
2006	94,390

Source: Port of Rijeka Authority

Graph 1 - Container traffic in the port of Rijeka from 1999 to 2006



Source: Port of Rijeka Authority

Table 4. Structure of the traffic realized in the port of Rijeka (2006) (in 000 t)

Cargo structure	Year 2006
General cargo	854,490
Bulk cargo	3,19,707
Timber	236,438
Containers	718,507
Crude oil	5,87,906
Total	10,887,048

Source: Port of Rijeka Authority

Today, the container terminal Brajdica covers an area of 125,843.5 m2 of which 60,950 m2 was rearranged as a container stacking yard. The entrance area, maintenance shops, shelters and warehouse 46, cover a total area of 34,893.5 m2. The part of the terminal not built up as yet, serving as an empty container yard, partly made of an embankment under construction, covers an area of 30,000 m2.

The existing container terminal wharf is made up as follows:

RO-RO ramp59 m
Brajdica - west 164 m
Brajdica – south 295 m

In the second stage of the construction, the existing south wharf should be extended eastward by 328 m with a draft depth of 14.5 m. Once extended, the south wharf will reach a total length of 623 m. The container stacking yard, now covering 60,950 m2, will be further developed and expanded by additional 61,239 m2, so that, at the end, it will comprise an area of 122,189 m2.

The new entrance – exit complex, is envisaged to comprise an area of 9,215.5 m2, where an office building containing all necessary facilities required for the operations of the customs office, police, forwarding agents, security services and port administration is planned to be built. This entrance –exit complex, will provide the terminal with a direct link, through the existing east gate and new road, to the Croatian highway network.

There are plans to have a railway station – shunting yard, arranged in the second stage within the terminal area, so that containers may be loaded/discharged from wagons. There are also plans, depending on the traffic volume and traffic trends, for further expansion of the terminal to the current railway station Sušak. The space intended for the emptying and stuffing of the containers will, according to needs, remain within the warehouse 46, while the remaining space in this part of the terminal should be redesigned and adapted to the needs of various maintenance-repair shops.

According to the physical planning documents and construction site permit in force, disposed of by the Port of Rijeka Authority, the total area intended for container handling at Brajdica totals to 167,469.05 m2.

When the container terminal current state and the need for its expansion are at stake, the following technical characteristics should be taken into consideration:

1.	CURRENT STATE	m2
	- Container stacking yard	60,950.00
	- Maintenance-repair shops, entrance and similar spaces	34,893.50
	- Part of terminal not built up (embankment and the like)	30,000.00
	TOTAL	125,843.50
2.	THE SECOND STAGE OF CONSTRUCTION –TERMINAL COMPLETELY FINISHED	
	- New wharf (328 m) and container stacking yard	61,239.00
	- Entrance – exit complex	9,210.05
	- Container rail station	15,000.00
	- Container stuffing-emptying yard	21,250.00
	- Existing wharf and container stacking yard	60,950.00
	TOTAL	167,649.05

As for the container terminal Brajdica, the Port of Rijeka Authority development plans provide for the expansion of the existing terminal capacities.

The aim of the planned vital improvements in the terminal infrastructure and its reconstruction, is to make the terminal capable, in terms of technical-technological and organizational aspects, of achieving a throughput of around 200,000 TEU.

The realization of this objective requires the corresponding reconstruction projects based on:

- construction of another coastal berth and extension of the existing wharf, from 328 to 624 m of total length with the quay way depth of 14.5 m
- construction of a storage facility at the back of the quay Kostrensko pristanište provided with corresponding infrastructure and superstructure.

7. REASONS FOR THE EXPANSION OF THE CONTAINER TERMINAL "BRAJDICA" AND ITS NEW SPACE CONCEPT

Bearing in mind the traffic upward tendency in the last few years, there is every reason for the expansion of the terminal. There are a number of events essential for the development of the container traffic in the port of Rijeka, which can be summarized as follows:

- Feeder service was introduced in March 1999 by m/v LIPA of Lošinjska plovidba d.d..
- In October 2001 Lošinjska plovidba d.d. introduced another feeder liner, its ship the m/v LOŠINJ
- In October 2002, the container shipping company CMA-CGM became a part of the feeder service
- New container cranes were put into operation in February 2003
- The shipping company ZIM LINE joined the feeder service in August 2003
- Mother-ships joined the service in September 2003
- In November 2003 the container operator LLT/CMA-CGM introduced its feeder service
- In April 2004 the third ship – m/v SUSAK of Lošinjska plovidba joined the feeder fleet
- As from May 2005, ZIM LINE is not calling at the port of Rijeka any more
- In February 2006, X Press Container Line joined the feeder service.

In 2006, the various shipping companies had different shares in the total throughput of the terminal which, in comparison to the year 2005, was considerably higher (tables 5 and 6).

Table 5. Container throughput in the port of Rijeka - January - December 2005/2006 (TEU)

Months	January – December 2005.	January – December 2006.	Index (2006/2005)
January	5,629	5,231	93
February	5,192	5,605	108
March	6,264	6,546	105
April	5,709	7,527	132
May	6,862	8,842	129
June	6,616	7,867	119
July	5,674	7,674	135
August	6,137	7,140	116
September	7,786	10,004	128
October	7,071	8,242	117
November	5,943	10,670	180
December	7,375	9,042	123
January – December	76,258	94,390	124

Source: Port of Rijeka Authority

Table 6. Port of Rijeka –total container throughput per container operator/user (in TEU)

Operator/year	YEAR								
	1999	2000	2001	2002	2003	2004	2005	2006	Total
Hapag-Lloyd	1,360	2,225	3,714	3,580	4,742	4,294	4,107	5,213	29,235
Jadroplov-Canmar	641	0	0	0	0	409	351	0	1,401
Italia marittima	472	866	1,578	2,672	1,181	5,336	10,283	14,570	36,958
Evergreen marine Corp.	0	0	0	13	1,291	10,852	19,615	25,349	57,120
CMA – CMG	145	862	2,830	4,184	12,454	19,060	19,192	26,658	85,385
Lošinjplov	28	670	1,730	959	762	597	242	428	5,416
MAERSK	48	2	13	226	1,746	5,805	11,024	16,694	35,558
ZIM	0	0	2	2	1,111	6,830	3,346	338	11,629
P&O Neddlloyd	0	47	448	493	874	478	626	10	2,976
Senator Co.	0	0	0	686	1,352	369	688	516	3,611
Hanjin	0	0	0	0	0	0	0	0	0
UASC	47	107	619	856	1,079	1,507	1,010	1,461	6,686
Ostali	4,125	4,146	1,777	1,544	1,706	515	1,656	2,935	18,404
Sermar Line	0	0	0	0	0	68	2	1	71
Norasia	0	0	0	0	0	3,460	3,497	8	6,965
APL	0	0	0	0	0	825	619	185	1,629
Safmarine	0	0	0	0	0	459	0	24	483
TOTAL	6,866	8,925	12,711	15,215	28,298	60,864	76,258	94,390	303,527

Source: The Port of Rijeka Authority

There are two limiting factors standing in the way of the container terminal Brajdica further development. These are: inability to accommodate larger vessels (with draft exceeding 12.5 m) and an inadequate area. The second construction stage should be therefore entered upon immediately with the aim of providing for the following facilities:

- a new 328 m long wharf able to accommodate vessels up to 60,000 DWT. This new wharf will provide for the berthing of either one ship of the stated deadweight capacity or two half the size ships
- new stacking and handling areas (around 1.4 ha) which will make it possible for the terminal to improve its performance and achieve a throughput of around 150,000 – 200,000 TEU per year.

The transport and stacking area shall be provided with an open space to be used for the trans-shipment, loading and discharging containers from ships to the quay apron and vice versa, and loading and discharging containers between ship – wagon and vice versa, ship –

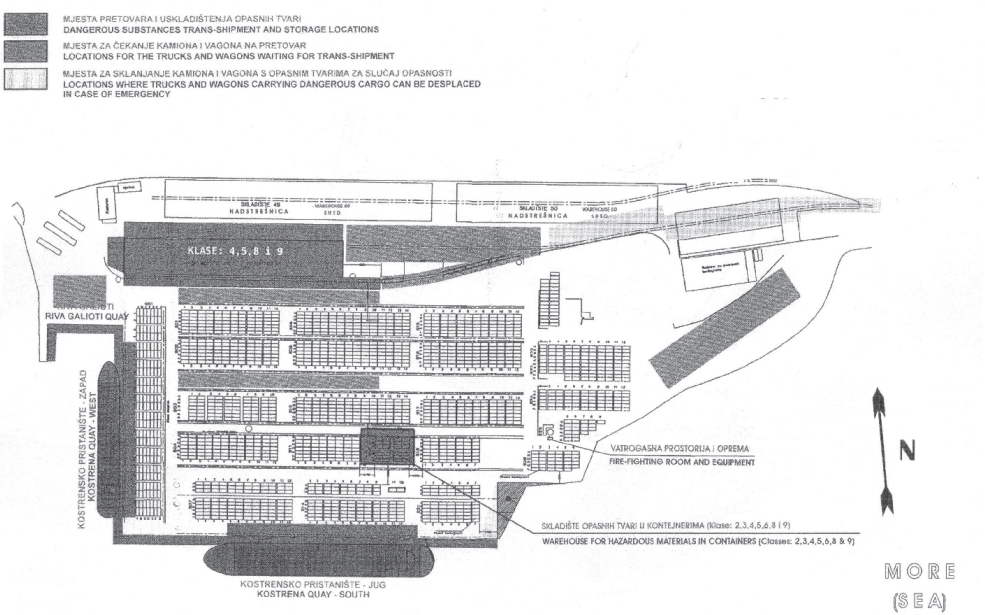
truck and vice versa, wagon – truck and vice versa and finally container yard-wagon -truck. A part of the space is intended for the ancillary buildings and objects of the traffic and public service infrastructure.

The landside of the terminal needs to be developed as a functional complex in accordance with the technological requirements. The complex can be divided into five zones, with specific types of construction and land development planned for each of them:

I. Port-operational areas –these are planned to be arranged as an open storage space for the handling and stacking of containers
II. Wharf with a back-up area – for container loading and discharge by RO-RO ramps
III. Roads and infrastructure facilities – there are plans to construct new lines of communications within the terminal (roads and railway) and upgrade the access roads and railway passing through the port area
IV. Covered storage –will be constructed to allow for container stuffing and emptying operations
V. Ancillary facilities – as planned there will be a building serving for the control and protection of the main entrance with parking lots for freight vehicles and cars and maintenance –repair shops located nearby.

In view of the enormous quantity of material required to fill up the sea and create new storage facilities, a much better solution would be to have a part of the current timber storage adapted for the needs of the container terminal. Locations for dangerous substances trans-shipment and storage should be also provided for in that area (fig.3).

fig.3



The terminal will allow for an annual turnover of some 150,000 to 200,000 TEU of which about 30% is supposed to be transported by train and the remaining 70% by truck.

For the loading and discharge of the rail wagon, it is planned to introduce a number of new track connections from the shunting yard Brajdica which is located in the close vicinity of the Rijeka port area in the Sušak basin.

As for the road traffic, there will be a new main entrance to the Sušak basin for trucks which will be connected with the Croatian highway network, via the recently built national road D-404.

In addition to this main entrance, several other back entrances should also be made available, either to connect the port with the shunting yard Brajdica or serve as entrance to the port for the service vehicle and port employees' cars.

The traffic within the terminal is planned to proceed as follows:

- There will be a principal peripheral collecting multi-lane communication line located between the open and covered storage facilities with a number of internal transversal roads routed toward it, whose position depends on the cargo handling technology.
- As for the parking lot, its location is envisaged within the port area, by the main entrance to the terminal. It will be large enough to accommodate about 30 cars (20 employees' and 10 port service users' cars).

No increase of the terminal performance and productivity can be expected before the competent authorities establish the current factual state of the railway siding (tracks) and their capacity and specify the works to be done. It's about the following:

- Construction of a new drawing-out siding of 274 m useful length,
- Construction of new port tracks for the rail transport of containers,
- Purchase of a necessary number of transtainers and other port equipments to handle cargo loading/discharge at the railway terminal,
- Construction of a container receiving plateau and appropriate road accesses,
- Port of Rijeka and Croatian Railway Authorities should make arrangements about the use of the 12th and 13th tracks for the cargo handling operations at the container terminal,
- Providing for a necessary number of engines and workers for the needs of shunting operations at the terminal,
- Providing for a necessary number of plateau carts (Rga and Kgs) for the container transport
- Ensuring early supply of a necessary number of engines for " marche-route" trains,
- Making provisions for a regular drive.

In order to improve the container handling efficiency at the new terminal wharf, it would be necessary to install two new container cranes. Moreover, the warehousing and stacking operation require new portal cranes (transtainers), freight lifters and straddle carriers.

The costs related to the realization of the new conception of the container terminal Brajdica are assessed as follows:

1.	Wharf structure	9,600,000.00 €
2.	Geotechnical and research works	310,000.00
3.	Storage facilities and roads	11,200,000.00
4.	Railway tracks in the terminal	782,000.00
5.	Water supply and drainage	1,980,000.00
6.	Electrical installation	2,445,000.00
7.	Architectural and building design projects (terminal facilities)	6,890,000.00
	TOTAL	30,962,000.00 €

8. CONCLUSION

The rapidly growing traffic at the container terminal of the port of Rijeka, needs an equally rapid construction of adequate port facilities. With the existing terminal having already reached its maximum capacity of some 100,000 TEU and the construction of the new terminal at the pier Zagrebačka obala not brought to completion as yet, the need arises for a new quay capable of accommodating larger containerships to be constructed as soon as possible. As for the new storage capacities, these can be obtained by extending the existing storage area to the location currently used for timber warehousing.

It's the construction of the new operational quay and adequate storage facilities, as well as the supply of new container cranes and warehouse cargo handling equipments that will make the current container terminal capable of accommodating larger vessels and achieving a container throughput of 150,000 to 200,000 TEU. Consequently, until the construction of the new terminal at the pier Zagrebačka obala is completed, the existing container terminal Brajdica, after going through the necessary superstructure and infrastructure interventions, can completely meet the needs of the port of Rijeka .

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NOVA KONCEPCIJA KONTEJNERSKOG TERMINALA U LUCI RIJEKA

SAŽETAK

Luka Rijeka je luka državnog značaja otvorena za domaći i međunarodni javni promet. Namijenjena je pretežito teretnom prometu u čijoj strukturi važnu ulogu ima kontejnerski promet. Razvrstajem luka i prostornim planom Primorsko-goranske županije određeno je da je luka Rijeka luka od osobitog, međunarodnog gospodarskog značaja za Republiku Hrvatsku.

Hrvatska ostvaruje najveći dio svog uvoza i izvoza roba preko riječke luke koja je ujedno i najveća tranzitna hrvatska luka za robe iz Mađarske, Slovačke, Češke, Austrije, Italije i Srbije. Bitni činitelji geoprometnog položaja luke Rijeka su fizičke značajke njene lokacije i prometna povezanost luke sa zaleđem.

Izgradnjom nove ravničarske pruge od Zagreba do Rijeke, dogradnjom punog profila autoceste Rijeka – Zagreb, kanaliziranjem Save od Šamca do Siska, te izgradnjom kanala Vukovar – Šamac, riječka luka postat će važna luka za robne tokove od Podunavlja do Jadrana. U strukturi robnih tokova u budućem razdoblju posebno će biti izražen rast kontejnerskog prometa koji je već danas dostigao krajnje granice prostornih i prekrcajnih kapaciteta kontejnerskog terminala. Povećani promet zahtijeva odgovarajuće proširenje i nove investicije u kratkoročnom razdoblju, ukoliko se želi zadržati konkurentnost u gravitacijskom području sjevernojadranskih luka.

U ovome radu posebno su istražene mogućnosti proširenja kontejnerskog terminala Brajdica s obzirom da već postoje određene prostorne i prometne predispozicije u odnosu na druge projekte koji zahtijevaju duže razdoblje i odgovarajuća prometna rješenja.

Ključne riječi: *luka, lučka uprava, kontejnerski promet, kontejnerski terminal Brajdica, Gateway projekt*

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THE HETEROGENEITY IN SHIPPER'S VALUE OF TIME, RESULTS FROM AN SP EXPERIMENT USING MIXED LOGIT AND LATENT CLASS

The understanding of the heterogeneity of preferences is taking an increasing role in the analysis of transport behaviour. Such understanding has been developed more extensively regarding passenger transportation than regarding freight transportation. However there are solid reasons, based on empirical evidences or heuristic knowledge, to believe that transportation science should take advantage of the new analytical tools developed in the latest decades to incorporate heterogeneity in the framework of Random Utility Maximisation. This paper aims at shedding some light on the question of heterogeneity of preferences among shippers.

A first section sets up a model to investigate the cause of heterogeneity for a specific transport attribute namely transport time. Then the different methods to estimate heterogeneity are reviewed. In a second section, we implement analytical tool such as Latent Class and Mixed Logit in order to show evidences of heterogeneity. These results are based on preliminary data processing of a survey among shippers in North-East and Central Italy. We also calculate bayesian posterior individual estimates of parameters for Mixed Logit model and a class membership model for LC analysis.

Key words: *freight transportation, value of time, mixed logit, latent class, heterogeneity*

INTRODUCTION

The theoretical framework for the transport behaviour analysis is moving toward the increased awareness of heterogeneity among agents. Extensive work has been done in the area of passengers' transportation to take into account the distribution of tastes among individuals. In the general framework of Random Utility Maximisation (BenAkiva and Lerman 85), this increasing awareness has resulted in the use of various techniques and especially Latent Class models, Mixed Logit and other similar techniques (McFadden and Train (2000)). Still most of

these developments have been made in the area of passenger transportation, and only part of the available toolbox of transport modelling has been implemented in freight transportation. However, there are various reasons to think that heterogeneity is a serious concern for the understanding of freight transportation too. These reasons range from the inherent variety of the transported goods to the large variety of firms logistic strategies. Additionally, transport analysts are searching for answers to specific questions. To name a few: Is classification based on industrial sector, an acceptable modelling strategy? What share of variability do we loose if we use more standard (although more rough) heterogeneity modelling techniques like classification? If we want to use distribution assumptions, is it more relevant to consider a distribution of parameters among shippers or among shipping occurrences?

This article tries to investigate how empirical evidences of heterogeneity can be included in a formal analysis and how this heterogeneity can be measured. This is a preliminary to answer the few questions mentioned above.

In the first section, this article analyses how heterogeneity emerges for one specific transport attribute, namely, transport time, and discusses the different methods available to capture heterogeneity. In the second section, we provide preliminary results of the application of Latent Class and Mixed Logit models on a data set collected among shippers of North East and Central Italy.

1. EXISTING METHODS AND RESULTS

In this section, we first discuss the theoretical aspects of heterogeneity related to the sources of tastes variation for one specific transport attribute, transport time. Then the question of the distribution function to adopt for parameters is discussed. Subsequently we move on to the description of the main estimation methodologies available to describe heterogeneity.

1.1. Theoretical framework

Where does heterogeneity stem from? The case of transport time.

In order to investigate the distribution of "tastes" among shippers, it is necessary to analyse which determinants make the shipper more or less sensitive to a certain feature of the transport service. In this paragraph we use a model to describe the shippers' behaviour with regard to one specific transport attribute. We concentrate on time as this attribute is probably an important source of heterogeneity. Kawamura (00) finds for instance that preferences exhibit higher heterogeneity for time coefficient than for costs coefficient. Although this latest result was derived for truck companies, one could suppose that the result would as well hold for shippers.

In order to investigate the effects of transport service attributes such as time, one should recognise the crucial role of the so called "productive configurations". Taking inspiration from the classification of Salais R. and Storper M. (1993), as described in Burmeister (2000), we can differentiate goods based on the specific or generic nature of the inputs and outputs

involved in their production. In this article we will focus on two situations: specific goods that are produced based on specific inputs, following the client's specification; and generic goods that are goods that can be produced in advance using interchangeable inputs. The main difference is that when goods are generic it becomes possible to answer to the unexpected request by stocks. This will create a different relation to the voyage duration.

In the situation of **Generic goods** the shipper can hold stocks to satisfy demand. This corresponds to the traditional micro economic approach as exemplified by Baumol and Vinod (70). Two situations exist: (i) in a simplified situation the demand is constant and perfectly predictable, the total handling costs (meaning the cost of transportation and stockholding) will be:

$C = rT + utT + a/s + wsT/2$, with:

C = annual variable handling costs,
a = cost of ordering processing,
r = transport cost per product unit,
T = quantity of good transported,
u = carrying cost per unit of time,
t = transit time,
w = warehouse carrying cost per unit per year,
s = the annual frequency of shipment (for instance 0.1 if their are ten shipments per year).

The shipper will control s. While choosing an optimal s*; it will face a cost function defined as: $rT + utT + 2awT^{1/2}$. Then the benefit (per unit of product) of the reduction of transport duration t, will be u. As a consequence, the dispersion of transport time duration will reflect the dispersion of the u parameter among shippers or shipping occurrences. (ii) A more complex situation might be envisaged with a non predictable demand. This situation is reflected in the handling cost function $C= rT + utT + a/s + wsT/2 + wk((s+t).T)^{1/2}$, where the latest term refers to the cost of the safety stock hold in order to minimize the consequences of lost sales opportunities (stock out risk). The extra k notation is introduced to represent the accepted probability of stock out. In this situation the marginal benefit of the reduced transport time is two folds: reduction of in transit inventory costs and reduction of safety stock. Similarly the effect of transport time reduction for all shipments sent within one year is

$$\delta C/\delta t = uT + \frac{wkT}{2\left((s+t)T\right)^{1/2}},$$ and the effect for each shipment will be the same formula multiplied by *s*. Again the dispersion of the value placed by shippers on the reduced transport time will depend on the distribution of the u and wk among shippers.

The neo-classical analytical framework needs however to be broadened in order to take into account the case for non generic goods, meaning goods that cannot be stocked in advance to serve a certain demand, as they are produced based on clients requests.

In such a situation, corresponding to **specific goods**, the optimal program of the producer is a bit more tense as it cannot use stocking as a buffer between production rate and the time pattern of demand. New analytical problems arise based on the fact that for instance the shipper will be able to trade off between paying a faster and more expensive transport service, or, by anticipating the finalisation of the goods. Actually, it would not be sensible for the shipper to pay for a fast transportation if he could, at lower cost, have the goods leaving

the factory earlier and use a more economical transport service. Let us suppose a shipper that can choose t_0, the arrival time of inputs for the production process, t_d the departure time of outputs, t, the transport time. Goods will arrive at a destination at a time $(t_d + t)$, time available for production will be $(t_d - t_0)$. Again two situations need to be distinguished one where minimum transport time duration is an active constraint (the shipper would be prepared to pay for faster transportation but none is available); and the other one where time enters the program through a cost (reducing transport time is more costly). We will focus on the second situation considering that situations where the time constraint is active are not the most likely.

In this situation the program for maximising the profit of the shipper is:
$\text{Max } \pi(t_0, t_d, t) = r(t_d + t) - cp(t_d - t_0) - cti(t_0) - cto(t)$.
with:
π = profit of the shipper;
$r(t_d + t)$ = revenue depending on the arrival time of the goods at the destination;
$cp(t_d - t_0)$ = production costs depending on the duration available for production;
$cti(t_0)$ = cost for transport of the input;
$cto(t)$ = cost for transport of the output;

All the 4 components of the profit function listed above can reasonably be assumed to be U shaped.

This program leads to the following first order conditions (we will suppose that the second order conditions are satisfied):

$cti'_{t0} = -cp'_{t0}$,
$r'_{td} = cp'_{td}$,
$r'_{t} = cto'_{t}$.

The optimal situation is when $r'_t = cto'_t = cp'_{td} = cti'_{t0}$. The sign of all the derivatives will be determined by the sign of r'_t meaning whether the client prefers faster or slower deliveries. In a typical situation all derivatives will be negative. In this case when the transport time is changed by Δt (<0 for time savings), the benefits for the shippers will be $cto' \times \Delta t = r' \times \Delta t = cti' \times \Delta t$ [(1)]. Interestingly we see that the value placed by the shipper on the transport time savings will depend of some "*time sensitivity*" that is explained by the sensitivity of the client to the product delivery schedule, and the sensitivity of the production and input logistics process to duration. Firms where producing quickly is expensive, or firms facing clients very sensitive to early availability of goods, or also firms where early arrival of inputs is expensive will give high value to the reduction of the transport duration. The analysis of which sectors correspond to these features will be discussed in other works.

What can we conclude here about heterogeneity. We may find that some firms are more sensitive to (transportation) time than others and give some understanding of which production features can explain the value placed by a company on the time attribute. But this may give insufficient indication to know what is the distribution of parameters among shippers or shipments. This point will be discussed more in detail in the following section.

Distribution of parameters

In this section we discuss how distributed coefficients can capture heterogeneity among shippers. In the general framework of Random Utility Maximisation, the notion of distributed coefficients refers to the assumption that at least some of the utility coefficients are random variables. The assumption made about the distribution of the parameters is one of the crucial aspects of heterogeneity modelling. It has been discussed extensively in scientific literature, although no firm conclusion has been established yet. However, here again, much of the discussion has been made in the area of passenger transportation, while freight transportation has received less attention. Probably some of the conclusions reached by passenger transport analysts still hold for freight transportation. This mainly regards warnings made about incautious use of distributed coefficients. This is the case presumably for the warning regarding the existence of negative values in some distribution or the issue raised by 0 values for coefficients used as denominators (typically cost coefficient) or again, the thickness of the distribution tails that can raise serious doubts about the existence of some choice occurrences with very extreme values of the utility coefficients.

Furthermore we have to tackle some other analytical difficulties are freight specific. Typically, while in passenger transportation there is an empirical foundation for the distribution of the cost attribute, based on the empirical log normal distribution of income, that in turn implies that the inverse of the cost coefficient will be log normally distributed, there is no such yardstick for freight transportation. Another potential difficulty is that the coefficients of the utility function will result from a mix of several distributions (for instance, as illustrated above, a distribution for generic goods producers and a distribution for specific good producers).

Another source of information regarding the distribution of parameters, is to exploit information coming from *hauliers'* preferences in order to derive information on those of the *shippers*. As suggested by Massiani (2003), hauliers' willingness to pay for transport attribute variations can be written as the sum of changes in transport costs + changes in revenues (i.e. changes in the payment made by the shippers). If we use a first order approximation for these different functions we get:

$wtp_h \times \Delta t = c'_t.\times\Delta t + wtp_s\times\Delta t$, with:

$wtp_h \times \Delta t$ = willingness to pay of the haulier for Δt.

$c(t)$ = transportation costs depending on t. c_t' is positive or negative, depending on location of current transport time on the time depending transportation cost curve

wtp_s = willingness to pay of the shipper for Δt . wtp_s being negative for $\Delta t > 0$ (and positive for time gains i.e. $\Delta t<0$).

In the short run (meaning revenues will not be changed by market price adjustments but only by changes in quality) the changes in hauliers' revenues (or shipper's payment) will reflect the willingness to pay for changes in quality, plus the reduction in costs. Thus one can reverse this equality and write: $wtp_s = wtp_h - c'_t.\times\Delta t$. At this point it becomes possible to use the empirical information collected for instance by Wynter (95) or by Kawamura (00) showing evidences of a log-normal distribution of carriers' willingness to pay. The difficulty here is however that the sum of a log normal distribution and another distribution may not always give rise to a tractable probability distribution function.

1.2. Available methodologies

In this paragraph we present the methodologies available for representing heterogeneity in the preferences. Diverse methodologies are available. Note that, in the Random Utility Maximisation (R.U.M.) framework, even when heterogeneity is not explicitly considered in the model, it is still present in the random component of the indirect utility function. This means that an analyst using standard modelling techniques is not omitting heterogeneity he is only using a rough way of modelling it.

There are two main categories of applications:

- those based on *a priori* specification of the variable giving rise to heterogeneity among shippers and shipments. This method somehow embeds some *a priori* assumptions of what creates heterogeneity.
- those making no *a priori* assumptions on the causes of heterogeneity, but trying to find quantitative evidences of the distribution of tastes among shippers or shipments.

The first category includes for instance **a priori classification** or **cross variable specification** of the utility function as exemplified by Jiang (97). This approach provides the additional advantage of giving information about which elements provoke the change of the attribute parameter from one individual to the other. *A priori* classification is quite a straightforward approach, but the evidences based on these classifications have raised contrasted comments in recent works. While Bolis and Maggi (02) find that: *"Our experiment confirmed the view that goods classifications are no longer an important means to analyse transport decisions. While we found no evidence for differences in calculation among sectors, we found high values for high quality goods*". Maier et Bergman (02) reach the opposite conclusion: *"The valuation placed on alternative dimensions of transport services by logistics managers of Austrian companies differs significantly by both their regional and the industrial cluster affiliation.*

The actual question for heterogeneity analysis is whether segmentation is a relevant way of capturing heterogeneity. The comparison of a number of results suggests that patterns about what segments have higher or lower value of time (v.o.t) are not very stable., Moreover segmentation can be reliable only if a high level of disagregation is reached, the difficulty is then that the likely relevant segmentation will be highly disaggregated. This will create problems regarding (i) the estimation of each class's coefficient vector will become almost impossible due to the low number of firms that will be available in each segment; and (ii) the utilisation of a set of numerous coefficient vectors will in many application be at least as hard to manipulate as will be distributed coefficients.

Eventually one should consider that for the main applications of transportation choice models, namely forecast and evaluation, the decomposition of present or forecasted traffic by sector is often unavailable, making sectorial estimates not the most valuable tool. The conclusion is that probably a priori sectorial classification, even though it is relevant for the understanding of different industries, will be supplanted by other methods in a number of situations.

The second category of approaches, with **no a priori specification on the cause of variability**. It might , in turn, be divided into two main branches.

The first branch is based on the estimation of individual coefficients. Most of these applications are based on SP data that, compared with RP data, gives to the analyst the

flexibility in the design necessary to isolate individual parameters. This branch corresponds to Transfer Prices and is illustrated by Wynter (95) for transport operators. Wynter finds a mean VOT of 8.65 FF/min and a standard deviation of $\sigma(v)=5.94$. Another method are iterative SP that tend to narrow the range of possible parameters values for each individual. This approach is illustrated by Fowkes et alii (89), or Danielis et Rotaris (02).

The second branch is based on the use of distributed coefficients among the population of shippers (or shipments). This is the flourishing area of Mixed Logit, and Latent Class. The combination of these different methodology can give rise to very varied applications as illustrated for instance by Mixed Mass Point Logit (Dong and Koppelman (03)).

The methods belonging to this second branch will not be presented in this paragraph, but will be illustrated in the section dedicated to empirical application.

After having presented the main methodologies available, we can now proceed with the empirical application.

2. EMPIRICAL APPLICATION

Because of the theoretical arguments presented above, we expect shippers to hold a very diversified set of preferences for freight service. In the next paragraph we will discuss how to model, measure and explain heterogeneous preference. Two models will be presented: the random parameters logit model (also called Mixed Logit) and the Latent Class model, which can be thought of as a special case of the former, but with special and distinctive features.

Though such models have been developed more than a decade ago, their application has become common only in recent years thanks to improvements in the simulation methods made possible by the availability of faster computers. Their estimation procedure is currently included in some econometric software (such as NLOGIT 3.0, an extension of LIMDEP 8.0, a software developed specifically for limited dependent variable models (http://www.limdep.com/) or it is developed by researchers using common programming software (typically, GAUSS). As illustrated by some authors (Greene and Hensher, 2003; Hensher et al., 2003, Revlet and Train, 1998; Train, 2001, 2003) the choice probabilities of the aforementioned models can be used to estimate posterior individual parameters or posterior class membership probabilities via Bayes' rule. Such measurements of preference heterogeneity, hence, can be correlated to the available socio-economic variables leading to a statistical explanation of the sources of heterogeneity.

After presenting the main features of the random parameters logit model and the Latent Class model (paragraph 2), we will illustrate the data set collected via stated preference choice experiments of shippers" preferences for freight service (paragraph 3) and provide an estimate of the models and a discussion of the results (paragraph 4).

1.3. Modelling heterogeneity

The random parameters logit model

The random parameters logit model is illustrated by several authors, including among the most important McFadden and Train (2000), and Train (2003). Assume each shipper

faces a choice among J alternatives in each of T choice situations. J and T can vary over shippers (in our SP experiment J was set equal to 2 and T was decided by the software). The utility of alternative i as faced by shipper n in situation t is modelled as;

$$U_{nit} = \beta_n^{'} X_{nit} + \varepsilon_{nit}$$

where X_{nit} is the vector of independent, non stochastic variables that are observed by the researcher, such as the attributes of the alternative i in choice situation t. By contrast, the terms β_n and ε_{nit} are not observed by the researcher and considered stochastic. Adopting the RUM hypothesis, customer n is assumed to choose alternative *i*, in the choice situation, t, having the highest utility or, equivalently, it is assumed that the shipper knows the value of his own β_n and ε_{nit}'s for all j and chooses alternative i if and only if

$$U_{ni} > U_{nj}, \forall j = i \ .$$

The coefficient vector, β_n is assumed to be distributed, independently of ε and X, with distribution equal to $f(\beta / \theta)$ where θ are the parameters of the distribution in the population, e.g. the mean and covariance. Note that the use of the subscript n indicates that parameters are allowed to vary across individuals. Such a specification is useful to capture variation in preferences among shippers. Several distribution can be assumed: typically, normal, lognormal, triangular, uniform, etc.. Instead, the error term ε_{nit} is assumed to be independently and identically distributed (iid) extreme value type I (also called Gumbel).

If the researcher observed β_n, then the choice probability would be a standard logit. That is the probability conditional on β_n is

$$L_{ni}(\beta_n) = \frac{\exp(\beta_n^{'} X_{ni})}{\sum_{j=1}^{J} \exp(\beta_n^{'} X_{nj})}$$

However, the researcher does not know β_n. The unconditional choice probability is therefore the integral of $L_{ni}(\beta_n)$ over all possible variables of β_n

$$P_{ni} = \int L_{ni}(\beta_n) f(\beta \mid \theta) d\beta$$

which is consequently called a Mixed Logit model or Random Parameter Logit. A Mixed Logit probability is the integral of standard logit probabilities over a density of parameters, or, in other terms, a weighted average of the logit formula evaluated at different values of β, with the weights given by the density function $f(\beta / \theta)$. If the density of β can be specified to be normal with mean β and covariance W, the choice probability is

$$P_{ni} = \int \frac{\exp(\beta_n' X_{ni})}{\sum_{j=1}^{J} \exp(\beta_n' X_{nj})} \Phi(\beta \mid b, W) d\beta$$

These probabilities cannot be solved analytically but can be approximated through simulation (Train, 2003, p. 148). Having the researcher specified the functional form, for any given value of θ: (1) draw a value of β from $f(\beta / \theta)$, and label it β^r with the superscript $r = 1$ referring to the first draw; (2) calculate the logit formula with this draw; (3) repeat steps 1 and 2 many times and average the results. This average is the simulated probability

$$\hat{P} = \frac{1}{R} \sum_{r=1}^{R} L_{ni}(\beta^r)$$

where R is the number of draws. The simulated probabilities are inserted into the log-likelihood function to give a simulated log likelihood

$$SLL = \sum_{n=1}^{N} \sum_{j=1}^{J} d_{nj} \ln \hat{P}_{nj}$$

where $d_{nj} = 1$ if n chose j and zero otherwise. The maximum simulated estimator is the value of θ that maximises SLL.

The researcher estimates the parameters, θ, e.g. β and W , which describe the density function. The parameters β are integrated out. Thus, the β 's are similar to the ε's, in that both are random terms that are integrated out to obtain the choice probability.

But this procedure is unsatisfactory if we want to study the variation of preferences among shippers. In this case, we want to obtain information about the β 's for each sample decision maker, as well as the parameters θ that describe the distribution of β 's across shippers. Train (2003, chapter 11 and 12) explains how such information can be obtained via classical estimation and the Bayesian procedure. We will concentrate on the former.

In order to understand the derivation it is important to distinguish among two distributions: the distribution of tastes in the population described by $g(\beta \mid \theta)$, and the distribution of tastes in the subpopulation of people who make particular choices, described by $h(\beta \mid i, x, \theta)$ to indicate the people who choose the alternative i in a choice situation consisting of several alternatives described collectively by variables x . Let $y_n = (y_{n1}, \ldots\ldots y_{iT})$ denote the shipper's sequence of chosen alternatives. The probability of the shipper's sequence of choices is the integral of $P(y_n \mid x_n, \beta)$ over the distribution of β

$$P(y_n \mid x_n, \beta) = \int P(y_n \mid x_n, \beta) g(\beta \mid \theta) d\beta$$

which is a Mixed Logit model. $h(\beta \mid y_n, x_n, \theta)$ can be derived by the Bayes' rule

$$h(\beta \mid y_n, x_n, \theta) \times P(y_n \mid x_n, \theta) = P(y_n \mid x_n, \beta) \times g(\beta \mid \theta)$$

stating that the joint density of β and y_n can be expressed as the probability of y_n times the probability of β conditional on y_n (which is the left-hand side), or with the other direction of conditioning, as the probability of β times the probability of y_n conditional on β (which is the right-hand side). Rearranging

$$h(\beta \mid y_n, x_n, \theta) = \frac{P(y_n \mid x_n, \beta) g(\beta \mid \theta)}{P(y_n \mid x_n, \theta)}$$

all the elements on the right-hand side are known. Note that the denominator is the integral of the numerator. As such it is a constant which makes h integrate to 1, as required for any density. h is therefore proportional to the numerator and can be interpreted as follows: the density of β in the subpopulation of shippers who would choose sequence y_n when facing x_n is proportional to the density of β in the entire population times the probability that y_n would be chosen if the shipper's coefficients were β .

The model can be solved via the simulated maximum likelihood methods The likelihood function is:

$$L(b, W) = \prod_n L_n(b, W)$$

where

$$L_n(b, W) = P(y_n \mid b, W)$$

is the probability of the customer n's sequence of choices given b and W .

The Latent Class model

If the mixing distribution $f(\beta)$ is discrete, that is, it takes a finite set of distinct values, the Mixed Logit becomes a Latent Class model. The utility function can be specified as

$$U_{nit} = \beta_c' X_{nit} + \varepsilon_{nit}$$

where β_c is the class specific parameter vector. Within each class, choice probabilities are assumed to be generated by the MNL model.

$$P(i \mid c) = \frac{\exp(\beta_c' X_{ni})}{\sum_{j=1}^{J} \exp(\beta_c' X_{nj})}$$

Class probabilities are also specified by the MNL form

$$P(c) = \frac{\exp(\delta_c' z_t)}{\sum_{c=1}^{C} \exp(\delta_c' z_t)}, \delta_C = 0$$

where z_t is an optional set of person, situation invariant characteristics, which may be a set of fixed constants if no such characteristics are observed. In this case, the class probabilities are simply the function of C parameters, δ_c, the last of which is fixed to zero (Nlogit 3 Manual, 2003, p. N9-1).

For any given individual, the joint probability of chosen alternative j and being part of class c is equal to

$$P(i,c) = P(i \mid c)P(c) = \frac{\exp(\delta_c' z_t)}{\sum_{c=1}^{C} \exp(\delta_c' z_t)} \cdot \frac{\exp(\beta_c' X_{ni})}{\sum_{j=1}^{J} \exp(\beta_c' X_{nj})}$$

Similarly to the Mixed Logit - as explained in the Nlogit 3 Manual, (2003, p. N9-3) - using Bayes' formula it is possible to derive the posterior estimate of the individual specific class probability and, hence, the individual specific posterior estimate of the parameters.

1.4. The data

The data were collected in 29 face-to-face stated choice experiments administered via a laptop computer to logistics managers of manufacturing firms located in two Italian regions, Friuli Venezia Giulia and Marche. The choice experiment implied choosing between two types of freight transport service, as in the example of fig. 1, characterized by 4 attributes.

Table 1. An example of a graded paired-comparison question

Which transport service would you prefer?								
10% above current cost				5% below current cost				
Zero risk of delay				Risk of a 1-day delay				
Zero risk of damage and loss				Risk of damage and loss equal to 10% of shipment value				
1 day more than the current time				3 days more than the current time				
Strongly Prefer Left				Indifferent				Strongly Prefer Right
1	2	3	4	5	6	7	8	9

The attribute levels were the ones presented in Table 2.

Table 2. Attributes and attribute levels used in the ACA experiment

Attribute # 1	Attribute # 2	Attribute # 3	Attribute # 4
Cost	Travel time	Punctuality	Damage and loss
10 % below current cost	Equal to current travel time	no risk of delay	no risk of damage and loss
5 % below current cost	1 more day than current travel time	Risk of a ½-day delay	Risk of damage and loss equal to 5% of shipment value
Equal to the current cost	3 days more than current travel time	Risk of a 1-day delay	Risk of damage and loss equal to 10% of shipment value
5 % above current cost	5 days more than current travel time	Risk of a 3-day delay	
10 % above current cost			

The choice experiments were preceded by an in-depth interview which touched upon several characteristics and the choice made by the firm regarding its production and logistics arrangement as illustrated by Table 3. Before the beginning of the choice experiment, the typical shipment was defined. More detail on the research project, which involved 69 interviews and the use of the ACA Software, can be found in Danielis et al. (2004)

Table 3. Questions asked in the first part of each interview

Basic Information
- Which is the size of the firm in terms of revenues and employees?
- How many production and distribution plants are there and where are they located?
- What are the main and secondary productions carried out?

Information about relationship with customers and sellers
- Where are buyers and sellers located?
- What is the type of contract used (FOB, CIF, other)

Information on production organisation
- How would you describe the firm production organisation?
- How is inventory managed?

Information on outsourcing of logistics and transport
- Which activities are outsourced and under which contractual arrangement?

Information on typical shipment (for inputs and for outputs)
- Which is the origin/destination?
- Which is the average travel time?
- Which is the average volume/weight?
- Which is the average unit value?

- What kind of good is shipped?
- Is special package needed?
- What is the transport cost?
- What is the transport mode?

1.5. Empirical results

A standard multinomial logit (MNL) model is first estimated. The results are reported in the first column of Table 4. The explanatory values are the attributes of the choice experiments only. The signs are as expected. The coefficients are significant, except for the cost which is weakly significant.

It is noteworthy that no socio-economic variable proved significant within MNL framework, both modelled autonomously or interacted with the choice attributes (as reported in Danielis et. al., 2004). The heterogeneity of the preferences could not therefore be captured or explained within the simple MNL framework.

Random parameter logit model estimation

Three RPL specifications are estimated: an RPL model with all parameters distributed normally (RPL N), an RPL model with parameters distributed normally except for cost variable which is assumed to be distributed triangularly (RPL TC), and an RPL model with all parameters distributed triangularly (RPL T).

Since economic theory implies that cost has a negative effect on utility, the first specification is not consistent since the normal distribution includes positive values. The log-normal distribution is defined for positive values only. When negative values are expected, as in the case of the cost variable, a conventional solution is to take the negative value of the cost variable. The resulting coefficient will be consistent with the economic theory. Alternatively, Greene and Hensher (2002) suggest to use the triangular distribution restricting the scale parameter to 1. This is the method used with the second model. The third model assumed that all variables follow that specific triangular distribution.

Three important instructions were given to the Nlogit 3.0 software used to estimate the models: (1) to use a 100 point simulation using Halton draws; (2) to correct for potential correlation within the same choice experiment; and (3) to estimate individual parameters via a simulation methodology using Bayes' rule. Two tables of results for the posterior individual parameters are included in Appendix A.

Table 4. Results for the MNL and RPL models

	MNL	*RPL N*	*RPL TC*	*RPL T2*
Cost	-4.2378	-7.7618	-2.8657	-5.2252
	(-1.75)	(-1.29)	(1-.24)	(-2.34)
Time	-0.6335	-2.7362	-2.6199	-0.5265
	(-5.69)	(-2.97)	(-3.20)	(-3.61)
Delay	-0.5597	-2.8703	-2.6416	-0.4758
	(-3.90)	(-2.54)	(-2.27)	(-2.89)
Damage	-20.9030	-59.3230	-60.2798	-18.1036
	(-5.24)	(-3.76)	(-3.83)	(-3.45)
Sd cost*		9.0147	5.7314	10.4504
		(1.37)	(1.24)	(2.34)
Sd time*		1.8241	1.7980	1.0529
		(3.01)	(2.83)	(3.61)
Sd delay*		4.7856	4.5530	0.9515
		(2.74)	(2.77)	(2.89)
Sd damage*		26.6981	31.7238	36.2072
		(2.56)	(2.79)	(3.45)
L-Lik.	-124.6444	-74.5160	-74.8704	-102.7694
L-L(0)	-156.6513	-156.6513	-156.6513	-156.6513
Pseudo-R^2	0.1751	0.5069	0.5068	0.3321

MNL = Multinomial logit model, RPL N=Random parameter logit model with all parameters distributed normally, RPL TC = Random parameter logit model with parameters distributed normally except for Cost which is distributed triangularly, RPL T = Random parameter logit model with all parameters distributed triangularly. The values in parenthesis are t-Statistics for the above parameters.
**Derived standard deviations of parameter distributions;*
L-L(0)=log-likelihood with coefficients restricted to zero.

Comparing MNL and RPL results one can notice different log-likelihood values. In fact the RPL models have a much better fit in all specification. This implies that relaxing the hypothesis of homogeneous shippers' preferences and allowing for non-homogeneous ones greatly improves the significance and predictive capability of the model:

The RPL N model has the best fit, but carries two shortcomings: the cost coefficient is not significant and the posterior individual estimates of the cost and risk of delay variables can be negative (see Table 8 in Appendix A).

The RPL TC model has a fit almost equivalent to the RPL N model and the negative value shortcoming for the cost variable is corrected. However, there are still negative values in the risk of delaying individual estimates and the cost coefficient is not significant.

The RPL T model solves the negative value issue in the individual estimates because of the specific triangular distribution assumption, but at a cost of diminishing the fit of the model (though still largely better than the MNL model). It should also be noted that all coefficients are significant.

Latent Class model estimation

The estimate of the Latent Class model requires the analyst to pre-determine the number of classes. We specified the model with 2, 3, 4 and 5 classes. Table 5 reports the estimates.

Table 5. LC model estimates with increasing number of classes.

	2 classes		3 classes		4 classes		5 classes	
Variable	*Coefficient*	*t-Statistic*	*Coefficient*	*t-Statistic*	*Coefficient*	*t-Statistic*	*Coefficient*	*t-Statistic*
Cost 1	8.434	1.646	1.574	0.112	2.163	0.148	2.176	0.148
Time 1	-2.138	-5.211	-38.071	0.000	-12.463	-2.099	-12.405	-1.989
Delay 1	-1.359	-4.886	-10.976	-2.429	-9.632	-2.022	-9.582	-1.914
Damage 1	-24.904	-4.309	-57.701	-2.487	-48.232	-1.969	-47.926	-1.838
Cost 2	-12.788	-4.179	1.294	0.243	-11.897	-0.330	-54.422	-0.818
Time 2	-0.382	-3.468	-1.470	-5.388	-1.518	-0.756	-4.153	-1.005
Delay 2	-0.284	-1.283	-0.711	-3.197	-356.884	0.000	-56.503	-0.747
Damage 2	-31.701	-6.388	-42.040	-5.306	-2052.35	0.000	-335.091	-1.015
Cost 3		6.040	-34.335	-4.241	1.780	0.305	-0.536	-0.087
Time 3		4.045	-0.340	-2.341	-1.967	-5.348	-2.117	-4.856
Delay 3			-0.508	-1.585	-0.677	-2.614	-0.851	-2.712
Damage 3			-53.280	-5.565	-47.298	-5.231	-53.847	-4.586
Cost 4				3.029	-37.157	-4.077	-195.216	-0.361
Time 4				3.156	-0.371	-2.355	-0.648	-2.067
Delay 4				3.000	-0.548	-1.645	-1.064	-2.137
Damage 4					-48.769	-4.985	-530.036	-0.420
Cost 5						2.183	127.372	1.172
Time 5						1.602	10.488	1.200
Delay 5						3.045	119.484	1.067
Damage 5						2.914	569.680	1.222
*PrbCls_1	0.599		0.334		0.262		0.260	2.106
*PrbCls_2	0.401		0.387		0.136		0.141	1.535
*PrbCls_3			0.280		0.349		0.329	2.878
*PrbCls_4					0.252		0.193	2.492
*PrbCls_5							0.077	1.411

**Estimated Latent Class probabilities. Log-likelihood is reported in the next table*

Furthermore, we programmed the econometric software to correct the correlation within each choice experiment and to estimate individual parameters and class probabilities.

Boxall and Adamowicz (2002) propose to select the optimal number of classes using the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) as reported in Table 6.

Table 6. Selection of the optimal number of classes

N° of classes	Parameters	L-Likelihood	LL0	Pseudo- R^2	AIC	BIC
2	9	-105.545	-156.651	0.326	229.1	120.7
3	14	-87.3709	-156.651	0.442	202.7	110.9
4	19	-83.1173	-156.651	0.469	204.2	115.1
5	24	-71.3318	-156.651	0.545	190.7	111.7

Sample size equal to 226 choices from 29 choice experiments (N).
Pseudo- R^2 is calculated as 1-(LL)/LL(0).
AIC (Akaike Information Criterion) is calculated using {-2(LL-P)}. P stands for the n° of parameters.
*BIC (Bayesian Information Criterion) is calculated using {-LL+[P/2)*ln(N)]}.*

According to the AIC criterion the optimal number would be 5, whereas according to the BIC criterion it would be 3. However, given the small sample size, Table 5 shows that, if the number of classes is greater than 2, the significance of the estimates decreases rapidly. Therefore, we performed the next step in the analysis considering only two classes.

Characterising Classes

The socio-economic data can be used to characterise the two classes. A cluster analysis is usually performed to characterised classes (e.g., Train, 2003). In our application, given the number of classes, the size of the sample and the limited number of explanatory variables as reported in Appendix B, a close look at the table is sufficient to state that class 1 is characterised by high negative coefficients of time and risk of delay and class 2 by being high negative coefficients of cost and damage. It is hence proposed to denote class 1 as grouping time and reliability sensitive shippers and class 2 as grouping cost and damage sensitive shippers. These represent the latent characteristics of the two classes.

Let us now turn to analyse how class membership is affected by socio-economic observable characteristics of the shippers. Gupta and Chintagunta (1994) propose a methodology consistent with the LC model using regression analysis. The formulation is the following

$$\ln\left(\frac{P_{c1}}{P_{c2}}\right) = \alpha + \gamma D + \varepsilon$$

The dependent variable is the vector of the natural log of the ratio of posterior class membership probabilities. The explanatory variables are observable socio-economic variables such as the firm and shipment characteristics.

Table 7. Class membership model estimates.

	Coeff.	*t-ratio*
Constant	-15.8749	-4.24082
Short Trips	2.26771	0.785286
JIT adoption	11.1116	3.63181
District	7.53719	2.56607
Employees	0.00279	0.646792

R-squared = .5185869; Adjusted R-squared = .4383514
Model test F[4, 24] (prob) = 6.46 (.0011); Chi-sq [4] (prob) = 21.20 (.0003)
Akaike Info. Criter. = 4.089319; Autocorrel Durbin-Watson Stat. = 1.5991217; Rho = cor[e,e(-1)] = .2004392

Four explanatory variables were introduced in the equation. About half of the variability is explained by the model. The length of the shipment voyage and the size of the firm (n° of employees) do not seem to affect class membership. On the contrary, the adoption of just-in-time techniques enhances the probability of being a member of class 1 (the time and reliability sensitive class) as well as the location of the firm within an industrial district, that is a cluster of firms specialising in the same class of products which characterises the industrial structures of the Region under investigation [(2)] . Whereas the first finding is rather obvious, the second is a bit unexpected and very interesting since it signals special transport needs for firms operating within the interdependent industrial environments described as industrial districts.

2. CONCLUSION

In this article we have shed some light on the reasons underlying the heterogeneity of the shippers' preferences for transport attributes. We have found that for transport time, the distribution of the parameter reflects both the distribution of shippers among different productive configurations. This refers to the specificity of the inputs and outputs of the production process. This refers as well as to market related parameters like the time sensitivity of production costs or the willingness of clients to pay for fast delivery.

Among the methods available for capturing heterogeneity we implemented a Mixed Logit and a Latent Class analyses. This application based on a preliminary data set confirms that heterogeneity is very high. The RPL and LC models outperform, in most specifications, the standard MNL assuming homogenous preferences.

Though the available sample is quite small to produce robust statistical estimates, we were able to detect the main determinants of preferences, to isolate two main classes of preferences and to explain some of the variability in class membership probabilities. It is found that logistics managers of firms adopting JIT techniques or of firms belonging to an industrial district are more time and reliability sensitive, whereas firm size or the shipment length does not seem to influence preferences and class membership probabilities.

These results suggest that heterogeneity deserves the attention that transport analysts are now dedicating to this subject.

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NOTES

[1] In this section we only consider short term benefits, in the meaning that we do not consider further benefits deriving from potential decrease in prices in occurrences where the decrease in transport time is reducing the cost of the transport operator and if the market conditions are such that these gains will be passed on to the shipper.

[2] The sectors classified as part of a industrial district are the following: shoes, furniture, wood, construction, food for animals, clothing, whereas are not part of a regional district rubber, electronics, paper, textile.

APPENDIX

Appendix A - Individual parameter estimates derived from the RPL model

Table 8. RPL model with normal distribution of parameters

Choice exp.	*B_cost*	*B_time*	*B_delay*	*B_damage*	*sdB_cost*	*sdB_time*	*sdB_delay*	*sdB_ damage*
1	-7.3227	-3.31222	-3.02771	-54.9967	8.26195	1.23372	4.54141	22.7209
2	-5.22923	-2.89018	-2.84819	-71.3406	8.33838	1.85995	4.41175	20.6707
3	-5.6239	-2.80041	-6.63813	-57.0159	8.3816	1.81416	2.88251	25.8527
4	-7.4965	-0.74901	-2.82931	-70.9958	9.06947	1.03038	4.30929	23.0043
5	-8.62162	-2.28875	-2.87666	-59.5109	8.14109	0.960658	4.43959	25.9574
6	-7.33322	-2.64218	-7.40918	-46.9519	8.3557	1.73649	2.81695	23.3
7	-7.51189	-3.43189	0.96317	-58.3225	8.52519	1.69924	2.92096	26.2794
8	-4.3599	-2.89433	-2.77711	-71.8694	7.83271	1.90987	4.48288	21.0381
9	-6.19831	0.198387	-2.95883	-67.4643	8.27794	0.669163	4.21146	18.7937
10	-8.39489	-3.48068	-2.95313	-55.0944	8.46132	1.21169	4.67585	23.6687
11	-7.71825	-2.76171	1.88985	-63.9407	8.47463	1.64283	2.47215	26.9403
12	-7.46718	-1.0518	-2.62104	-27.4903	6.29959	0.882923	4.57313	26.2299
13	-7.69855	-3.73108	0.652036	-60.2996	8.87208	1.54006	2.41999	25.2281
14	-7.87946	-3.53216	0.764658	-58.5475	8.55057	1.69718	3.07265	26.839
15	-7.9905	-3.66501	1.09432	-60.4509	8.86125	1.46775	2.22706	25.1573
16	-7.07526	-2.83467	-8.16262	-56.2771	8.39887	1.02669	2.41681	27.0989
17	-16.9295	-3.57729	0.519122	-45.3416	7.35163	1.5816	0.81236	24.248
18	-7.62815	-3.35424	-6.16884	-57.4519	9.50769	1.30962	2.64826	25.1081
19	-8.08653	-3.81608	0.065653	-61.0894	8.81075	1.50685	1.95851	24.0049
20	-7.31671	-2.93869	-3.1209	-54.7841	8.28714	1.72707	4.57134	18.0692
21	-6.90456	-2.55373	-7.7528	-44.0872	8.47212	1.79711	3.33674	21.1362
22	-8.06982	-2.53946	-8.7015	-56.3587	8.60452	1.84582	3.48196	22.5583
23	-4.11499	-2.79973	-2.83885	-74.0296	7.56382	1.82065	4.93865	20.8334
24	-3.89278	-2.77204	-2.86579	-73.7151	7.78299	1.82883	4.96785	21.0834
25	-6.46757	0.840309	-4.53123	-54.8199	9.50955	0.413585	5.7793	16.9372
26	-17.6227	-2.92892	-0.68636	-14.2915	8.82474	1.78707	5.26742	14.398
27	-7.43812	-1.79957	-2.45556	-76.1993	9.07381	0.778343	4.81258	21.1541
28	-2.11167	-2.13205	-0.39475	-66.3224	5.90432	0.602385	0.40495	16.2033
29	-13.6918	-3.7011	-3.56084	-70.4089	8.30295	1.15694	1.41507	17.9559

Table 9. RPL model with triangular distribution of all parameters

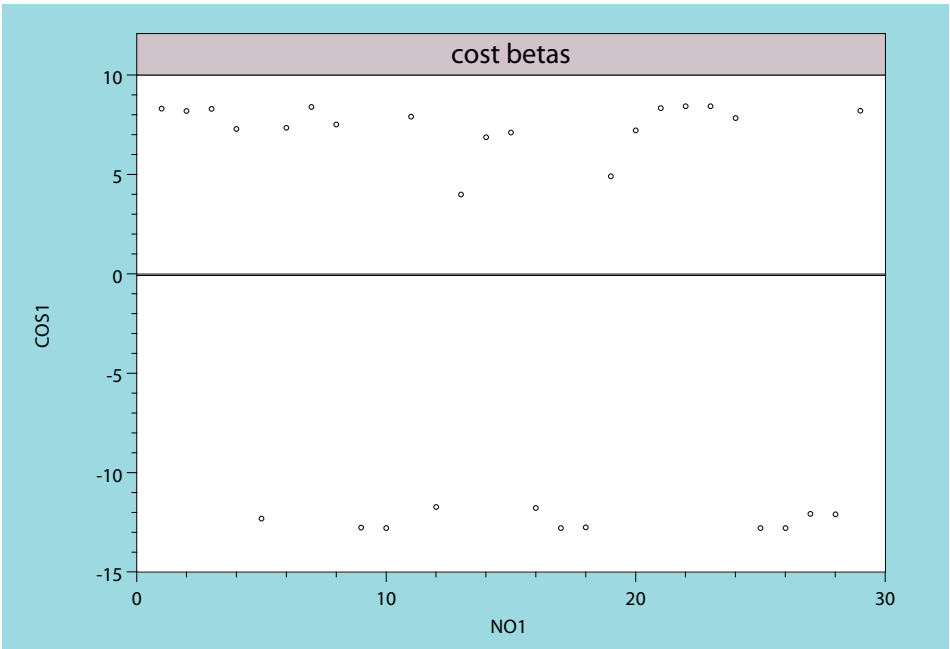
Choice exp.	**B_cost**	*B_time*	*B_delay*	*B_damage*	*sdB_cost*	*sdB_time*	*sdB_delay*	*sdB_ damage*
1	15.7569	1.81117	1.39912	42.8503	3.99373	0.371707	0.391018	12.1084
2	14.2377	1.5536	1.4298	62.7002	4.09129	0.437182	0.366103	11.917
3	12.4743	1.56601	1.65298	53.7402	3.62711	0.413243	0.328336	15.6824
4	15.657	1.31726	1.42223	62.0811	4.30383	0.385913	0.371359	12.6502
5	15.0996	1.68947	1.43433	53.3108	4.07556	0.357843	0.370495	14.7836
6	15.2444	1.5482	1.76773	32.7457	4.16036	0.430068	0.329631	10.4192
7	15.6025	1.81842	1.25029	53.5159	4.15496	0.368691	0.336835	14.3952
8	13.5182	1.56603	1.43225	63.818	3.87587	0.44628	0.369231	11.9777
9	16.5786	0.77157	1.31276	69.9083	3.30808	0.14708	0.26648	9.63019
10	15.7781	1.87664	1.40533	39.5627	4.10565	0.348562	0.40746	11.0667
11	15.6809	1.54737	1.2575	62.7003	4.32117	0.445872	0.331324	12.2065
12	15.6806	1.51571	1.44998	44.5914	4.30274	0.358255	0.381202	11.587
13	15.6176	1.87991	1.13391	52.5596	4.20129	0.361854	0.29751	13.9462
14	15.5854	1.87626	1.22966	53.0526	4.14778	0.343873	0.329494	14.2695
15	15.4818	1.86475	1.08975	52.3269	4.22381	0.375182	0.28769	13.8736
16	16.4237	0.91856	1.73529	52.4861	4.05403	0.207958	0.325591	14.6451
17	19.5896	1.65441	0.8483	60.4745	2.86891	0.446165	0.241293	14.6753
18	15.7024	1.43418	1.66059	53.6822	4.23279	0.37539	0.326908	15.0087
19	15.729	1.9033	1.1226	53.0614	4.35821	0.351973	0.333233	14.7508
20	15.0775	1.55075	1.42273	55.814	4.17615	0.425618	0.383276	11.8761
21	15.9515	1.6509	1.86585	27.3501	4.18116	0.41364	0.315329	7.77969
22	16.1077	1.66327	1.92158	26.1606	4.02634	0.406573	0.278694	6.81732
23	13.1335	1.57728	1.43857	65.5364	3.68187	0.421055	0.387922	11.8901
24	13.1624	1.58256	1.43617	65.6218	3.72217	0.422156	0.39073	11.8955
25	17.2375	0.705539	1.32465	55.5926	3.27248	0.124517	0.258768	12.3402
26	19.3369	1.49202	1.65492	29.0428	4.12156	0.44594	0.41954	6.43609
27	15.736	1.46163	1.41952	61.8517	4.25759	0.374058	0.390479	11.9488
28	11.6428	1.77806	1.0417	61.2258	3.31583	0.410279	0.289542	10.7749
29	14.7797	1.85068	1.56412	53.37	3.87695	0.347703	0.343036	12.5373

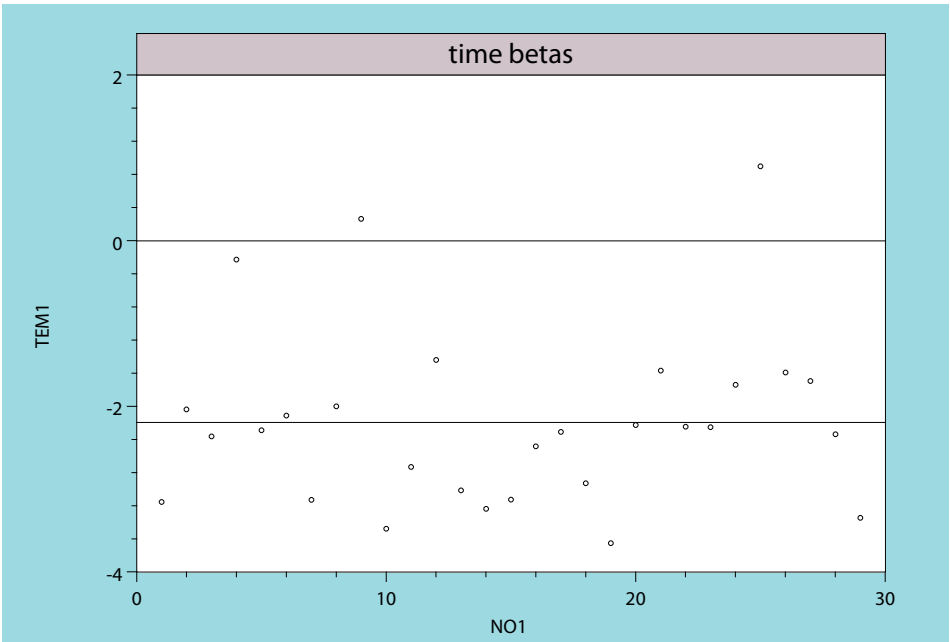
APPENDIX B

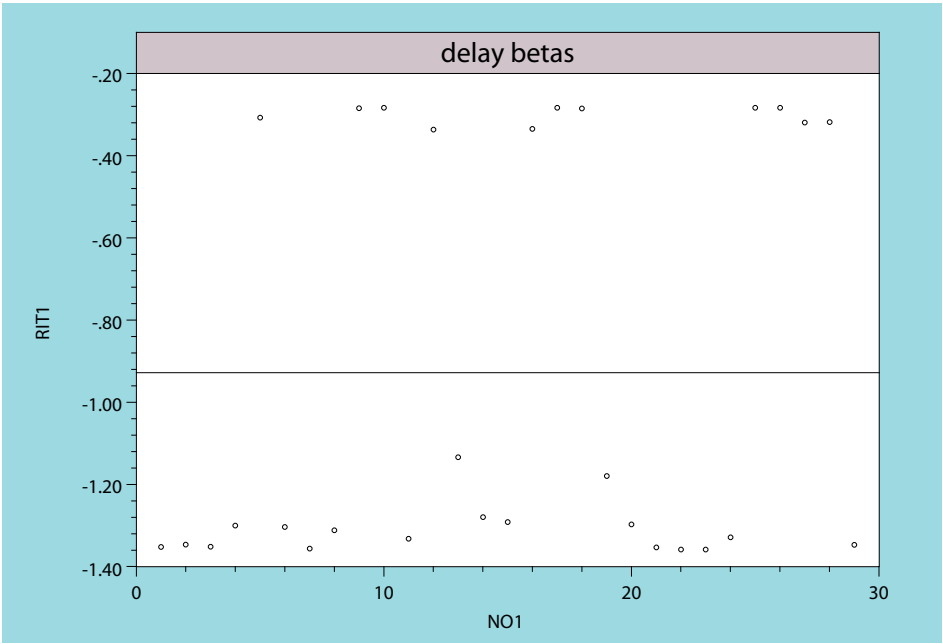
Table 10. Individual parameter estimates derived from the LC model.

Choice exp.	*B_cost*	*B_time*	*B_delay*	*B_damage*	*Class prob 1*	*Class prob 2*
1	8.300	-2.127	-1.352	-24.947	0.994	0.006
2	8.180	-2.117	-1.346	-24.986	0.988	0.012
3	8.289	-2.126	-1.352	-24.951	0.993	0.007
4	7.276	-2.042	-1.301	-25.275	0.945	0.055
5	-12.312	-0.421	-0.308	-31.549	0.022	0.978
6	7.335	-2.047	-1.303	-25.256	0.948	0.052
7	8.382	-2.134	-1.357	-24.921	0.998	0.002
8	7.502	-2.061	-1.312	-25.203	0.956	0.044
9	-12.772	-0.383	-0.285	-31.696	0.001	0.999
10	-12.787	-0.382	-0.284	-31.701	0.000	1.000
11	7.903	-2.094	-1.332	-25.074	0.975	0.025
12	-11.735	-0.469	-0.337	-31.364	0.050	0.950
13	3.988	-1.770	-1.134	-26.328	0.790	0.210
14	6.865	-2.008	-1.280	-25.407	0.926	0.074
15	7.100	-2.028	-1.292	-25.332	0.937	0.063
16	-11.775	-0.465	-0.335	-31.377	0.048	0.952
17	-12.788	-0.382	-0.284	-31.701	0.000	1.000
18	-12.755	-0.384	-0.285	-31.691	0.002	0.998
19	4.895	-1.845	-1.180	-26.038	0.833	0.167
20	7.210	-2.037	-1.297	-25.296	0.942	0.058
21	8.325	-2.129	-1.354	-24.939	0.995	0.005
22	8.423	-2.137	-1.359	-24.908	0.999	0.001
23	8.418	-2.137	-1.358	-24.909	0.999	0.001
24	7.831	-2.088	-1.329	-25.098	0.972	0.028
25	-12.788	-0.382	-0.284	-31.701	0.000	1.000
26	-12.788	-0.382	-0.284	-31.701	0.000	1.000
27	-12.083	-0.440	-0.320	-31.475	0.033	0.967
28	-12.103	-0.438	-0.318	-31.482	0.032	0.968
29	8.202	-2.119	-1.347	-24.979	0.989	0.011

APPENDIX C : PLOT OF INDIVIDUAL VALUES FOR PARAMETERS :



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RAZNOVRSNOST O POIMANJU VAŽNOSTI VREMENA OD STRANE KRCATELJA, KOJA JE NASTALA KAO REZULTAT SP EKSPERIMENTA UZ PRIMJENU MJEŠOVITE LOGIT METODE I METODE LATENTNIH GRUPA

SAŽETAK

Poimanje raznovrsnosti u odabiru poprima sve veću ulogu kod analize ponašanja u transportu. Takvo je poimanje mnogo šire kad je prijevoz putnika u pitanju, nego li kad je riječ o prijevozu tereta. Međutim, postoje čvrsti razlozi, temeljeni na empiričkim dokazima ili heurističkom znanju, na osnovi kojih se može doći do zaključka da bi znanost o transportu morala iskoristiti sva nova analitička sredstva koja su se u posljednjih nekoliko desetljeća razvila, kako bi se raznovrsnost utjelovila u okvire maksimizacije slučajnih korisnika. U ovom se radu željelo pobliže razjasniti pitanje poimanja raznovrsnosti u odabiru, akoje se pojavljuje među krcateljima tereta.

Prvi dio članka bavi se modelom koji se koristi kod istraživanja uzroka pojave raznovrsnosti u okviru specifične značajke transporta, naime u okviru vremena transporta. Zatim su analizirane različite metode kojima se procjenjuje raznovrsnost. U drugom su dijelu korištena analitička sredstva kao što su metode latentnih grupa i mješovite logit metode kako bi se dokazalo postojanje raznovrsnosti. Rezultati se temelje na preliminarnoj obradi podataka istraživanja koje je obavljeno među krcateljima u sjevernoistočnoj i središnjoj Italiji. Također su date i individualne Bayesove procjene parametara za mješoviti logit model kao i model razrade razreda za analizu latentnih grupa.

Ključne riječi: *prijevoz tereta, važnost vremena, mješovita logit metoda, metoda latetnih grupa, raznovrsnost*

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PRILOG DEFINIRANJU KVALITETE TRANSPORTNO-LOGISTIČKE USLUGE NA PROMETNOM PRAVCU

Posebnosti prometnog tržišta, koje se ogledaju u konkurentnim odnosima prometnih subjekata i prometnih pravaca, nalažu ozbiljnost kreiranju cjelokupne ponude na prometnom pravcu. Svojom atraktivnošću, brzinom, sigurnošću te ukupnim kvalitetnim servisom, prometna usluga mora udovoljiti sve većim zahtjevima korisnika. U tom smislu, osnovni cilj ovog istraživanje je prilog definiranju pojma transportno-logističke usluge prometnog pravca kao složenog fenomena kojeg uvjetuju brojne okolnosti i specifičnosti prometnog tržišta. Sukladno postavljenom cilju istraživanja, u radu se definiraju teorijske determinante pojmova kvalitete prijevozne usluge, kvalitete prometne usluge i kvalitete transportno-logističke usluge te standardizirana baza za definiranje, osiguranje i upravljanje kvalitetom prometne usluge. Posebno se analiziraju kriteriji i specifičnosti prometnog tržišta, odnosno zahtjeva korisnika prometnih usluga, budući da upravo oni uvjetuju definiranje temeljnih pretpostavki i ciljeva u realizacije što višeg stupnja kvalitete i konkurentnosti usluge prometnog pravca.

Ključne riječi: *kvaliteta, transportno-logistička usluga, prometni pravac*

1. UVOD

Tržište prometnih usluga koje postaje sve zahtjevnije i otvoreno konkurenciji od organizatora i izvršitelja prometne usluge zahtijeva zadržavanje proklamirane kvalitete s intencijom njenog poboljšanja. To je razlogom da se definiranje politike kvalitete prijevozne i prometne (transportno-logističke) usluge izgradnjom primjerene organizacije smatra osnovnim preduvjetom konkurentnosti prometnog pravca.

Sukladno definiranom problemu istraživanja u radu, koji se odnosi na kvalitetu transportno-logističke usluge, postavljena je osnovna hipoteza koja glasi:

Uspjeh na tržištu prometne usluge moguće je ostvariti jedino trajnim osiguranjem kvalitete, koja bi trebala osigurati minimalno onu razinu usluge koju nude konkurentni prometni pravci i sudionici u proizvodnji prometne usluge na tom pravcu (luke, željeznica, cestovni prijevoznici i dr.).

Kako bi se moglo pristupiti vrednovanju kvalitete prometne usluge na prometnom pravcu, u radu se detaljno analiziraju pojam i značenje kvalitete prijevozne, prometne, tj. transportno-logističke usluge, standardizirana ISO baza kao okvir za definiranje, osiguranje i upravljanje sustavom kvalitete transportno-logističkih usluga.

U funkciji definiranja mjera i aktivnosti za kvalitativnu opstojnost pravca na tržištu prometnih usluga, posebno se analiziraju pretpostavke i ciljevi osiguranja sustava kvalitete. Pri tome se poseban naglasak daje očekivanjima korisnika usluge, budući da se samo ispunjavanjem zahtjeva i eventualnim premašivanjem korisnikovih očekivanja mogu ostvariti pozitivni rezultati, odnosno realizirati visok stupanj kvalitete, a time i konkurentnosti prometne usluge.

2. TEORIJSKE DETERMINANTE KVALITETE TRANSPORTNO-LOGISTIČKE USLUGE

Osiguranje kvalitete prometne usluge i upravljanje kvalitetom zasigurno je jedan od važnijih čimbenika valorizacije svakog prometnog pravca na tržištu prometnih usluga. Kako bi se istaknuo značaj kvalitete usluge za konkurentnost prometnog pravca te definirale osnovne teorijske postavke i kvalitativni kriteriji temeljem kojih je moguće analizirati „vrijednost usluge“ na pojedinim prometnim pravcima u odnosu na alternativne pravce, u narednim se poglavljima definiraju: pojam i mogući aspekti definiranja kvalitete, pojam kvalitete prijevozne usluge i kvalitete prometne usluge, te vrste kvalitete.

2.1. Poimanje kvalitete transportno-logističke usluge

Pojam **“kvaliteta”** je pojam latinskog podrijetla *qualitas* i znači; kakvoća, svojstvo, vrsnoća neke stvari, vrednota, odlika, značajka, sposobnost. Prema ISO 8402 (BS 4778) kvaliteta je «ukupnost osobina i karakteristika proizvoda ili usluga na kojima se temelji njihova sposobnost da zadovolje izričite ili očekivane zahtjeve». S aspekta proizvoda i usluga kvaliteta je, dakle, određena specifikacijom svojstava i obilježja koju proizvod ili usluga trebaju zadovoljiti, a propisana je standardom. Postoji više klasa kvalitete koje predstavljaju indikatore kategorije ili ranga s obzirom na obilježja ili značajke koje pokrivaju potrebu u odnosu na proizvode ili usluge namijenjene istim funkcionalnim uporabama. Iz toga proizlazi da je kvaliteta usklađenost sa zahtjevima specifikacije, odnosno standardima.

Pojam kvalitete, u smislu kvalitete proizvoda i usluga, danas se najčešće definira s dva osnovna aspekta, a to su [4, str. 81]:

- aspekt proizvoda i usluga
- aspekt potrošača (korisnika) usluge.

Sukladno tome, treba naglasiti da danas, kao rezultat tržišta i marketinga, prevladava definicija kvalitete s aspekta kupca, potrošača, klijenta, odnosno općenito korisnika proizvoda ili usluga. S toga aspekta, kvaliteta podrazumijeva razinu zadovoljenja potreba i zahtijeva

korisnika, odnosno, usklađenost s njihovim većim zahtjevima i očekivanjima, pri čemu je osnovni cilj proizvod ili uslugu maksimalno približiti razini očekivanja korisnika. Sukladno tome da navedenu kvalitetu određuje korisnik, neophodno je unaprijed predvidjeti njegove potrebe, očekivanje i želje [4].

Temeljem opće definicije pojma kvalitete, moguće je definirati pojam kvalitete prijevozne usluge i kvalitete transportno-logističke usluge kao bitne čimbenike valorizacije prometnih pravaca i konkurentnosti usluga koje se na njima nude tržištu prometnih usluga.

Tako je u skladu s definicijom prijevoza kao „…specijalizirane djelatnosti koja pomoću prometne suprastrukture i prometne infrastrukture omogućuje proizvodnju prometne usluge, prevozeći robu (teret, materijalna dobra) ljude i energiju s jednog mjesta na drugo uz svladavanje prostorne i vremenske udaljenosti." i definicijom prometa koji „…u užem smislu obuhvaća prijevoz ili transport, ali i operacije u svezi s prijevozom robe i putnika (ljudi) te komunikacija" [11, str. 40,41]; moguće zajednički definirati pojam kvalitete prijevozne/prometne usluge i kao ukupnost osobina i karakteristika prijevozne/prometne usluge na kojima se temelji njihova sposobnost da zadovolje izričite ili očekivane zahtjeve svojih korisnika.

Unutar toga, a u skladu s definicijama pojmova prijevoz i promet, navedene je pojmove moguće definirati zasebno na sljedeći način:

- **„kvaliteta prijevozne usluge"** je ukupnost osobina i karakteristika prometne infrastrukture, prometne suprastrukture i uvjeta prijevoza robe (tereta, materijalnih dobara), ljudi i energije od kojih zavisi njihova sposobnost da zadovolje izričite ili očekivane (pretpostavljene) zahtjeve i potrebe svojih korisnika,
- **„kvaliteta prometne usluge"** je ukupnost osobina karakteristika prijevozne usluge i operacija u svezi s prijevozom robe, putnika (ljudi) i komunikacija od kojih zavisi njihova sposobnost da zadovolje izričite ili očekivane (pretpostavljene) zahtjeve i potrebe svojih korisnika.

Pri tome treba istaknuti da je u okviru kvalitete prijevozne usluge moguće razlikovati: kvalitetu prometne infrastrukture, kvalitetu prometne suprastrukture, kvalitetu uvjeta prijevoza na prometnom pravcu; dok je u okviru kvalitete prometne usluge uz navedene moguće razlikovati: kvalitetu prometne infrastrukture, kvalitetu prometne suprastrukture, kvalitetu uvjeta prijevoza na prometnom pravcu, i kvalitetu operacija u svezi s prijevozom (kvalitetu ukrcaja/utovara, iskrcaja/istovara, prekrcaja/pretovara, sortiranja, slaganje, punjenje, signiranje (obilježavanje) te kvalitetu niz drugih dodatnih logističkih aktivnosti koje povećavaju vrijednost usluge i predstavljaju argument prema kojoj se kvaliteta prometne usluge može nazvati „**kvaliteta transportno-logističke usluge**".

Pojam kvalitete prijevozne usluge može se u svim fazama prijevoza (priprema, izvršenje, završetak) smatrati vrijednošću ukupnosti svih usluga u tom procesu. Određivanje kvalitete prijevozne usluge može se pretpostaviti i ocjenjivanjem niza bitnih podsustava čiji pokazatelji nisu uvijek jednaki, što znači da većim dijelom imaju varijabilno obilježje. Upravo zbog takvih specifičnosti, definicija kvalitativnih svojstava prijevoza može se i matematički prikazivati kao vektor [1, str. 55]:

$$\overline{F}(Q) = f(Y_1, Y_2, Y_3, \ldots Y_I, \ldots Y_n).$$

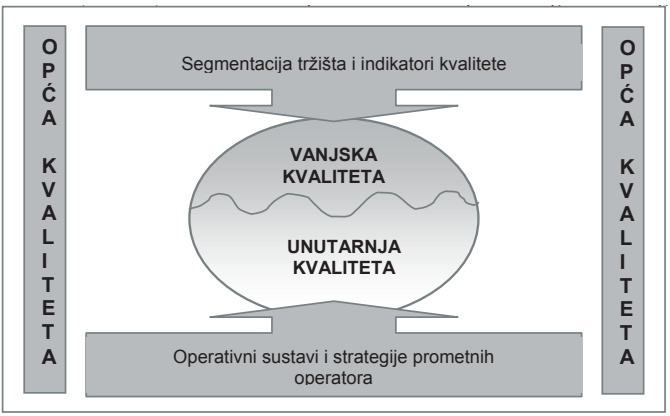
Dakle, svojstva prijevoza predstavljala bi dimenzioniranu aleatornu varijablu čija su obilježja temeljne vrijednosti pojedinih podsustava $(Y_1, Y_2, Y_3, ...Y_I, ...Y_n)$ te varijable sa značajkama vrijednosti.

Kvaliteta koja je predmetom istraživanja u ovom radu, a odnosi se konkretno na **kvalitetu transportno-logističke usluge,** predstavlja ključni čimbenik konkurentnosti prometnih pravaca i svih onih sudionika koji sudjeluju u proizvodnji prijevozne i prometne usluge na tim pravcima (transportni operateri, cestovni prijevoznici, željeznica, logistički operatori, kopneni terminali, robno-distribucijski centri…).

Unutar navedene kvalitete razlikuju se [5]:

- vanjska kvaliteta *External Quality*
- unutarnja kvaliteta *Internal Quality*
- opća kvaliteta *External Quality + Internal Quality.*

Shema 1. Unutarnja + vanjska kvaliteta = opća kvaliteta transportno-logističke usluge



Izvor: «Intermodal Quality», IV Framework Programme of the European Commission, Integrated Transport Chains, 1996-1999.

Vanjska kvaliteta je kvaliteta koju određuju krajnji korisnici usluge, kroz segmentaciju tržišta i kvalitativne indikatore, dok je unutarnja kvaliteta, ona kvaliteta koju određuju i ostvaruju sudionici u proizvodnji prometne usluge i njihove strategije. Iz toga proizlazi i osnovno stajalište da je **opća kvaliteta transportno-logističke** usluge produkt vanjske i unutarnje kvalitete, pri čemu je vanjsku kvalitetu potrebito temeljiti i analizirati u odnosu na:

- segmentaciju tržišta – kvalitativni indikatori korisnika koji se razlikuju s obzirom na različite segmente transportnog tržišta, odnosno s obzirom na specifične kvalitativne zahtjevi i potrebe različitih segmenata;

dok je s druge strane unutarnju kvalitetu potrebito temeljiti i analizirati u odnosu na:

- prometni potencijal – koncept prometne usluge koji mora odražavati različitost tržišta te razviti široku ponudu rješenja orijentiranih korisniku.

Prema dinamici nastajanja usluge, unutar kvalitete transportno-logističke usluge treba razlikovati:

- kvalitetu razvojnih i projektnih aktivnosti - kvaliteta izrade novih usluga s obzirom na tehničko-tehnološke mogućnosti koje udovoljavaju zahtjevima tržišta, a prijevozniku omogućuje rentabilno i ekonomično poslovanje,
- kvaliteta realizacije transportno-logističke usluge – manifestira se pouzdanošću koja se može iskazati kao vjerojatnost funkcioniranja prometnog podsustava sukladno unaprijed definiranim parametrima u pretpostavljenim internim i eksternim uvjetima i utjecajima.

Treba istaknuti da je specifičnost kvalitete u području transporta da ona ne može biti «krivotvorena», samom činjenicom da je dostava trenutna i vidljiva. Drugim riječima:

- vlakovi su na vrijeme ili nisu na vrijeme,
- usluge udovoljavaju obećanjima ili ne udovoljavaju,
- konačna faktura (račun) je ili nije u posljednji trenutak,
- roba je dostavljene oštećena ili neoštećena.

Kvaliteta je toliko vidljiva u transportu da neki otpremnici ili logistički operateri nastoje definirati vlastiti obračun troškova pri čemu izdvajaju nekoliko osnovnih područja vezanih za kvalitetu usluge, a to su primjerice: opća operativna efikasnost, administrativne procedure, odnosi među ljudima/komunikacije, profil pravca i tarife.

O značenju kvalitete u transportu svjedoči i zajednička prometna politika Europske unije kojom su definirana tri još uvijek važeća prioriteta, a to su [6, str. 153-168]:

- sigurnost,
- zaštita okoliša i korisnika usluge te
- unapređenje kvalitete prometnih usluga.

Stoga, kvaliteta i orijentiranost korisniku usluge postaje ključni čimbenik za uspjeh na tržištu u području prometnih usluga, u svrhu čega domaće transportne i logističke kompanije trebaju osigurati svoju strategiju prateći praksu europskih transportno-logističkih kompanija s ciljem uspostavljanja, održavanja i kontinuiranog unapređenja kvalitete svojih transportno-logističkih usluga.

2.2. Standardizirana baza za definiranje, osiguranje i upravljanje kvalitetom prometne usluge

Kvaliteta i standard (norma) čine jedinstvo s obzirom da je standard ništa drugo nego propisana kvaliteta, ali i mjerilo ostvarene kvalitete. To znači da bez jasnih i razumljivih standarda nema kvalitete koja bi trebala biti mjerljiva veličina.

Kvaliteta mora biti stalna i kontinuirana. Dokaz za to su **ISO certifikati kvalitete** (ISO 9000,9002, 9003 i 9004) koje izdaju verificirane certifikacijske institucije, a koji imaju „ograničen vijek trajanja“, odnosno vrijede tri godine te se provjeravaju svakih šest mjeseci.

Sudionici u proizvodnji transportno-logističke usluge moraju pažljivo osmisliti i primijeniti strategiju za osiguranje kvalitete usluga na određenom prometnom pravcu. Uspostavljanje, održavanje kao i neprekidno unaprjeđenje kvalitete transportno-logističke usluge podrazumijeva ispunjenje dvaju osnovnih preduvjeta, a to su:

- definiranje kvalitete usluge i
- uspostavljanje sustava kvalitete za osiguranje kvalitete usluge.

Definiranje i primjena sustava kvalitete u prometnim uslugama specifičan je zadatak, s obzirom na nepostojanje odgovarajućih standarda. Iz toga je razloga od velikog značaja definirati metodološku osnovu za ostvarenje primarnih preduvjeta za uspostavljanje, održavanje i unapređenje kvalitete transportno-logističkih usluga, pri čemu su na raspolaganju standardi ISO 9000 čije definicije i usvajanje u području prometnih usluga traži doduše izvjesne profesionalne napore.

Jedna od temeljnih odluka u osiguranju sustava upravljanja kvalitetom je usvajanje modela sustava kvalitete prometne usluge, što može biti učinjeno temeljem sustava standarda ISO 9001. U skladu s temeljnim aktivnostima transporta i logističkih operatora, sustav standarda ISO 9002 je pravi izbor. ISO 9002 je identičan s ISO 9001, osim što ne sadrži zahtjeve dizajna i razvoja. Ipak, on je kompleksniji u odnosu na ISO 9003 koji je napravljen za organizacije koje jedino zahtijevaju konačnu inspekciju i testiranje svojih proizvoda i usluga.

Uz prihvaćanje toga, primjena sustava kvalitete treba biti realizirana slijedeći 19 standardnih elemenata iz sustava standarda ISO 9002. Ti standardni elementi trebaju biti dokumentirani u priručniku kvalitete, osnovnom dokumentu primijenjenog sustava prema ISO 10013 standardu. Osim odabira sustavnog modela, primjena podrazumijeva prilagodbu i specificiranje kvalitativnih termina vezanih za transport i logističke usluge što treba biti bazirano na sustavu ISO 8402, koji uključuje rječnik pojmova i definicija. Nakon odabira sustavnog modela, trebaju se odrediti elementi i struktura sustava kvalitete na način da sustav odgovara konkretnoj aktivnosti kompanije ili da joj se na najbolji način prilagođava. U tome, sustav 9000-1 pomaže u sljedeća tri aspekta:

- daje principe kvalitete koji praktički mogu biti principi sustava kvalitete svakog poduzeća pa tako i prometnih,
- Sadrži principe o tome kako izabrati i primijeniti standarde sustava kvalitete za vlastite ciljeve unutarnje kvalitete organizacije i
- određuje ciljeve vanjske kvalitete.

Temeljem spomenutih principa u narednoj su tablici prikazani **principi primjene sustava kvalitete u području transportno-logističkih usluga**.

Tablica 1. Principi razvoja osiguranja kvalitete transportno-logističkih usluga prema sustavu ISO 9000-1

PRINCIPI RAZVOJA OSIGURANJA TRANSPORTNO-LOGISTIČKE KVALITETE	
1.	determiniranje i reguliranje glavnih dijelova i odgovornosti u svezi s kvalitetom
2.	istraživanje i udovoljavanje očekivanjima i zahtjevima organizacije
3.	uzimanje u razmatranje nekoliko grupa proizvoda (*hardware, software*, materijali, usluge) i njihovih karakteristika
4.	definiranje četiri elementa kvalitete (marketing, planiranje, proizvodnja, korištenje)
5.	prepoznavanje orijentacije procesa, sustavu upravljanja kvalitetom treba pristupiti kao procesu, smisao orijentacije procesa je u tome što svaki proces ima svoje ulaze, transformacije, izlaze
6.	princip mreža: procesi kreiraju mreže
7.	prepoznavanje činjenice da je sustav kvalitete sam za sebe mreža, pa bi trebao biti harmoniziran
8.	sustav kvalitete bi se trebao istraživati i provjeravati kontinuirano
9.	vrijednost proizvoda uključuje oboje: kvalitetu i cijenu, budući da cijena nije element kvalitete
10.	korisnik osim kvalitativnih karakteristika uzima u obzir dodatne vrijednosne elemente: • tržišnu situaciju i strategiju isporučitelja • financijsku situaciju i strategiju isporučitelja • situaciju na temu ljudskih resursa i strategiju isporučitelja
11.	težnje trebaju biti usmjerena na: • udovoljavanje svim korisnikovim očekivanjima • određivanje ciljeva i dužnosti u svezi s kvalitetom • razvoj mogućih rizika i prednosti

Izvor: Management-Concept and Quality - Strategic Elements of Transport Logistics Services, Periodica Politechnica, Ser. Soc. Man. Sci., 9(2001), 2, str. 153-168.

Osim principa sustava kvalitete, neophodno je definirati i osnovne elemente koje treba sadržavati sustav kvalitete što je moguće temeljem principa sustava standarda ISO 9004 koji predstavlja navedene elemente. Pored toga, karakteristike transportno-logističkih usluga bi trebale uzeti u obzir redom: uslugu, pružanje usluge i kontrolu usluge što je detaljnije eleborirano u ISO 9004-2 standardu u odnosu na upravljanje, izvore, dokumentaciju i operativne podsustave. I na kraju, reguliranje inspekcija i pregledavanje sustava kvalitete koji su detaljno opisani u standardu ISO 10011-1, mogu u tu svrhu poslužiti i kod transportno-logističkih usluga.

3. PRETPOSTAVKE I CILJEVI OSIGURANJA KVALITETE TRANSPORTNO-LOGISTIČKE USLUGE

Uspjeh u postizanju željenih rezultata pri izgradnji kvalitete transportno-logističkih usluga zahtijeva: marketinški pristup, ideju, zamisao i njenu razradu i operacionalizaciju ideje. U tom je smislu, nadalje, definiran: način planiranja kvalitete prometne usluge s obzirom na osnovne postavke i ciljeve kojima sustav kvalitete mora udovoljiti.

3.1. Pretpostavke osiguranja kvalitete

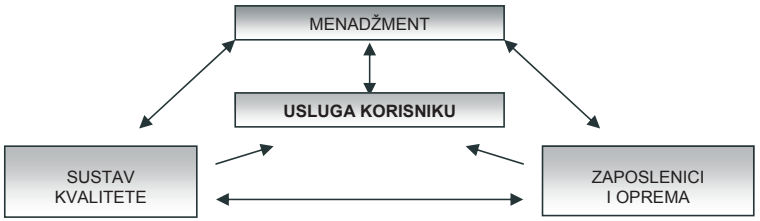
Procesi čijim ostvarenjem nastaje prometna usluga angažiraju ljudske i tehničke potencijale koje je potrebno neprekidno modernizirati i ujednačavati. Drugim riječima, to znači da razvojna ujednačenost prometne infrastrukture, suprastrukture, tehnologije i kadrovskih potencijala čine preduvjet za kvalitetan marketinški pristup, kreativnost u oblikovanju, prezentiranje, te ekonomsku prihvatljivost prometnih usluga.

Ono što je dodatno potrebno utvrditi su:

- osnovne radnje koje znatnije utječu na utvrđena svojstava prometne usluge;
- odabir svojstava i načina provođenja analiza, radnji i postupaka koji osiguravaju proklamiranu kvalitetu;
- metode kojima se vrednuju odabrana svojstva;
- sredstva s pomoću kojih se može utjecati na svojstva ili upravljati svojstvima unutar utvrđenih granica.

Kao temelj ili baza za razradu strategije kvalitete transportno-logističkih usluga može poslužiti tzv. **„trokut osiguranja sustava kvalitete“** prikazan na shemi 2., u čijem je centru usluga korisniku, odnosno konačni korisnik usluge ili sudionik u proizvodnji usluge. Drugi dio trokuta su tri elementa koji trebaju biti balansirani. Među njima je važan element odanost menadžmentu kao glavna politika transportno-logističkih poduzeća (imidž, ciljevi, strategija) unutar kojega politika kvalitete određuje budući uspjeh i kvalitativnu poziciju organizacije.

Shema 2. Transportno-logistički trokut osiguranja sustava kvalitete



Izvor: Autorica

Kvaliteta prometne usluge kao složen ciklus (Shema 3.) treba obuhvaćati realizaciju sljedećih zadataka: **planiranje kvalitete, realizacija kvalitete, kontrola i ocjena kvalitete, te poboljšanje kvalitete.**

Faza planiranja i poboljšanja kvalitete spada u domenu upravljanja, budući da na temelju iskustava iz prakse (realizacija kvalitete) i novih spoznaja (istraživanje) menadžment razrađuje način poboljšanja kvalitete i to unosi u novi plan kvalitete. Time se ciklus kvalitete prometne usluge ponavlja budući da se temelji na konstantnom poboljšanju. Za osiguranje sustava kvalitete, planiranje kvalitete pri čemu je krajnji cilj učinkovito pridobivanje korisnika prometne usluge, a time i povećanog obujma rada u putničkom i teretnom prijevozu treba provoditi s tehničkog, tehnološkog, ekonomskog i tržišnog aspekata.

Shema 3. Ciklus kvalitete transportno-logističke usluge

Izvor: Autorica

Osiguranje sustava kvalitete općenito, pa tako i u slučaju transportno-logističkih usluga je kontinuiran proces budući da se zahtjevi korisnika neprestano mijenjaju u smislu da traže bolje i više. Pri tome treba reći da i sama ponuda utječe na formiranje i mijenjanje njihovih zahtjeva i želja. U svezi s ponudom treba spomenuti prisutnost konkurencije koja kod korisnika povećava slobodu izbora.

Trajnost aktivnosti zahtijeva, s obzirom na interdisciplinarnost problematike, osposobljene kadrove i kvalitetnu strukturu zaposlenih za osiguranje kvalitete. Sve su navedene aktivnosti uzaludne ukoliko se ne ostvari zadovoljstvo i povjerenje korisnika prometne usluge. Stoga, korisničke potrebe izražene razinom zahtijevane usluge, analize ostvarenja opće djelotvornosti i učinkovitosti procesa, promjene nastale primjenom novih suvremenih tehnologija, kao i

optimizacija troškova povezanih s kvalitetom, trebaju predstavljati okosnicu svake aktivnosti, budući da se samo sustavnim pristupom mogu eliminirati eventualni propusti.

Iz navedenih zadataka za realizaciju sustava kvalitete, vidljivo je da je pristup kvaliteti evoluirao od pojma vezanog za proizvodnju do pojma vezanog za upravljanje što potvrđuje i definicija *Total Quality Managment*-a (TQM). Polazeći od značenja pojma „kvalitete" (*qualitas* - lat. kakvoća, svojstvo, vrsnoća neke stvari, vrednota, odlika, značajka, sposobnost), značenja pojma „totalan" (*totus* – lat. cio, sav, čitav, cjelokupan, ukupan, posvemašnji, potpun, sveobuhvatan) te značenje pojma „menadžer" (*manager* – *engl.* upravitelj, poduzetnik, rukovodilac), pojam *Total Quality Management* – TQM može se prevesti kao "upravljanje cjelokupnom (ukupnom ili potpunom) kvalitetom". Vođen korisnikom usluge te potpuno orijentiran na tržište, TQM predstavlja sustav unapređenja, povećanja fleksibilnosti, efektivnosti i efikasnosti poslovanja. Temelji se na konceptu stalnog unaprjeđenja i poboljšavanja procesa na trajnoj kvaliteti, timskom radu, što ima za rezultat stalno napredovanje.

Definirajući razinu kvalitete potrebno je uzeti u obzir i troškove kvalitete koji se odnose na troškove postizanja i održavanja kvalitete, a mogu se podijeliti u dvije osnovne skupine [4., str. 81-95]:

- interni troškovi kvalitete – troškovi marketinga, troškovi planiranja, troškovi dizajna proizvoda i usluga, troškovi planiranja procesa i izrada specifikacije (standarda), troškovi istraživanja uzroka propusta i pogrešaka, troškovi kontrole materijala, proizvoda i usluga, troškovi unaprjeđenja kvalitete, troškovi obrazovanja, i dr.
- eksterni troškovi kvalitete: troškovi zamijene proizvoda, propusti zbog lošije kvalitete, i dr. troškovi koji se mogu mjeriti i evidentirati u poduzeću.

Međutim najveći, nemjerljivi gubici , kada je posrijedi transportno-logističke usluga, su sljedeći eksterni troškovi kvalitete: izgubljeni ugled na tržištu, gubitak povjerenja kupaca, smanjenje konkurentne sposobnosti, gubitak tržišta, niže cijene, manji prihodi, (…). Naime, definirajući razinu kvalitete potrebno je objektivizirati troškove kvalitete, ali i uporabnu vrijednost novoponuđene transportno-logističke usluge. Optimizacijom tih veličina dobiva se rezultanta tehničko-ekonomske i tržišno prihvatljive razine kvalitete.

Učinkovitost i djelotvornost u zadovoljenju korisničkih potreba zahtijeva poznavanje svih onih potprocesa, elemenata i čimbenika koji određuju proces proizvodnje prijevozne usluge, a koji su međusobno povezani i isprepleteni. Samo je tako moguće ostvariti sustav kvalitete, upravljanje kvalitetom prema utvrđenim ciljnim vrijednostima te zadovoljavajuće poslovne rezultate koji ne dolaze sami od sebe već zahtijevaju adekvatnu strategiju upravljanja i planiranja svih aktivnosti u svrhu konkurentnosti na tržištu prometnih usluga.

3.2. Ciljevi osiguranja kvalitete

Navedene značajke sustava kvalitete transportno-logističke usluge i mogućnost valoriziranja određenog prometnog pravca na tržištu prometnih usluga predodređuju budućnost poslovanja pa se stoga ciljevima koji se uvođenjem sustava kvalitete žele postići treba posvetiti posebna pažnja. Tako se prema ljestvici prioriteta, razlikuju tri osnovna cilja:

- zadovoljenje potreba korisnika,
- neprekidno poboljšanje prijevoznih, prometnih i popratnih logističkih usluga, te
- zaštita okoliša i zahtjevi društvene zajednice.

Kao najvažniji cilj na prvom se mjestu ističe **zadovoljenje potreba korisnika** što je razumljivo s obzirom da stvaranje transportno-logističke usluge nije samo sebi svrhom, već ima za zadatak zadovoljiti potrebe prometnog tržišta prevozeći putnike i robu prema namjeravanom odredištu u određenom razdoblju, te nudeći široku lepezu popratnih logističkih usluga. Korisnik transportno-logističke usluge ime središnje mjesto, budući da upravo njegovo zadovoljstvo, odnosno nezadovoljstvo (posredno ili neposredno) definira i određuje razinu kvalitete prijevozne usluge. Drugim riječima, ocjenu konačne kvalitete određuje odnos realiziranih želja i stvarnih potreba korisnika i finalnog proizvoda – transportno-logističkim uslugama. Sukladno dobivenoj ocjeni, može se očekivati povoljan ili nepovoljan rezultat sa svim reperkusijama koje on generira.

Drugo mjesto na ljestvici prioriteta zauzima neprekidno **poboljšanje transportno-logističke usluge**. Ostvarenje kvalitete provodi se preko kontrolnih funkcija čija se osnovna zadaća svodi na utvrđivanje podudarnosti projektirane i realizirane prometne usluge.

Zaštita okoliša i zahtjevi društvene zajednice sljedeći je cilj uvođenja sustava kvalitete. S obzirom da je zaštita okoliša i upravljanje okolišem dominantno područje ne samo u najširem pojmu kvalitete, već i u opstanku ljudske vrste, aktivnost na području zaštite okoliša zadatak je koji treba prihvatiti kao jedan od temeljnih čimbenika osnovne kvalitete ljudske vrste i kvalitete življenja. Budućnost sustava osiguranja i upravljanja kvalitetom temelji se na čvršćem povezivanju s ekološkim i sigurnosnim kriterijima kao logičnom pretpostavkom ostvarivanja totalnog upravljanja kvalitetom. Stoga, uvažavanje i težnja realizaciji ovoga cilja obvezuje prijevoznike i sve druge subjekte koji sudjeluju u proizvodnji prometne usluge na stalnu kontrolu i kontinuirano poboljšanje utjecaja na okoliš u svim fazama pripreme i realizacije usluge što stvara uvjete za pružanje kvalitetne usluge uz maksimalno očuvanje prirodnih resursa.

U odnosu na navedeno može se zaključiti da je osnovni cilj osiguranja sustava kvalitete u proizvodnji transportno-logističke usluge na određenom prometnom pravcu povećanje vrijednosti usluge. Pri tome treba istaknuti da proizvod ili usluga ne udovoljava kvaliteti u potpunosti: ukoliko je opasan za okolinu ili zdravlje, ukoliko nije siguran i ukoliko ne odgovara uvjetima navedenim u ugovoru (o prijevoznoj, transportno-logističkoj usluzi).

Svi ti zahtjevi zajedno s kvalitativnim zahtjevima mogu se definirati kao **„vrijednost transportno-logističke usluge“**. U isto vrijeme ukoliko svi kvalitativni zahtjevi na zadovoljavaju obećanu razinu to definira kvalitetu usluge. Stoga se iz toga može zaključiti da je najvažniji cilj osiguranja sustava kvalitete onaj koji se odnosi na postizanje što veće vrijednosti usluge.

Spomenuta vrijednost transportno-logističke usluge određena je odgovarajućim kvalitativnim kriterijima, koji se mogu podijeliti na (Tablica 2.):

- kriterije transporta,
- kriterije usluge i
- logističke kriterije.

Tablica 2. Kvalitativni kriteriji transportno-logističke usluge

KRITERIJI	TRANSPORTNI KRITERIJI	KRITERIJI USLUGE	LOGISTIČKI KRITERIJI
P O T K R I T E R I J I	• pouzdanost • udovoljavanje vremenskim ograničenjima • točnost • fleksibilnost • sprječavanje nezgoda • praćenje, • informacije o transportu • sprječavanje oštećenja • raspoloživost transportnih kapaciteta • pravodobna doprema/ otprema	• kvalificiranost • motivacija • osjetljivost • predusretljivost • kvalificiranost za poslove pregovaranja • pouzdanost • impresija • odgovornost • poznavanje tržišta • pravila marketinga • brzina dostave • lakoća anketiranja • prisutnost na skali	• dostava iz prve ruke • mogućnost prodaje i kupnje • transportni lanac • carinjenje • osiguranje tereta • praćenje • konzultacije • dodatne logističke usluge • dostupnost • logistički operatori

Izvor: Autorica

Sukladno činjenici da je opstojnost prometnog pravca na konkurentnom transportnom tržištu prvenstveno određena zahtjevima i potrebama trenutnih i potencijalnih korisnika, pri planiranje kvalitete transportno-logističke usluge neophodno je uzeti u obzir i **„strukturu preferencije kvalitativnih kriterija"**, odnosno strukturu značaja (težine) pojedinih kvalitativnih kriterija s aspekta korisnika usluge, te s aspekta pojedinih vidova prijevoza [7, str. 47-64]. Dakle, zadržati korisnika zadovoljnim postaje zadatkom od iznimne važnosti u osiguranju kvalitete prometne usluge, s obzirom i na još jedan razlog koji se odnosi na prekapacitiranost u prijevoznoj industriji zbog koje se od prijevoznika i ostalih sudionika u proizvodnji prometne usluge sve više očekuje.

4. ZAKLJUČAK

Da bi određeni prometni pravac i subjekti u proizvodnji transportno-logističke usluge na tom pravcu zadržali svoje mjesto na tržištu prometne usluge, moraju osigurati učinkovitost, usmjerenost korisnicima usluga, racionalnost, ekološku prihvatljivost i dominantnost kvalitetom ponuđene usluge. Usmjerenost prema korisnicima i fleksibilno reagiranje na zahtjeve tržišta stvaraju pretpostavke za ustrojavanje modernog i atraktivnog prometnog pravca i transportno-logističkih uslužnih subjekta koji sudjeluju u proizvodnji prometne usluge na tom pravcu. Stoga, valoriziranje prometnog pravca na tržištu prometnih usluga podrazumijeva i zahtijeva drugačije ponašanje, prihvaćanje i pridržavanje standarda i novih mjerila kvalitete transportno-logističke usluge.

Pri tom se prvenstveno misli na to da filozofiju opstojnosti prometnog pravca treba graditi na ostvarenju jamstva kvalitete cjelokupne prometne usluge, a upravljanje kvalitetom mora postati sastavni dio strategije planiranja valorizacije i konkurentnosti prometnog pravca.

Sustav kvalitete treba realizirati postupno „korak po korak", slijedom zadatka koji se odnose na: ostvarenje kontrole kvalitete, osiguranje kvalitete i upravljanje kvalitetom. Stoga je

jedna od temeljnih odluka u osiguranju sustava upravljanja kvalitetom transportno-logističke usluge usvajanje modela sustava kvalitete. Navedeni je model moguće koncipirati korištenjem standardizirane baze za definiranje, osiguranje i upravljanje kvalitetom (sustav standarda ISO), sukladno svim pretpostavkama i ciljevima osiguranja kvalitete specifičnim za transportno-logističke usluge.

Kao najvažniji cilj na prvom se mjestu ističe zadovoljenje potreba korisnika što je razumljivo s obzirom da stvaranje transportno-logističke usluge nije samo sebi svrhom, već ima za zadatak zadovoljiti potrebe prometnog tržišta, odnosno zahtjeve, potrebe i interese korisnika usluga. Nemati kupca, odnosno korisnika usluge znači nuditi uslugu koju nitko ne treba. U skladu s time opstojnost prometnog pravca je upitna ukoliko se osnovno pravilo poslovanja ne temelji na zadržavanju postojećih korisnika i pridobivanju novih. Pri tome je prvenstveno potrebno poznavati trenutne i buduće potrebe, želje i očekivanja korisnika, kako bi se temeljem toga moglo realizirati ispunjavanje zahtjeva i eventualno premašivanje korisnikovih očekivanja. Samo se na taj način mogu ostvariti pozitivni rezultati u privlačenju korisnika prometnih usluga i robnih tokova na prometni pravac, što utječe na povećanje obujma prijevoza, prihoda i samog valoriziranja prometnog pravca.

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A CONTRIBUTION TO THE DEFINITION OF TRANSPORT-LOGISTICS SERVICES OFFERED ON A TRANSPORT ROUTE

SUMMARY

The specific qualities of the transport market, reflected on the competitive relations of transport subjects and transport routes, imply seriousness in creating a complete service offered on a transport route. The transport service has to satisfy the increasing demands of the users, by being attractive, speedy, safe and offering a high-quality service. In that sense, the main goal of this research is to contribute to defining the transport-logistics services on the transport route as a complex phenomenon influenced by many circumstances and particularities of the transport market. In view of the determined goal, this paper aims at defining the theoretical guidelines on the quality of transport and of transport-logistics services, as well as the standardized basis for the definition, insurance and management of the transport service quality. A special analysis is carried out of the criteria and specific qualities of the transport market and of the demands of the transport service users, since the definition of the basic prerequisite conditions and goals for effecting an increasing quality and competitive level of the transport route services are directly conditioned by these criteria.

Key words: *quality, transport-logistics service, transport route*

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RAZMATRANJE UTJECAJNIH ČIMBENIKA NA OPSEG SLUŽBE ODRŽAVANJA

Održavanje broda je jedan od čimbenika koji bitno utječu na konkurentnost brodara na tržištu brodskog prostora. Stoga svako brodarsko društvo teži smanjivanju troškova održavanja na najnižu prihvatljivu razinu. U tom smislu, najnižom prihvatljivom razinom troškova valja smatrati najmanju sumu troškova zahvata, troškova službe održavanja i troškova zastoja koja jamči uspostavljanje i održavanje propisanih uvjeta tehničke sigurnost te sigurnosti plovidbe. Dodatno, u radu su razmotreni i utjecaji dvaju bitnih čimbenika – vrste djelatnosti (područje poslovanja) te starosna dob broda, s obzirom da oni u najvećoj mjeri određuju prihvatljivost određenog načina održavanja.

Ključne riječi: *održavanje, brodski sustavi, brodarsko društvo, intenzitet održavanja, ukupni troškovi poslovanja*

1. UVOD

Na ekonomičnost poslovanja brodarskog društva i njegovu konkurentnosti na tržištu brodskog prostora utječu mnogi čimbenici među kojima se posebice ističe održavanje. Pod pojmom održavanja podrazumijeva se skup postupaka koji imaju za cilj sprječavanje kvarova na brodskim sustavima, produženje trajnosti te otklanjanje nastalih kvarova na najučinkovitiji način. Učinkovitost održavanja broda valja razmatrati primarno sa stajališta sigurnosti plovidbe i zaštite morskog okoliša, a sekundarno i s gospodarskog stajališta.

Održavanje ima i svoju cijenu – ona se očituje kao izravan trošak brodarskog društva. Ovaj trošak pak izravno ulazi u ponudu kojom određeni brodar konkurira na tržištu brodskog prostora. Zbog toga brodarsko društvo svojom poslovnom politikom nastoji ostvariti takvo održavanje koje će osigurati željenu razinu te pritom imati najmanje moguće troškove.

Troškovi održavanja se mogu razlučiti na izravne i neizravne. Izravan trošak se u ovom

radu dijeli na trošak zahvata i trošak službe održavanja. Trošak zahvata obuhvaća troškove nastale korištenjem materijalnih resursa i sve ostale troškove koji nisu povezani s troškovima službe održavanja, stoga se može razmatrati neovisno o trošku službe održavanja. Nasuprot tome, neizravan trošak je zbroj svih troškova koji su posljedica zastoja.

Ovakva strukturalna razdioba izravnih troškova omogućuje analizu posljedica u odnosu na zastoj i razmatranje čimbenika koji utječu na odnos opsega službe održavanja i fleksibilnost broda prema zastoju. U ovome radu kao utjecajni čimbenici razmatrat će se vrsta morskog brodarstva u kojoj je određeni brod uposlen te godine starosti broda.

Stoga se u ovom radu razmatra mogućnost određivanja troškova održavanja koje bi brodarsko društvo opterećivalo najmanjim troškovima po kriteriju funkcije optimalnosti.

2. MOGUĆI PRISTUPI ODRŽAVNJU BRODSKIH SUSTAVA

Održavanje ima značajan utjecaj na poslovanje brodarskog društva. Brodarsko društvo svoju uslugu prijevoza robe morem nudi na tržištu brodskog prostora, a cijenu za uslugu prijevoza utvrđuje u obliku vozarine, odnosno najma broda za određeno razdoblje ili putovanje. Kako bi brodarsko društvo moglo ponuditi odgovarajuću cijenu za prijevoznu uslugu robe morem mora poznavati svoje troškove. Značajan udio u ukupnim troškovima broda predstavljaju troškovi održavanja broda. Pod troškovima održavanja podrazumijevaju se troškovi nastali planiranjem, izvršenjem i pregledom učinjenih radova održavanja na brodskim sustavima u cilju njegove sigurnosti, poslovne iskoristivosti, osiguranja životnih i radnih uvjeta osobama koje na njemu borave te svi drugi troškovi vezani uz održavanje, uključujući u to i izmaklu dobit, ako je posljedica nekog od postupaka održavanja. Prema nekim pokazateljima1 oni sačinjavaju do približno jedne trećine ukupnih troškova, a ovise prvenstveno o vrsti broda. Pritom, najveći troškovi održavanja uobičajeno se pojavljuju kod brodova za prijevoz kontejnera, a najniži kod tankera.

Brodarska društva u stanovitom smislu slobodno odlučuju o visini troškova održavanja svojeg brodovlja s ciljem ostvarivanja što boljeg poslovnog učinka broda uz uvjet zadovoljavanja zahtjeva sigurnosti i očuvanja morskog okoliša. Visina utrošenih sredstava za održavanje nije temeljena na međunarodnim normama i često je povezana sa stanjem na tržištu brodskog prostora. Uobičajeno veća dobit brodaru omogućuje veći trošak održavanja.

Održavanje brodskih sustava može se sagledavati sa stajališta troškova te sa stajališta pouzdanosti. Cilj prvog pristupa je postići najmanje troškove održavanja broda, ne uzimajući pritom u obzir mogućnost i obilježja kvarova pri takvom načinu održavanja. Drugi pristup je na neki način upravo suprotan – njime se nastoji u potpunosti spriječiti kvar i njegove posljedice pri čemu se troškovima ne pridaje značaj. Posljedično, ova dva nasuprotna pristupa imaju za posljedicu različitu učestalost kvarova, potrebu za pričuvnim dijelovima, troškove nastale zbog zastoja broda te konačno i bitno različite poslovne ishode.

Neupitno je da korištenje samo jednog ili drugog pristupa nije primjereno za brodara koji ima za cilj poslovni uspjeh. Stoga, u tom slučaju brodarsko društvo nužno mora izabrati

1 US ACE 2000 (Economic Quidance Memo), EMARC Project

takav način održavanja koji će, ovisno o poslovnim prilikama, osigurati zadovoljavajuću razinu pouzdanosti uz prihvatljivu razinu troškova održavanja.

3. POJAM OPTIMALNOG ODRŽAVANJA BRODSKIH SUSTAVA

Ukupne troškove održavanja brodskih sustava sačinjavaju izravni i neizravni troškovi. Izravni troškovi su svi troškovi vezani uz održavanje brodskih sustava, dok se neizravni troškovi promatraju kroz izmaklu dobit broda zbog nastalog zastoja uslijed neprimjerenog održavanja njegovih sustava.

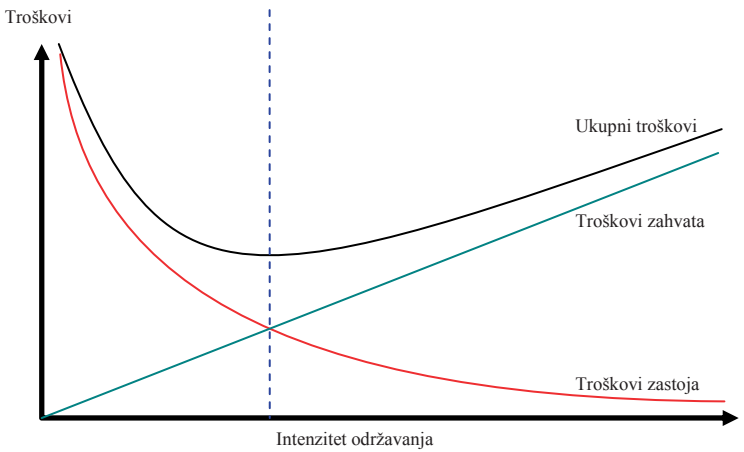
Izravni troškovi, odnosno troškovi zahvata, povećavaju se s intenzitetom održavanja.

Nasuprot tome, zastoji broda, pa tako i troškovi koji iz njih proizlaze jesu vrlo veliki kada nema održavanja broda. Porastom intenziteta održavanja troškovi zastoja padaju približno po hiperboličnoj krivulji.

Zbroj izravnih troškova koji proizlaze iz učinjenih zahvata i neizravnih troškova koji se javljaju kao posljedica zastoja su ukupni troškovi. Iz navedenog, a polazeći od načela poslovne uspješnosti brodara kao njegovog temeljnog cilja, moguće je odrediti pojam optimalnog održavanja kao ono održavanje pri kojem se ostvaruju najmanji ukupni troškovi.

U cilju boljeg određenja optimalnog održavanja nužno je izravne troškove održavanja podijeliti na troškove službe održavanja i troškove zahvata koji obuhvaća troškove materijalnih resursa te sve ostale troškove održavanja koji nisu vezani uz službu održavanja.

Slika 1. Pojam optimalnih troškova održavanja (prema [1])



Troškovi službe održavanja sačinjavaju značajni udio u izravnim troškovima. Služba održavanja obuhvaća posadu broda i potporu s kopna. Pod pojmom potpora s kopna podrazumijevaju se radionice koje mogu, ali i ne moraju biti u sastavu brodarskog društva, odgovarajuća služba logističke potpore unutar samog brodarskog društva i remontna brodogradilišta. Organizacijski se službe održavanja mogu znatno razlikovati, što prvenstveno ovisi o poslovnoj politici brodarskog društva. Kod današnjih brodara mogu se razaznati dva

osnovna predloška:

- velika i dobro organizirana služba održavanja koja pruža vrlo učinkovito održavanje no stoga iziskuje velike troškove za svoje poslovanje i
- mala služba održavanja koja iziskuje manje troškove, ali i pruža manju mogućnost potpore pa se u pravilu koristi uslugama trećih osoba.

Međutim, ne postoji rješenje koje dugoročno i za sve uvjete poslovanja brodarskog društva na tržištu brodskog prostora može ponuditi opće prihvatljiv model službe održavanja.

Pod pojmom troškova zahvata podrazumijevaju se svi ostali segmenti izravnog troška, izuzev troškova službe održavanja, koji imaju svoju određenu cijenu temeljenu na opsegu zahvata i materijalnim resursima. Općenito, trošak zahvata održavanja može se sagledati kao trošak samog zahvata koji se pojavljuje radi sprječavanja mogućeg kvara (preventivno djelovanje), kao i u slučajevima otklanjanja uzroka zastoja (korektivno djelovanje). Vrijedno je istaći da cijena koštanja zahvata bitno ovisi o tome kada je učinjen, prije ili nakon što je prouzročio zastoj.

Nasuprot navedenim izravnim troškovima čija su obilježja i veličine uglavnom dobro poznate, neizravne troškove obilježava vrlo velika raznolikost u iznosima i nastupu pa ih je vrlo teško ili čak i nemoguće odrediti. Stoga se oni u pravilu ne uzimaju u obzir ili ih se neizravno anticipira pri izboru predmeta održavanja u okviru preventivnog djelovanja.

Valja istaći da pojam optimalnog održavanja određuje i odgovarajuću razdiobu sredstava koja valja uložiti u zahvate preventivnog održavanja te za pokriće troškova službe održavanja, odnosno troškova zastoja. U tom pogledu se, umjesto analitičkog pristupa može poći i od teorije redova čekanja i to ponajprije stoga što se zahvati održavanja mogu promatrati kao zahtjevi za pružanjem usluga koji pod određenih uvjetima moraju čekati prije nego su opsluženi. Na isti način se služba održavanja može smatrati radnim mjestom koje pruža traženu uslugu i koje mora čekati na jedinice koje treba opslužiti. U skladu s uobičajenim pristupom [2] jedinice dolaze (sa zahtjevom za održavanjem) na mjesto za opsluživanje po nekoj općoj zakonitosti te u slučaju nedostatnog kapaciteta ili neusklađenosti zakonitosti dolazaka i posluživanja, a unatoč dovoljnom kapacitetu, dolazi od stvaranja reda čekanja. Stoga se može reći da je nastanak reda čekanja posljedica neusklađenosti kapaciteta uslužnih mjesta i zahtjeva korisnika. U teoriji reda čekanja se susreću dvije karakteristične veličine:

- prosječan broj dolazaka klijenata u vremenskoj jedinici λ
- kapacitet mjesta za opsluživanje μ.

Omjer navedenih veličina ρ predstavlja stupanj opterećenja, odnosno iskorištenja kapaciteta:

$$\rho = \frac{\lambda}{\mu} \quad .$$

Kada je $\rho > 1$ sustav je preopterećen. U takvom sustavu će se ispred mjesta posluživanja neprekidno povećavati red čekanja. Kada je $\rho < 1$ korisnik će biti opslužen u nekom trenutku, ovisno o trenutnim okolnostima. Da bi sustav bio stabilan u svim slučajevima, ρ mora biti manji od 1 (λ mora biti manja od μ).

Navedeni uvjet vrijedi za sustave s neograničenom duljinom reda. Kod redova čekanja

s ograničenom duljinom reda ne može doći do zagušenja sustava budući da će sve jedinice koje pristignu nakon što je red popunjen biti odbijene.

Optimizacija sustava održavanja na temelju redova čekanja razmjerno je jednostavna u slučajevima kada svi pristigli zahtjevi imaju isti red prvenstva, npr. održavanje borbene pripravnosti ratnih brodova. Tada se navedenim pristupom može osigurati postojanje dovoljnih kapaciteta službe održavanja kako bi svi zahtjevi bili usluženi u zadatom (prihvatljivom) vremenu. Nasuprot tome, u poslovnim sustavima navedeni pristup ima ograničene mogućnosti primjene i to ponajprije stoga što pojedini zahtjevi imaju bitno različite troškove održavanja, odnosno neizravne troškove pa time i bitno različita prvenstva obrade. U tom pogledu pristup putem redova čekanja ima opravdanje ponajprije u određivanju dovoljnog radnog kapaciteta službe održavanja u odnosu na zadati opseg poslova koji treba obaviti.

4. OSNOVNA OBILJEŽJA OPTIMIZACIJE ODRŽAVANJA BRODSKIH SUSTAVA SA STAJALIŠTA UKUPNIH TROŠKOVA POSLOVANJA

Polazeći od pojma održavanja, odnosno od njegove dvije osnovne djelatnosti, sprječavanja i otklanjanje nastalih kvarova na primjereni način, osnovnim ciljem održavanja valja smatrati sprječavanje zastoja broda ili neke njegove bitne funkcije. Drugim riječima, osnovna namjena broda jest prijevoz tereta i putnika iz polazne u odredišnu luku na najbrži i najučinkovitiji način, pri čemu održavanje brodskih sustava mora omogućiti da se ta zadaća odvija bez zastoja, odnosno da se broj zastoja svede na najmanju moguću mjeru.

Službu održavanja valja sagledavati unutar uobičajeno piramidalnog upravljačkog ustroja brodarskog društva gdje se ona uobičajeno promatra kao prateća služba koja ne donosi nikakvu zaradu već stvara određeni trošak. Stoga je brodarskom društvu u interesu da troškovi održavanja, koji će on uvrstiti u cijenu prijevozne usluge, budu što manji pa optimalnim održavanjem valja smatrati ono koje brodarsko društvo opterećuje najmanjim troškovima uz zadovoljavanje propisanih uvjeta:

$$TR = c_m + \sum_{i=1}^{n} c_i t_i + \sum_{j=1}^{m} c_j t_j \rightarrow \min ,$$

gdje je:

TR - trošak održavanja
cm - troškovi zahvata održavanja
c_i - gubitak u jedinici vremena zbog čekanja i–tog elementa brodskog sustava na zahvat održavanja
t_i - prosječno vrijeme čekanja i–tog elementa brodskog sustava na zahvat održavanja
c_j - troškovi člana posade ili osobe u službi potpore s kopna u jedinici vremena
t_j - vrijeme u kojem član posade ili osobe u službi potpore s kopna nisu iskorištene
n - broj elemenata brodskih sustava koji su u promatranom vremenu čekali na održavanje
m - broj članova posade i/ili osoba u službi potpore s kopna predviđenih za održavanje.

Pretpostavlja se da je trošak zahvata u ovom slučaju nastao zastojem broda i očituje se troškovima proizašlim iz utrošenih materijalnih resursa i drugih troškova potrebnih da brod ponovo počne pružati prijevozne usluge. S obzirom na obilježja uzroka zastoja, odnosno kvara može se odrediti vrijednost proizašlog troška, pri čemu ona ponajprije ovisi o dostupnosti materijalnih resursa.

U slučaju kada brod ne raspolaže dostatnim materijalnim resursima tada se oni nabavljaju na tržištu pri čemu konačan iznos u najvećoj mjeri određuje mjesto (pozicija) broda u trenutku zastoja. Vrijedi istaći da u stvarnosti veći utjecaj na cijenu ima zahtijevana brzina dostave nego udaljenost. Trošak zahvata održavanja u slučaju zastoja razmatran na ovaj način može se uzeti neovisno o sastavu službe održavanja koja će otkloniti uzrok zastoja.

Drugi dio izraza koji se odnosi na troškove službe održavanja i troškove zastoja može se razmatrati kroz njihove uzročno-posljedične veze. Ulaganjem u učinkovitost službe održavanja (znanje, oprema, tehnologija) smanjivat će se vjerojatni trošak zastoja. Nasuprot tome, manjim ulaganjem u službu održavanja povećavat će se vjerojatnost većeg troška zastoja. Zasigurno da se ulaganja u službu održavanja proporcionalno ne odražavaju na smanjenje cijena zastoja. Ulaganja u službu održavanja spadaju u direktne troškove koji se povećavaju s intenzitetom održavanja. Zastoji broda, te troškovi koji iz njih proizlaze smanjuju se po približno hiperboličnoj krivulji.

Osnovni čimbenik koji utječe na djelotvornost službe održavanja i fleksibilnost[2] broda prema zastoju je vrsta morskog brodarstva, odnosno područje poslovanja. Morsko brodarstvo je gospodarska djelatnost [3] prijevoza robe i ljudi brodovima morem i dijeli se na slobodno (trampersko), tankersko i linijsko brodarstvo. U slobodnom brodarstvu brodovi nemaju stalno uposlenje i linije već terete pronalaze na tržištu, uobičajeno preko posrednika. Tankersko brodarstvo ima dosta zajedničkih obilježja sa slobodnim brodarstvom te se u početku i smatralo dijelom slobodnog brodarstva. U tankerskom brodarstvu namjenskim vrstama brodova se prevoze određeni tekući tereti.

Linijsko brodarstvo je zasigurno najzahtjevniji vid brodarstva. Brodovi plove po unaprijed određenom plovidbenom redu između imenovanih luka. Linijsko brodarstvo se može podijeliti u linijsko brodarstvo generalnih tereta i kontejnersko linijsko brodarstvo. Analiza zahtjeva koji se postavljaju pred određenu vrstu morskog brodarstva neupitno pokazuje da najmanju fleksibilnost u odnosu na zastoje imaju linijski brodovi i to posebice kontejnerski linijski brodovi. Današnji linijski kontejnerski prijevoz, u najvećoj mjeri, obavljaju brodovi matice i feeder brodovi. Njihova organizacijska shema prijevoza ne dozvoljava zastoj koji bi utjecao na plovidbeni red jer se time remeti čitav logistički lanac otpreme i dopreme roba. Stoga kod takvih brodova služba održavanja mora biti po svim svojim obilježjima visoko djelotvorna, a najveći dopustivi zastoj broda ne smije biti veći od odstupanja predviđenih plovidbenim redom. Sastav službe održavanja prvenstveno će ovisiti o obilježjima linije na kojoj brod plovi. Na određenim linijama brod će se morati više oslanjati na vlastitu posadu, dok će pak na drugim linijama većeg udjela u održavanju imati radionice s kopna.

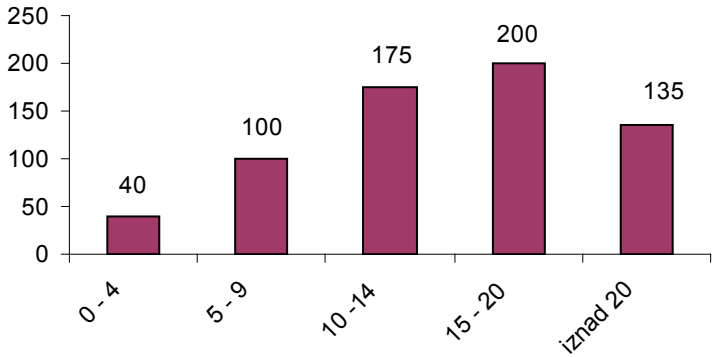
Slobodno i tankersko brodarstvo pokazuju najveću fleksibilnost prema zastojima broda. Doprema i otprema tereta u ovim načinima morskog brodarstva nije strogo uvjetovana drugim čimbenicima transportnog lanca tako da postoji mogućnost pojave čekanja bez većih

2 Fleksibilnost ovdje valja razumjeti kao poslovnu sposobnost broda da izdrži negativne učinke zastoja na uobičajeno poslovanje. Drugim riječima, što je veća poslovna šteta zbog zastoja broda to je fleksibilnost manja.

posljedica, bilo da prijevozno sredstvo čeka teret ili teret čeka prijevozno sredstvo, na dijelu prijevoznog puta. Čekanje kao posljedica zastoja nastalog na strani broda, uslijed nedostatnog održavanja, ne stvara značajan neizravni trošak. Nastavak transportnog lanca remeti se u manjoj mjeri nego kod linijskog brodarstva. Stoga će kod ove vrste morskog brodarstva služba održavanja biti uobičajeno manjeg opsega i iziskivat manje troškove uz nešto manju mogućnost pružanja potpore brodu. U pravilu se brodar kod otklanjanja zastoja, koji ne mogu biti otklonjeni od strane posade broda, koristi uslugama trećih osoba.

Sljedeći čimbenik koji presudno utječe na opseg potrebnog održavanja, a time i na obilježja službe održavanja, odnosno vjerojatnost zastoja zbog kvara na brodskim sustavima jesu godine starosti brodova. Vjerojatnost zastoja procijenjena je neizravno, kroz porast troškova održavanja brodova u različitim dobnim skupinama. Veći troškovi održavanja uslijed kvara upućuju na veću mogućnost zastoja broda.

Slika 2. Prosječni troškovi kvarova (za brodove 5-9 godina uzet indeks100) obzirom na starost broda (prema [4])



Brodovi starosti od 0–4 godine su u početku iskorištavanja te su stoga troškovi održavanja uslijed kvarova više od dvostruko manji od referentne skupine brodova (brodovi od 5–9 godina starosti). Stanje većine komponenti i cijelih sustava se nalazi unutar svog korisnog vijeka. Stoga se najveći postotak kvarova vezuje uz uhodavanje broda odnosno usklađivanje rada različitih sustava. Troškovi održavanja uslijed kvarova se za brodove starosti od 10 do 14 godina naglo povećavaju dok se za brodove starosti od 15 – 20 godina povećava za 25. U dobnoj skupini brodova starijih od 20 godina indeksni pokazatelj se smanjuje za 65 u odnosu na prethodnu dobnu skupinu. Uobičajeno obrazloženje za ovakvo kretanje troškova jest pretpostavka da se je u prethodnim dobnim skupinama izmijenio značajan broj komponenti pojedinih brodskih sustava pa stoga dolazi do pada troškova održavanja uslijed kvara, a time i smanjivanje vjerojatnosti zastoja broda.

Model službe održavanja koji bi dugoročno i za sve uvjete poslovanja brodarskog društva mogao ponuditi opće prihvatljivo rješenje, temeljeći se pritom na načelu učinkovitosti i opravdanosti ulaganja, ne postoji. Upravljački sustav brodarskog društva, mora za određene tržišne uvjete i razdoblje, odrediti presudne čimbenike te u skladu s tim izabrati model službe održavanja. Promjene u starosnoj strukturi brodova tijekom vremena u pravilu nameću promjene u organizaciji službe održavanja kako bi razina održavanja ostala nepromijenjena.

Kod linijskog brodarstva, kao najzahtjevnije grane brodarstva, će se povećanjem starosti brodova služba održavanja nužno morati povećavati kako bi održavanje osiguralo zastoje unutar granica prihvatljivosti. Slobodno i tankersko brodarstvo će u pravilu također zahtijevati određena povećanja službe održavanja u slučaju povećanja starosti brodova, ali znatno manje nego linijsko i to prvenstveno zbog većeg naglaska na zahtjeve sigurnosti plovidbe u odnosu na tržišne zahtjeve.

Posljedično, ako brodarsko društvo promijeni način poslovanja u morskom brodarstvu bit će nužno promijeniti i strukturu i način djelovanja službe održavanja.

Konačno, na potrebu promjene ustroja i načina djelovanja službe održavanja presudno utječu i promjene na tržištu brodskog prostora. Razdoblja konjukture na tržištu brodskog prostora u pravilu omogućuju brodarskom društvu veća ulaganja u flotu kojima se povećava kapitalna vrijednost broda, pa takvo povećanje flote iziskuje opsežniju službu održavanja, naročito u početnom razdoblju. Nasuprot tome dugotrajna recesija na tržištu brodskog prostora nametnut će ograničenja u djelovanju službe održavanja, pa samim tim i smanjenje njena opsega nakon određenog razdoblja.

Temeljem navedenog valja zaključiti da se obilježja službe održavanja moraju mijenjati u ovisnosti o prevladavajućoj starosnoj strukturi brodovlja, odnosno željenoj razini prihvatljivosti zastoja broda s obzirom na vrstu morskog brodarstva u kojoj je brod uposlen.

5. ZAKLJUČAK

Održavanje brodskih sustava sastoji se od učinkovitog sprječavanja kvarova na brodskim sustavima, produženja vremena njihova korištenja te otklanjanja nastalih kvarova. Uspješnost održavanja se može mjeriti ekonomskim pokazateljima koji neupitno uključuju i konkurentnost brodarskog društva na tržištu brodskog prostora.

Ciljevi održavanja broda uvijek se ogledaju u izabranom ustroju službe održavanja. Optimalni ustroj službe osiguranja kao i njezin rad moraju polučiti najmanji trošak za brodarsko društvo.

Pri izboru poslovne politike brodarsko društvo ponajprije mora voditi računa o vrsti morskog brodarstva u kojoj je određeni brod uposlen te o prevladavajućoj starosnoj strukturi svoga brodovlja. U skladu s tim najsloženiju službu održavanja valja očekivati kod kontejnerskih brodara dok kod drugih vrsta prijevoza robe morem valja očekivati jednostavnije organizacijske oblike. Nadalje, veće zahtjeve pred službu održavanja postavljat će nepovoljna starosna struktura brodovlja, posebice u slučaju neprimjerene politike zamjene brodovlja novim brodovima.

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ANALYSIS OF FACTORS AFFECTING THE SHIP'S MAINTENANCE SERVICE

SUMMARY

Ship's maintenance is considered as one of the factors that have a vital influence on the competitiveness of shipowners on the shipping market. Therefore, every shipping company aims at reducing maintenance costs to the lowest acceptable level, which, in this sense, represents the lowest total amount of the maintenance costs, comprising the maintenance service costs and the stoppage costs that guarantee the restoring and keeping up of the prescribed technical safety regulations as well as those related to the safety of navigation. In addition, the paper aims at analyzing the influence of two very important factors – the type of activities (operation area) and the ship's age, since they determine, in large part, the adequacy of a particular type of maintenance required..

Key words: *maintenance, ship's systems, shipping company, maintenance intensity, total amount of operating costs*

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OPĆI PRISTUP PRIMJENI NORME ISO 9001:2000 U UPRAVLJANJU KVALITETOM DJELATNOSTI VISOKIH POMORSKIH UČILIŠTA

Zahtjevi međunarodne norme ISO 9001:2000 primjenjivi su na visoko obrazovanje u pomorstvu. Primjena ove norme strateška je odluka visokog pomorskog učilišta. Učilište uspostavlja, dokumentira, primjenjuje i održava sustav upravljanja kvalitetom i stalno poboljšava njegovu učinkovitost u skladu sa zahtjevima ove norme. Pristup sustavu upravljanja kvalitetom upućuje učilište da analizira korisničke zahtjeve, definira procese koji doprinose ostvarenju obrazovanja koje je korisnicima prihvatljivo i upravlja tim procesima. To stvara samopouzdanje učilišta da je sposobno izvoditi obrazovanje koje dosljedno ispunjava zahtjeve. Uprava učilišta treba podastrijeti dokaze o svojoj privrženosti razvoju i primjeni sustava upravljanja kvalitetom i stalno poboljšavati njegovu učinkovitost. I konačno, uprava učilišta treba planirati i primjenjivati procese nadzora, mjerenja i analize i poboljšavanja procesa obuhvaćenih sustavom upravljanja kvalitetom.

Ključne riječi: *kvaliteta, politika kvalitete, upravljanje kvalitetom, poboljšavanje kvalitete*

1. UVOD

Uspješno obavljanje osnovnih djelatnosti svakog visokog pomorskog učilišta (u daljnjem tekstu: učilišta), a to su obrazovanje, znanstvenoistraživački rad i visokostručni rad u području pomorstva, zahtijeva da se učilištem upravlja na sustavan način. Uspjeh ovisi o primjeni sustava upravljanja učilištem osmišljenog tako da, pored ostalog, omogući kontinuirano poboljšavanje kvalitete osnovnih djelatnosti učilišta, stalno prateći i ostvarujući potrebe, zahtjeve i očekivanja korisnika tih djelatnosti (u daljnjem tekstu: korisnika).

Polazeći od činjenice da se ukupna poslovna aktivnost učilišta u osnovi svodi na:

- prepoznavanje potreba, zahtjeva i očekivanja korisnika,
- zadovoljavanje potreba, zahtjeva i očekivanja korisnika na najdjelotvorniji način,
- postizanje planiranih i stalno poboljšavanje poslovnih rezultata i

- potvrđivanje sposobnosti učilišta za postizanje poslovnih rezultata kojima se ostvaruje konkurentska prednost, upravljanje učilištem neminovno zahtijeva sustavni pristup upravljanju kvalitetom njegovih djelatnosti.

Sustavni pristup upravljanju kvalitetom podrazumijeva da učilište stalno analizira potrebe, zahtjeve i očekivanja korisnika, uspostavlja i stalno poboljšava poslovne procese kojima se osnovne djelatnosti ostvaruju te da učinkovito upravlja tim procesima. Zbog toga je primjena sustava upravljanja kvalitetom njegovih osnovnih djelatnosti strateško opredjeljenje svakog učilišta.

Normom ISO 9001:2000 [1] utvrđeni su opći zahtjevi na sustav upravljanja kvalitetom kada neka organizacija namjerava:

- dokazati vlastitu sposobnost za obavljanje djelatnosti koje zadovoljavaju potrebe, zahtjeve i očekivanja korisnika i
- ostvariti zadovoljstvo korisnika učinkovitom primjenom sustava upravljanja kvalitetom, uključujući i procese za poboljšavanje toga sustava.

Budući da to korespondira s poslovnim ciljevima učilišta, svrsishodna je primjena ove norme na upravljanje kvalitetom osnovnih djelatnosti učilišta.

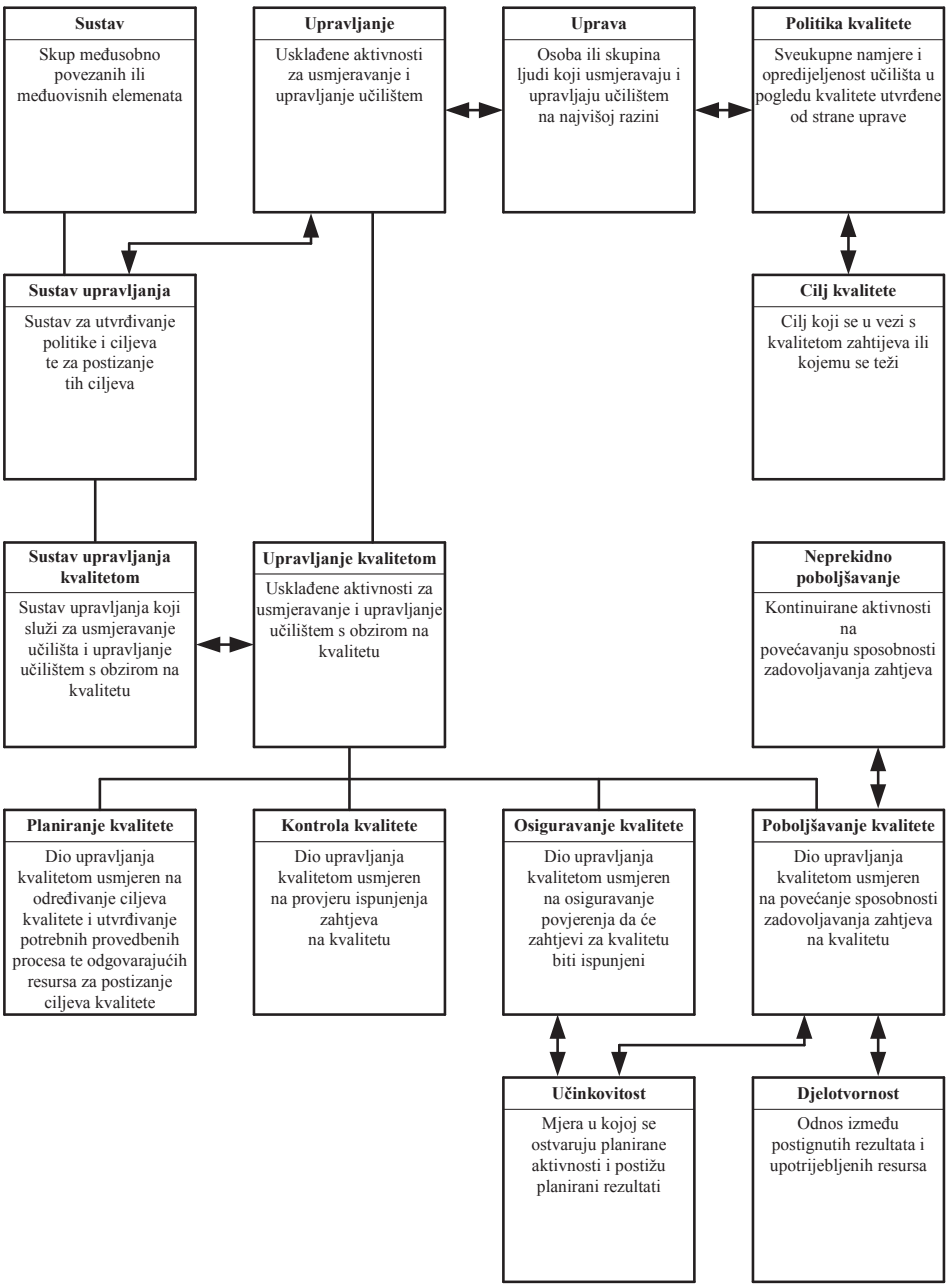
2. POLAZIŠTA NORME ISO 9001:2000

2.1. Osnovni pojmovi

Univerzalnost primjene norme ISO 9001:2000 zahtijeva jednoznačno razumijevanje karakterističnih pojmova koji se u tekstu norme susreću.

U pristupu primjeni norme ISO 9001:2000 od posebne je važnosti razumijevanje osnovnih pojmova koji se odnose na sustav upravljanja kvalitetom. To su: *sustav, upravljanje, upravljanje kvalitetom, planiranje kvalitete, kontrola kvalitete, osiguravanje kvalitete, poboljšavanje kvalitete, neprekidno poboljšavanje, sustav upravljanja, sustav upravljanja kvalitetom, uprava, politika kvalitete, cilj kvalitete, učinkovitost* i *djelotvornost.* Definicije ovih pojmova dane su u [2], a njihovi međuodnosi dani su na pojmovnom dijagramu prikazanom na slici 1.

Slika 1.Pojmovni dijagram koji se odnosi na upravljanje kvalitetom



2.2. Izvorišna načela norme

Izvorište zahtjeva na upravljanje kvalitetom djelatnosti učilišta prema normi ISO 9001:2000 tvori *osam načela* upravljanja kvalitetom [3] kojih se može pridržavati uprava učilišta kako bi vodila učilište prema postignuću planiranih i stalnom poboljšavanju njegovih poslovnih sposobnosti. To su:

- usredotočenost na korisnika
- vodstvo (liderstvo)
- uključenost zaposlenika
- procesni pristup
- sustavni pristup upravljanju
- stalno poboljšavanje
- činjenični pristup odlučivanju
- uzajamno korisni odnosi s dobavljačima.

Smisao ovih načela je razumljiv.Učilište ovisi o korisnicima i, prema tome, treba razumjeti potrebe, udovoljiti zahtjevima i nastojati premašiti očekivanja korisnika. Vođe (lideri) uspostavljaju jedinstvo svrhe i stremljenja učilišta. Oni trebaju stvarati i održavati unutrašnje ozračje u kojemu se zaposlenici učilišta mogu u potpunosti uključiti u postizanje poslovnih ciljeva učilišta. Zaposlenici učilišta su srž učilišta na svim razinama i njihovo puno uključivanje omogućuje da se njihove sposobnosti upotrijebe za boljitak učilišta. Željeni se rezultat postiže djelotvornije kada se aktivnostima i s njima povezanim resursima upravlja kao procesom. Utvrđivanje, razumijevanje sustava i upravljanje međusobno povezanim procesima kao sustavom, doprinosi učinkovitosti i djelotvornosti učilišta u postizanju njegovih poslovnih ciljeva. Stalno poboljšavanje sveukupne poslovne sposobnosti treba biti trajni cilj učilišta. Odluke su učinkovitije ako se temelje na analizi vjerodostojnih podataka i informacija. I konačno, učilište i njegovi dobavljači proizvoda i usluga međusobno su ovisni, a uzajamno korisnim odnosom povećava se sposobnost i učilišta i njezinih dobavljača u zadovoljavanju potreba, zahtjeva i očekivanja korisnika.

2.3. Značaj politike i ciljeva kvalitete

U primjeni norme ISO 9001:2000 ključno mjesto zauzimaju utvrđena politika i postavljeni ciljevi kvalitete djelatnosti učilišta. Politika i ciljevi kvalitete uspostavljaju se kako bi se odredile težišne aktivnosti za usmjeravanje poslovanja učilišta glede kvalitete. Njima se utvrđuju željeni rezultati i pomažu učilištu da djelotvorno upotrijebi raspoložive resurse za ostvarenje tih rezultata. Ciljevi kvalitete usklađuju se s politikom kvalitete i obvezom za neprekidno poboljšavanje, a njihovo ostvarivanje bi trebalo biti mjerljivo. Ostvarenje ciljeva kvalitete može imati pozitivan učinak na kvalitetu djelatnosti, radnu učinkovitost i financijski učinak, a time i na zadovoljstvo i povjerenje korisnika.

3. OSNOVNA OBILJEŽJA SUSTAVA UPRAVLJANJA KVALITETOM

Sustavni pristup upravljanju kvalitetom potiče učilište da analizira potrebe i zahtjeve korisnika, da utvrđuju procese kojima se ostvaruju osnovne djelatnosti učilišta prihvatljive za njihove korisnike, kao i da upravlja tim procesima. Takav pristup stvara povjerenje da je učilište sposobno obavljati osnovne djelatnosti koje dosljedno ispunjavaju potrebe i zahtjeve korisnika.

3.1. Procesni pristup

Da bi učilište učinkovito poslovalo mora utvrditi brojne međuovisne i međusobno povezane poslovne procese i njima upravljati. Sustavno utvrđivanje poslovnih procesa u učilištu i upravljanje tim procesima, naziva se *procesnim pristupom* [2]. Intencija je norme ISO 9001:2000 poticanje prihvaćanja procesnog pristupa u primjeni sustava upravljanja kvalitetom djelatnosti učilišta.

3.2. Karakteristične aktivnosti u primjeni sustava

Primjena sustava upravljanja kvalitetom djelatnosti učilišta obuhvaća nekoliko karakterističnih aktivnosti. To su:

- utvrđivanje potreba i očekivanja korisnika,
- uspostavljanje politike kvalitete i ciljeva kvalitete i odgovornosti za njihovo ostvarenje,
- utvrđivanje poslovnih procesa za ostvarenje ciljeva kvalitete,
- utvrđivanje i osiguravanje resursa potrebnih za ostvarenje ciljeva kvalitete,
- utvrđivanje metoda za mjerenje učinkovitosti i djelotvornosti svakog poslovnog procesa,
- primjena metoda za utvrđivanje učinkovitosti i djelotvornosti procesa,
- utvrđivanje načina sprječavanja negativnih pojava i uklanjanje njihovih uzroka i
- uspostavljanje i primjena procesa neprekidnog poboljšavanja sustava upravljanja kvalitetom.

Dosljednom primjenom naprijed navedenih aktivnosti učilište stvara povjerenje u sposobnost obavljanja njegovih osnovnih djelatnosti u skladu s potrebama i zahtjevima korisnika te neprekidno poboljšavanje te sposobnosti [4]. To je ujedno i jedan od ključnih poslovnih ciljeva učilišta.

3.3. Međuodnos sustava upravljanja kvalitetom i drugih sustava upravljanja

Sustav upravljanja kvalitetom je dio sustava upravljanja učilištem usmjeren na postizanje planiranih ciljeva kvalitete djelatnosti učilišta, kako bi se zadovoljile potrebe,zahtjevi i očekivanja korisnika. Ciljevi kvalitete nadopunjuju druge poslovne ciljeve učilišta, kao što su ciljevi povezani s rastom i razvojem, financiranjem, profitabilnošću, zaštitom okoliša, zaštitom na radu i sigurnošću.

Različiti dijelovi sustava upravljanja učilištem mogu zajedno sa sustavom upravljanja kvalitetom biti integrirani u jedinstven sustav upravljanja koji koristi zajedničke elemente. To može olakšati planiranje, raspodjelu resursa, određivanje dopunskih ciljeva i vrednovanje sveukupne učinkovitosti učilišta.

4. ZAHTJEVI SUSTAVA UPRAVLJANJA KVALITETOM

Osnovne djelatnosti učilišta u osnovi čini ostvarivanje, odnosno izvedba odobrenih studijskih programa obrazovanja te prihvaćenih znanstvenoistraživačkih i ugovorenih visokostručnih projekata u području pomorstva. Za te djelatnosti su, između ostalog, definirani ciljevi, načini i rokovi njihovog ostvarivanja, odnosno izvedbe. Međutim, to samo po sebi ne jamči postignuće potreba i očekivanja korisnika ovih djelatnosti, jer neki poslovni procesi, koji utječu na kvalitetu obavljanja tih djelatnosti, mogu biti manjkavi. Da bi se takvi procesi izbjegli, odnosno eliminirali, učilište treba uspostaviti što jednostavniji, ali učinkovit sustav upravljanja kvalitetom, čiji je doseg usklađen s planiranim ciljevima kvalitete.

Zahtjevi sustava upravljanja kvalitetom djelatnosti učilišta se, u osnovi, mogu podijeliti na opće i posebne.

4.1. Opći zahtjevi sustava

Učilište treba uspostaviti, dokumentirati, primijeniti i održavati sustav upravljanja kvalitetom i neprekidno poboljšavati njegovu učinkovitost u skladu sa zahtjevima norme. U tom smislu učilište treba:

- jednoznačno definirati i upravljati svim poslovnim procesima koji su uključeni u obavljanje njegovih osnovnih djelatnosti
- jasno definirati uvjete pod kojima se poslovni procesi ostvaruju
- osigurati dostupnost potrebnih resursa i informacija nužnih za potporu pri ostvarivanju i nadziranju tih procesa
- nadzirati, mjeriti i analizirati te procese i
- stalno poboljšavati te procese.

4.2. Posebni zahtjevi sustava

Posebni zahtjevi sustava mogu se, s obzirom na svoja specifična područja primjene podijeliti u pet skupina. To su skupine zahtjeva koje se odnose na:

- dokumentaciju sustava
- djelovanje uprave učilišta
- upravljanje resursima učilišta
- ostvarivanje djelatnosti učilišta i
- mjerenje, analizu i poboljšavanje sustava.

4.2.1. Zahtjevi za dokumentaciju sustava

Dokumentacija sustava upravljanja kvalitetom omogućuje komunikaciju o stremljenju učilišta u pogledu upravljanja kvalitetom te usklađivanje aktivnosti u primjeni toga sustava kao i ostvarivanje procesa potrebnih za obavljanje osnovnih djelatnosti učilišta. Zbog toga dokumentacija sustava upravljanja kvalitetom znatno doprinosi povećavanju učinkovitosti primjene toga sustava [5].

Dokumentacija sustava upravljanja kvalitetom, u osnovi, sadrži:

- dokumentiranu izjavu o politici i ciljevima kvalitete
- poslovnik kvalitete – dokument koji za unutarnje i vanjske potrebe daje informacije o načinu i području primjene sustava upravljanja kvalitetom,
- dokumentirane poslovne procese i radne postupke – dokumente koji daju obavijest o vrstama, načinu odvijanja i izvođenju pojedinih aktivnosti u obavljanju djelatnosti i
- zapise kvalitete– dokumente koji sadrže informacije i dokaze o provedenim aktivnostima i postignutim rezultatima u primjeni sustava upravljanja kvalitetom.

Učilište utvrđuje opseg i sadržaj potrebne dokumentacije, što ovisi o čimbenicima kao što su: brojnost, složenost i uzajamno djelovanje poslovnih procesa, vrsta i složenost djelatnosti, zahtjevi korisnika, važeći propisi, kompetentnost zaposlenika i razina do koje je potrebno dokazivati ispunjenje zahtjeva sustava upravljanja kvalitetom.

4.2.2. Zahtjevi za djelovanje uprave

Opći zahtjev koji se postavlja na upravu učilišta je da ona pokaže svoju predanost za postignuće postavljenih ciljeva kvalitete i poboljšavanje uspostavljenog sustava upravljanja kvalitetom.

Posebni zahtjevi za djelovanje uprave se, u osnovi, odnose na:

- obavješćivanje zaposlenika učilišta o važnosti zadovoljavanja zahtjeva korisnika
- uspostavljanje politike kvalitete
- uspostavljanje ciljeva kvalitete
- preispitivanje primijenjenog sustava upravljanja kvalitetom i
- osiguravanje dostupnosti potrebnih resursa.

Iz naprijed navedenih zahtjeva proizlazi da uprava učilišta treba osigurati postojanje vertikalnih i horizontalnih komunikacijskih procesa, radi distribucije informacija koje se odnose na učinkovitost sustava upravljanja kvalitetom. Politika kvalitete učilišta treba biti konzistentna s profesionalnim standardima, uredbama i propisima i drugim poslovnim politikama učilišta. Uprava učilišta mora biti sigurna da je politika kvalitete razumljiva i primjenjiva i da se u učilištu provodi. Planiranje kvalitete djelatnosti učilišta se, u osnovi, svodi na planiranje ciljeva kvalitete. Oni trebaju biti mjerljivi i primjereni aktivnostima i procesima sustava upravljanja kvalitetom te usklađeni s utvrđenom politikom kvalitete. Uprava učilišta treba jasno definirati organizacijsku strukturu učilišta. To podrazumijeva podjelu odgovornosti i ovlaštenja na zaposlenike prema funkcijskim područjima u procesima obuhvaćenih sustavom upravljanja kvalitetom. I konačno, uprava učilišta treba periodički obavljati preispitivanje sustava upravljanja kvalitetom, radi ustanovljavanja učinkovitosti u ispunjavanju zahtjeva i indikatora sustava upravljanja kvalitetom te utvrđivanja preventivnih, odnosno korektivnih aktivnosti za uklanjanje ustanovljenih, odnosno potencijalnih manjkavosti [6]. Preispitivanje sustava upravljanja kvalitetom uključuje i periodičko preispitivanje zadovoljstva korisnika, kriterija ocjenjivanja, rezultata vrednovanja i dokumentiranih poboljšanja.

4.2.3. Zahtjevi za upravljanje resursima

Posebni zahtjevi za upravljanje resursima se, u osnovi, odnose na:

- pribavljanje resursa
- ljudske resurse
- infrastrukturu i
- radno okružje.

Iz naprijed navedenih zahtjeva proizlazi da učilište treba provesti postupak za utvrđivanje potrebnih resursa te osigurati njihovu raspoloživost pri ostvarivanju procesa uključenih u obavljanje osnovnih djelatnosti učilišta. Također, treba osigurati raspoloživost resursa za učinkovito djelovanje sustava upravljanja kvalitetom kao i za povećavanje zadovoljstva korisnika ispunjavanjem njihovih zahtjeva. Nadalje, osoblje koje obavlja poslove koji utječu na kvalitetu osnovnih djelatnosti mora za to biti kompetentno. I konačno, učilište mora utvrditi, osigurati i upravljati infrastrukturom i radnim okružjem potrebnim za obavljanje njegovih osnovnih djelatnosti.

4.2.4. Zahtjevi za ostvarivanje procesa

Posebni zahtjevi koji se odnose na procese povezane s ostvarivanjem kao i samoostvarivanjem procesa uključenih u obavljanje osnovnih djelatnosti učilišta se, u osnovi, odnose na:

- planiranje procesa
- projektiranje i razvoj procesa
- nabavu proizvoda i usluga
- ostvarivanje procesa i
- upravljanje nadzornom i mjernom opremom.

Iz naprijed navedenih zahtjeva je razvidno da učilište treba planirati, projektirati i razvijati procese koji su nužni za ostvarivanje njegovih osnovnih djelatnosti. To se mora obavljati u skladu sa zahtjevima drugih procesa obuhvaćenih sustavom upravljanja kvalitetom. Nadalje, učilište mora osigurati da nabavljeni proizvod ili usluga potrebni za ostvarivanje procesa moraju biti u skladu s narudžbom. I konačno, učilište mora osigurati potrebne uvjete, sredstva i opremu za ostvarivanje procesa uključenih u obavljanje osnovnih djelatnosti učilišta, i njima upravljati.

4.2.5. Zahtjevi za mjerenje, analizu i poboljšavanje

Posebni zahtjevi za mjerenje, analizu i poboljšavanje se, u osnovi, odnose na:

- nadzor i mjerenje zadovoljstva korisnike
- unutarnju neovisnu ocjenu učinkovitosti primijenjenog sustava
- nadzor nad procesima i mjerenje procesa
- upravljanje nekvalitetnim uslugama
- analizu podataka
- korektivne aktivnosti i
- preventivne aktivnosti.

Naprijed navedeni zahtjevi pokazuju da učilište mora planirati i primjenjivati procese nadzora, mjerenja i analize koji su potrebni radi dokazivanja da je obavljanje osnovnih djelatnosti učilišta u skladu sa zahtjevima korisnika, kao i radi neprekidnogpoboljšavanja učinkovitosti primijenjenog sustava upravljanja kvalitetom. Pri tome se pri analizi podataka dobivenih mjerenjem, a u svrhu poboljšavanja učinkovitosti toga sustava, često koristi statističko upravljanje kvalitetom [7].

5. ZAKLJUČAK

Upravljanje učilištem, između ostalih vidova upravljanja, uključuje i upravljanje kvalitetom. Upravljanje kvalitetom osnovnih djelatnosti učilišta na sustavan način zahtijeva primjenu odgovarajućeg sustava upravljanja kvalitetom.

Prihvaćanje i primjena sustava upravljanja kvalitetom djelatnosti učilišta, prema zahtjevima norme ISO 9001:2000, strateška je odluka uprave učilišta. Time se uprava učilišta opredijelila da će upravljanjem kvalitetom u obavljanju osnovnih djelatnosti učilišta dosljedno primjenjivati sljedeće aktivnosti:

- utvrđivanje procesa koji su potrebni za sustav upravljanja kvalitetom i njihovu primjenu u poslovanju učilišta
- određivanje slijeda i međusobnog djelovanja procesa
- određivanje kriterija i metoda potrebnih da se osigura učinkovito odvijanje i upravljanje procesima
- osiguravanje dostupnosti potrebnih resursa i informacija nužnih za potporu pri provođenju i nadziranju procesa
- nadziranje, mjerenje i analiziranje procesa i
- provođenje postupaka nužnih za ostvarivanje planiranih rezultata i neprekidno poboljšavanje procesa.

Nadalje, prihvaćanje i primjena sustava upravljanja kvalitetom djelatnosti učilišta prema zahtjevima norme ISO 9001:2000 obvezuje upravu učilišta da definira dokumentaciju, uključujući i odgovarajuće zapise potrebne za uvođenje, primjenu i održavanje sustava upravljanja kvalitetom i za podržavanje učinkovitog i djelotvornog odvijanja procesa uključenih u obavljanje osnovnih djelatnosti učilišta.

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GENERAL APPROACH TO THE IMPLEMENTATION OF ISO 9001:2000 STANDARD IN THE QUALITY MANAGEMENT OF MARITIME-RELATED HIGHER EDUCATION INSTITUTION AVTIVITIES

SUMMARY

The requirements of the International Standard ISO 9001:2000 are applicable to maritime-related higher education. The implementation of this Standard is a strategic decision of a higher education institution. The institution establishes, documents, implements and maintains a quality management system, and continually improves its effectiveness in accordance with the requirements of the Standard. Within the quality management system, the higher education institution analyses customer needs, defines the processes that lead to providing education services that are acceptable to the customer, and keeps these processes under control. This enables the higher education institution to provide education that consistently fulfills these requirements. Top management provides evidence of its commitment to the development and implementation of the quality management system and the continual improvement of its effectiveness. Finally, the higher education institution plans and implements the monitoring, measurement, analysis and improvement of processes included in the quality management system.

Key words: *quality, quality policies, quality management, quality improvement*

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THE DEMAND FOR TRANSPORT AND LOGISTICS SERVICES IN THE FRIULI VENEZIA GIULIA REGION

The paper reports on a research carried on in April 2007 on a sample of manufacturing firms in the Friuli Venezia Giulia Region, Italy. The aim was to understand the nature and the prospects of the transport and logistics demand deriving from firms. It resulted that firms require an intense and growing amount of services to procure inputs and deliver products to a large number of destination, both nationally and internationally. A large percentage of the shipments is full load, point-to-point shipments which require traditional transport operators. However, there is a growing share of shipments which demand groupage\courier services implying logistics operators able to make higher levels of investments, manage a national or international network, exploit scale and scope economies and compete in quality and not only in costs.

Key words: *freight transport, logistic services, transport demand, outsourcing*

1. INTRODUCTION

Logistics is thought to be a crucial feature of a successful economy. A large body of scientific and policy literature stresses the importance of providing industries with a sound and well organized logistics infrastructure and services. But which logistics services do firms actually need in an advanced economy? What is their current demand for transport and logistics? Are logistics firms able to provide it in a satisfactory manner?

In order to reply to these important research and policy question, a telephone survey was carried out in the Friuli Venezia Giulia, a region located in the Northern Eastern border of Italy, one of the most industrial and economically successful region of Italy.

This paper is part of a broader stream of literature which includes recent papers as Hensher and Figliozzi (2007), Hensher, Puckett, and (2007) and Figliozzi (20007).

2. THE SAMPLE OF THE INTERVIEWED MANUFACTURING FIRMS

During April 2007, a total of 51 firms were interviewed, classified as reported in Table 1 and 2. They belong to a quite diversified set of sectors representing different technologies, industrial organization and logistics needs. Throughout most of the paper a detailed 5 sector classification will be maintained. Some tables will use the 2 sector classification of Table 2 when data are particularly scarce.

Table 1. The sample of the interviewed manufacturing firms by sector and by province at a 5 sector classification (n° of firms)

Province	Food	Beverages	Rubber and plastics	Manufactu-ring product*	Wine	Total
Gorizia	2	2	1	1		6
Pordenone	2		6	9	4	21
Trieste	3	1	1	2		7
Udine	4	3	2	7	1	17
Total	11	6	10	19	5	51

**The caption Manufacturing products includes chemical-pharmaceutical products, leather and skin products, editorial and paper products, textiles, glass and ceramics*

Table 2. The sample of the interviewed manufacturing firms by sector and by province at a 2 sector classification (n° of firms)

Province	Food, Beverages, Wine	Rubber and plastics e other Manufacturing products	Total
Gorizia	4	2	6
Pordenone	6	15	21
Trieste	4	3	7
Udine	8	9	17
Total	22	29	51

The average size of the firms interviewed measured by the number of employees is 50 (Table 3). Hence, the sample represents the large number of Small and Medium Enterprises (SMEs) which characterizes the Italian industrial structure, especially of the Northeastern and Central regions. The wine producers have an average size of about 20 employees, rubber and plastic firms are slightly larger. The manufacturing firms have a larger average size equal to about 70 employees. It is an industrial structure which shows high specialization, often in niche products, and low economies of scale and of scope in production, and, possibly, in the transport and logistics operations as well.

Table 3. The sample of firms by dimension

Sector	Average number of employees
Food	47,6
Beverages	41,4
Rubber and plastics	30,6
Manufacturing products	71,2
Wine	21,4
Total	49,98

3. THE CURRENT TRANSPORT AND LOGISTICS FOR INBOUND AND OUTBOUND FLOWS

A first set of questions was focused on quantifying the current transport and logistics activities carried out at firm level. Table 4 reports on the weekly average number of orders performed by a firm. The numbers are quite large signaling an intense buying and selling activity by the firms. It is most likely the effect of the de-verticalization of the regional industrial structure and of the on-going delocalization trends which probably strengthened the regional competitiveness but increased the transport and logistics requirements of the firms. It is responsible for the recent growth rate in freight transport at higher levels than the growth in the regional GNP.

Table 4. Weekly average number of orders

Sector	Total
Food	46,2
Beverages	290,5
Rubber and plastics	17,0
Manufacturing products	12,8
Wine	32,0
Total	65,1

Table 5. N° of truck that weekly visit the firm (n° of flows)

	Inbound flows		Outbound flows	
Sector	Full load	groupage/courier	Full load	groupage/courier
Food	2,1	9.2	9,7	7,1
Beverages	12,8	0.6	38,4	0,6
Rubber and plastics	4,8	2.1	15,3	2,7
Manufacturing products	5,3	4.2	14,6	15,0
Wine	50,7	0.3	54,5	21,0
Total	10,0	4.1	20,5	9,7

The industrial and commercial activity generates a demand for transport, which mainly takes place by road transport. Table 5 reports on the number of trucks that weekly visit the interviewed firms. Besides distinguishing between inbound flows (of inputs necessary for production purposes) and outbound flows (of outputs of the firm), the Table distinguishes between full load trucks and less-than-full load trucks, termed as *groupage* or *courier* because these loads are usually carried jointly with the products of other firms or grouped with other products, in part or all the distanced traveled by the truck. We feel that this is a crucial distinction since it takes a completely different transport operator to carry out the two kinds of services. Full load transportation are usually point-to-point transport services carried out by single truck operators (the so called "padroncini" in Italian) or by small transport firms operating a small number of trucks. These firms are characterized by a quite simple organization, low level of technological means, inability to exploit economies of scale or of scope, little use of information technology and simplified supply of logistics services. But firms operating point-to-point compete on intense cost-cutting strategies and carry out highly customized services. All in all, they provide a cheap and satisfactory service to small firms, often enjoying long-standing personal relationships with the manufacturing firms' manager which enables them to be almost integrated with the manufacturing firm.

Just the opposite is most likely true for the firms which offer *groupage\courier* services. Since they have to organize a complex network to be able to cover a large section of the market and to provide a vast array of services, they are characterized by a larger dimension (up to few thousands employees), often national or international coverage, extremely high investment levels and a specific focus on exploiting economies of scope and of scale by making use of state-of-the-art information and communication technology. Since there is a much smaller number of operators in this section of the market, competition levels are less fierce and based more on quality than on costs.

Going back to Table 5, it is evident that the average number of trucks visiting a firm for full loads is twice as much as those visiting a firm for less-than-full loads. At sectoral level the wine and beverage industry registers the highest number of trucks carrying inputs as well as outputs. In the manufacturing sectors the number of trucks delivering outputs is higher than that of the trucks bringing in inputs.

When examining the distinction between full load and less-than-full load shipments by type of customer (Table 6) it is found that the ratio is 3 to 1 for business-to-business (B2B)

transactions and almost 1 to 1 for business-to-consumer (B2C) transactions. At sectoral level, food is shipped mostly to consumers (75%), partly full load and partly by *groupage\courier*; when shipped to businesses it is shipped mostly by full-load trucks. A similar structure is in the beverage and wine sectors. Rubber and plastics are, on the contrary, shipped to businesses (69%) mainly full load; when shipped to consumers they are shipped full load in a 2 to 1 ratio. The other manufacturing products are partly shipped to businesses (44%) and partly to consumers; in the latter case they are shipped mostly by *groupage\courier*.

Table 6. Which type of shipments prevail (by volume or by value)? (percentage-wise)

Sector	Full load B2B	Groupage/ courier B2B	Full load B2C	Groupage/ courier B2C	Total
Food	21%	4%	35%	40%	100%
Beverages	25%	0%	58%	17%	100%
Rubber and plastics	50%	19%	21%	10%	100%
Manufacturing products	30%	14%	21%	35%	100%
Wine	18%	4%	57%	21%	100%
Total	30%	10%	32%	27%	100%

Examining the destination of the output shipments, it is evident that they are local or Italian but also with a good share of foreign destination both to bordering and farther away countries (Table 7).

Table 7. Localization of customers (average n° of destinations)

Sector	North of Italy	Italy	Bordering countries (Austria, Slovenia, Croatia, Hungary)	Other countries
Food, beverages, wine	7	12	5	6
Rubber and plastics and other manufacturing products	9	17	11	11
Total	16	29	16	17

A final point regarding the existing situation concerning the number of destination points (Table 8). As it is obvious, the share of firms by number of destination points increases when considering B2C firms against the B2B firms since consumers are more numerous and more scattered than firm customers.

Table 8. Share of firms by number of destination points (percentage-wise)

	B2B	B2C
From 1 to 5	15%	3%
From 5 to 10	10%	6%
From 11 to 30	10%	13%
from 31 to 60	5%	16%
From 60 to 100	40%	34%
More than 100	20%	28%
	100%	100%

4. FUTURE TRENDS AS TO APRIL 2007

The firms have also been asked about the forthcoming trends relative to April 2007. There is a large number of firms that think that the number of shipments is increasing, both with the Italian and foreign destinations. The market for transport and logistics is consequently going to increase.

Table 9. Questions of future increases in the n° of shipments (percentage-wise)

Question	Yes	No	Not sure
Will the n° of shipments increase?	58%	12%	54%
Will the n° of shipments increase in Italy?	32%	0%	68%
Will the n° of shipments increase in foreign countries?	34%	2%	68%

A prediction was also asked on the share of groupage\courier: 31% of the firms thought it is going to increase, 53% think it will stay constant and 16% do not know. None thinks it will decrease.

5. LOGISTICS MANAGEMENT AND OUTSOURCING

An important aspect of logistics and transport activities is who makes the main decisions. Italian firms, especially the SMEs in the industrial districts, are thought to disregard the organization of an efficient transport and logistics system for procurement of their inputs and shipment of their products by buying CIF (cost, insurance and freight) and selling FOB (free-on-board). With these contractual arrangements, it is the seller of inputs or the buyer of outputs who takes care and makes the important choices, hence, controlling the logistics and output activities. Consequently, the transport and logistics demand content deriving from Italian SMEs is rather poor and is not sufficient to allow a market for these services to develop.

In order to test this theory, a set of questions were included in the questionnaire.

Table 10. Who manages the groupage/courier input procurements to your firm? (percentage-wise)

Sector	By us	By the seller
Food	11%	89%
Beverages	25%	75%
Rubber and plastics	30%	70%
Manufacturing products	54%	46%
Wine	0%	100%
Total	31%	69%

A first question was about the management of the groupage/courier input procurements (Table 10). It resulted that on average, only 31% of the firms organized its own input procurements. At sectoral level, the percentage is higher in manufacturing products where most likely the productive logistics requirements are more stringent, whereas in the edibles and drinks sectors the percentage is much lower and in the case of wine equal to zero.

A second question was on the type of the logistics service bought\outsourced besides transportation (Table 11). It is evident that only few firms, 4 out of 51, buy warehousing services, none buys assembling or final product arrangements services, 4 buy invoicing services and 12 request payments-at-consignment services. Apart from the last case, it hence appears that firms buy most transport services whereas the demand for more complex logistics services is still rather low.

Table 11. Type of logistics services acquired\outsource besides transportation (n° of acquiring firms)

Sector	Warehousing	Assembling or final product arrangements	Invoicing	Payments at consignment
Food, Beverages, Wine	1	0	2	5
Rubber and plastics and other manufacturing products	3	0	2	7
Total	4	0	4	12

A last set of questions aimed at measuring whether there is a close one-to-one relationship between a firm and a transport and logistics provider or whether firms establish multiple relationships with providers in order to satisfy multiple requests or more simple to take advantage from the competition among providers.

The results are the following:

- For full load shipments the number of suppliers per firm is equal to 2.2 forwarders (with a maximum number of 10) and to 2.8 transport operators (max. 11).
- For less-than-full load shipments the number of suppliers per firm is equal to 2.3 forwarders (max. 7), 4.9 transport operators (2.6 for Italian destinations, 1 for abroad) (max. 12), 1 national courier (max. 2) and 3.3 international courier (max. 10).

It can be concluded then that manufacturing firms deal with more than one provider of transport and logistics firms, most likely both for quality and cost convenience. This results in an average cost for transport and logistics service estimated on average at 5% of the total value of production, which is a figure in line with the international average in developed countries. This figure, according to the literature has been declining over the last decades and is responsible for trends towards delocalization and globalization witnessed in recent years. It seems quite unlikely that it will further decrease. On the contrary, the tendency of road congestion to increase, the increasing cost of oil, the concerns with the environment and the political requests for decoupling and for internalizing road external costs is likely to keep that figure constant or, possibly, to increase it.

6. CUSTOMERS' SATISFACTION

A final set of questions comprised the level of satisfaction of firms with the transport and logistics services.

Table 12. Satisfaction with the tranportation door-to-door time?

Sector	*Not at all*	*Not much*	*Enough*	*Very*	*Tot.*
Food, Beverages, Wine	5%	25%	30%	40%	100%
Rubber and plastics and other manufacturing products	7%	0%	64%	29%	100%
Total	6%	10%	50%	33%	100%

Table 13. Satisfaction with the reliability of logistics services?

Sector	*Not at all*	*Not much*	*Rnough*	*Very*	Tot.
Food, Beverages, Wine	5%	11%	42%	42%	100%
Rubber and plastics and other manufacturing products	7%	0%	54%	39%	100%
Total	6%	4%	49%	40%	100%

The results are encouraging (Table 12 and 13). 83% of the firms deem themselves enough or very satisfied with the transport time and 89% of them are satisfied with overall logistics reliability. The share of firms not or little satisfied is equal to 16% for transport time and to 10% for reliability. The former percentage signals the existence of congestion problems in the network, both nationally and internationally, which are hard to solve, given the expected rapid growth rate in road transport and also because more and more limitations are imposed upon road transport (such as working hour, speed, day-of-the-week and route limitations) in order to decrease its negative environmental and safety impacts. Reliability appears to be less of a concern to firms and, contrasted with the huge reliability issues of intermodal road-rail transport, it is certainly one of the main competitive edges that road transport enjoys.

7. CONCLUSION

The paper presented a survey conducted on a sample of firms located in the Friuli Venezia Giulia region, Italy. It enquired on their current and future demand for transport and logistics services. It resulted that firms require an intense and growing amount of services to procure inputs and deliver products to a large number of destination, both nationally and internationally. A large percentage of the shipments is full load, point-to-point shipments which require traditional transport operators, equipped with few trucks and able to perform a low cost, highly customized service with low level of information technology skills. However, there is a, most likely, growing share of shipments which demand *groupage\courier* services implying logistics operators able to make higher levels of investments, manage a national or international network, exploit scale and scope economies and compete in quality and not only in costs.

Indicators such as the type of services (traditional transport services vs. logistics services) requested, the level of outsourcing, the control of the transport and logistics supply chain and the number of operators used confirm the picture sketched in the previous sentence: the demand for transport and logistics services is still of traditional type, focused more on costs than on innovative supply chain practices.

Most likely this depends on the current characteristics of the industrial system comprising a large array of SMEs focused on highly specialized niche markets. And, for the time being, they appear quite satisfied with the level of service they receive from the transport operators both in terms of transport time and reliability, although it is doubtful whether the current conditions could be sustained in the long run.

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POTRAŽNJA ZA TRANSPORTNO-LOGISTIČKIM USLUGAMA U REGIJI FRIULI VENEZIA GIULIA

SAŽETAK

U radu je prikazano istraživanje koje je, u travnju 2007., izvršeno na uzorku proizvodnih tvrtki iz regije Friuli Venezia Giulia u Italiji. Cilj istraživanja je bio da se utvrde vrste i mogućnosti udovoljavanja potražnjom transportno-logističkih usluga koje dolaze od samih tvrtki. Rezultati tog istraživanja pokazali su da tvrtke zahtijevaju intenzivniji i veći broj usluga kako bi ostvarile sve veći ulaz proizvoda kao i njihovu isporuka na veliki broj talijanskih i inozemnih odredišta. Veliki postotak proizvoda otpremljen je brodom kao puni teret, od mjesta ukrcaja do mjesta iskrcaja, što zahtijeva usluge tradicionalnih prijevoznika. Međutim, sve je veći broj proizvoda za čiju se otpremu brodom traže usluge zbirnog prijevoza, što uključuje logističke usluge prijevoznika na jednoj većoj razini, koji je u stanju sve više ulagati u razvoj te usluge, upravljati nacionalnom i međunarodnom mrežom transportnih usluga, iskoristiti stupanj i veličinu uštede, te konkurirati kvalitetom, a ne samo cijenom.

Ključne riječi: *prijevoz robe, logističke usluge, potražnja za prijevoznim uslugama, organizacija rada s ljudima izvan tvrtke*

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STRUKTURNA ANALIZA PRIJENOSNOG PELJARSKOG RAČUNALA

Prijevoz opasnih tereta velikim brodovima, evidentne pomorske nezgode te štete nastale tim nezgodama u morskom ekosustavu zahtijevaju bolju i sigurniju plovidbu. Primjenom novih tehnologija nastoji se smanjiti mogućnost nezgoda, polemizirajući oko efikasnosti istih na upravljanje plovidbom i peljarenjem brodom.

Funkcija peljara je izuzetno značajna za sigurnost plovidbe. Razvojem novih tehnologija stvorena je nova mogućnost za peljare - peljarenje uz pomoć prijenosnog peljarskog računala. Peljarska računala pružaju peljaru mogućnost praćenja relevantnih podataka za peljarenje na zaslonu računala kao i mogućnost komunikacije s ostalim sudionicima u pomorskom prometu što uvelike povećava točnost, kontrolu i brzinu prenesenih informacija. Korištenjem ovog suvremenog sustava u peljarenju učinjen je veliki korak povećanju sigurnosti plovidbe.

Ključne riječi: *peljari, prijenosno peljarsko računalo, metode peljarenja*

1. UVOD

Pomorski peljari su jedan od glavnih elemenata koji pridonose sigurnosti plovidbe u područjima visokog rizika plovidbe. Peljari su dobri poznavaoci relevantnih podataka za peljarenje lokalnog područja, brodova, brodskih interakcija te meteoroloških prilika na lokalnom području. Moraju isto tako biti vješti i u komunikaciji kako s posadom s kojom su u neposrednom kontaktu tako i s ostalim sudionicima u pomorskom prometu. Budući je posao peljara vrlo bitan za sigurnost plovidbe, peljarenje mogu obavljati profesionalne, kompetentne osobe s odgovarajućom vještinom upravljanja.

Kako bi se mogao sa sigurnošću obavljati posao peljarenja, peljarom se postaje nakon određene edukacije, stažiranja i usavršavanja što je propisano IMO Rezolucijom A 485(XII).

Sve veći brodovi s raznolikom opremom na zapovjedničkom mostu i sve manjim brojem članova posade različitog govornog područja, rezultiraju većim angažmanom peljara pri peljarenju brodom. U vrlo kratkom vremenu po dolasku na brod pri različitim meteorološkim prilikama peljar se mora upoznati s opremom na zapovjedničkom mostu ne

znajući ispravnost, (pouzdanost)preciznost tih instrumenata te mora vješto pratiti i očitavati bitne podatke za peljarenje srazličitih instrumenata na zapovjedničkom mostu.

Peljarenje se može klasificirati prema područjima peljarenja, prema tehnikama peljarenja i opremi koja se koristi tijekom peljarenja. Na brod se nerijetko ukrcavaju po dva peljara i to jedan za područje peljarenja kanalom, a drugi za peljarenje u luci. Prilikom peljarenja, peljaru mora biti dostupan pristup i korištenje svih uređaja na zapovjedničkom mostu te omogućen timski rad na zapovjedničkom mostu.

Prema opremi koja se koristi tijekom peljarenja, metode peljarenja mogu se podijeliti na:

- metodu peljarenja uporabom klasične opreme na brodu
- metodu peljarenja uporabom prijenosnog peljarskog računala.

Uporabom klasične opreme na brodu peljaru su na raspolaganju: Arpa radar uređaj, žiro-kompas, VHF, Inmarsat terminal, brzinomjer, dubinomjer, anemometar, papirnata karta, karta manevarskih karakteristika broda, itd. Radi nemogućnosti istovremenog praćenja podataka s različitih instrumenata, očitavanje istih obavljaju i prenose peljaru članovi posade na zapovjedničkom mostu.

Moderne metode peljarenja uporabom prijenosnog peljarskog računala uvode određene promjene, olakšavajući posao peljaru i povećavajući pritom sigurnost plovidbe.

2. NAUTIČKI PARAMETRI FUNDIRANI NA PRIJENOSNOM PELJARSKOM RAČUNALU

Prijenosno peljarsko računalo, kao moderno navigacijsko pomagalo pruža peljaru mogućnost da većinu potrebnih informacija, nužnih za obavljanje peljarenja može pratiti na jednom jedinom zaslonu, a po potrebi obavljati i komunikaciju. Ovisno o području peljarenja računalni program prijenosnog peljarskog računala daje peljaru mogućnost odabira rada u modu kanalnog peljarenja ili u modu lučkog peljarenja. Vrlo pozitivna značajka peljarskog računala je i mogućnost povezivanja peljarskog računala s uređajima na zapovjedničkom mostu i mogućnost praćenja tih podataka na zaslonu peljarskog računala.

Priprema peljarskog računala za uporabu vrlo je kratka i traje svega jednu minutu što uvelike olakšava primjen uprijenosnih peljarskih računala. Peljar se slobodno može kretati u tijeku peljarenja s peljarskim računalom jer prijenos podataka na peljarsko računalo obavlja se bežično do 100 m, a da pritom ni blizina obalnih dizalica ne pričinjavaju nikakve smetnje. Samo prijenosno peljarsko računalo kako bi bilo zaštićeno prilikom ukrcaja, iskrcaja peljara s broda pri lošim vremenskim prilikama nalazi se u zaštitnoj vodonepropusnoj kutiji.

Peljarska računala s obzirom na mogućnosti koje pružaju mogu se podijeliti na: osnovna, standardna, sveobuhvatna i peljarska računala VTS centra.

Tablica 1. Prikaz mogućnosti različitih prijenosnih peljarskih računala

SOFTVERSKIMODULI	OSNOVNO P.P.R	STANDARDNO P.P.R.	SVEOBUHVATNO P.P.R.	VTS P.R.
MMI	+	++	+++	+++
PODRŠKA PRI ODLUČIVANJU	-	+	+++/*	+++
UNIVERZALNO AIS IZVJEŠĆE	ɵ	ɵ	+++/*	*
NAVIGACIJSKA OGRANIČENJA IUZBUNJIVANJE	ɵ	ɵ	*	*
RAZMIJENA INFORMACIJA PRIPUTOVANJU	-	++	+++	+++
TAKTIČNI PRIKAZ PROMETA	+	++	+++	+++
GPRS/UMTS KOMUNIKACIJA	-	+	+++/*	+++
KOMUNIKACIJA INMARSATOM NA VELIKIM UDALJENOSTIMA	-	+	+++	+++
OČITAVANJE PODATAKA S INSTALIRANOG BRODSKOG AIS-a	-	-	*	-
PLANIRANJE I MOGUĆNOST UPRAVLJANJA PRI: VEZU, ULASKU U LOK/DOK	-	++	+++/*	+++/*
HIDROGRAFSKI PODACI,	ɵ	ɵ	+++/*	+++/*
TRENUTNI I BUDUĆI:	ɵ	ɵ	+++/*	+++/*
VRIJEDNOSTI PLIME	-	-	*	*
STRUJE	-	-	*	*
VALOVA I STANJA MORA	-	-	*	*
SALINITET	-	-	*	*
SNAGU VALOVA				
METEOROLOŠKI PODACI TRENUTNI I BUDUĆI: VJETAR, METEOR. PROGNOZA, METEOR. UPOZORENJA	ɵ	ɵ	+++/*	+++/*
ZAŠTITA OKOLIŠA, IZLJEVANJE ULJA I KONTROLARAZLIVENOG ULJA	-	-	+++/*	+++/*

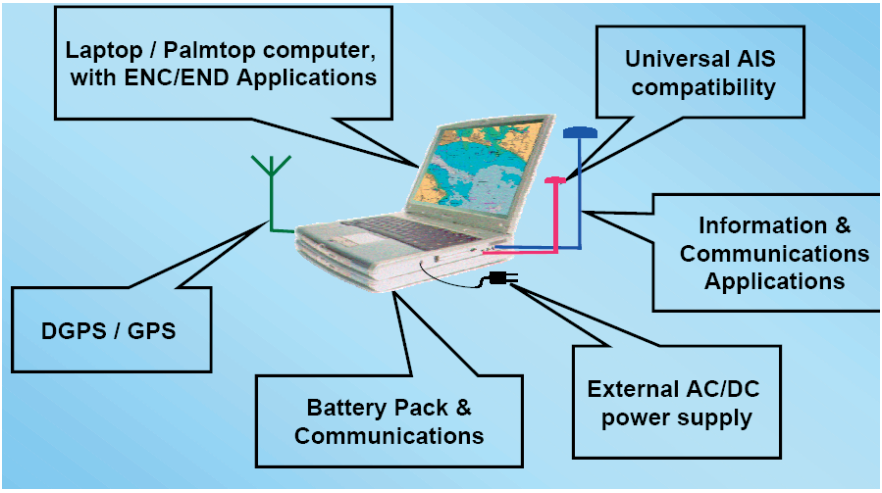
TRAGANJE I SPAŠAVANJE	-	-	+++/*	+++/*
ŽURNO DJELOVANJE I KOORDINIRANJE	-	-	+++/*	+++/*
DOKOVANJE I PRILAŽENJE	-	-	*	-
PREDVIĐANJE I SIMULACIJA PROMETA	-	-	*	*
OČITAVANJE PODATAKA SA SENZORA ZA UDALJENOST PRILIKOM PRIVEZA	-	-	*	-
LOKALNI ZAHTJEVI ZA: -IZVJEŠĆE O OPASNOM TERETU, - CARINSKO IZVJEŠĆE, - MIGRACIJSKO/ POLICIJSKO IZVJEŠĆE, - IZVJEŠĆE LUČKE KAPETANIJE	 - - - -	 +++ -- -- +	 +++/* +++/* +++/* +++/*	 +++/* +++/* +++/* +++/*
LOKALNI ZAHTJEVI ZA: -PRIKAZ PROTEZANJA I ŠIRINE PLOVNOG PUTA, -PRIKAZ PLOVNOG PUTA I PREDVIĐENO KRETANJE BRODA NA TOM PLOVNOM PUTU	 - -	 - -	 * *	 - -

LEGENDA:
* = maksimalno kompleksan, profesionalan nivo
\- = nije primjenjivo
ɵ = mogućnost standardne ais poruke
\+ = osnovni nivo kompleksnosti
++ = srednji nivo kompleksnosti
+++ = napredni nivo kompleksnosti

Slika 1. Prijenosno peljarsko računalo

Prijenosno peljarsko računalo sastoji se od sljedećih komponenata:

- računala sa sustavom elektroničkih navigacijskih karta i računalnim programom,
- GPS/DGPS prijamnika, pomoću kojeg se dobiva pozicija broda na elektroničkoj karti,
- instaliranog AIS-a ili univerzalnog AIS priključka,
- priključka za prijam informacija i komunikaciju s kopnom i okolnim brodovima,
- priključka za vanjski izvor napajanja,
- baterije za mogućnost rada bez vanjskog izvora napajanja.



Slika 2. Prikaz komponenata prijenosnog peljarskog računala

Peljar prijenosnim peljarskim računalom može ostvariti komunikaciju preko GSM, WAP, SMS, GPRS, AIS, INMARSAT-a.

Peljar povezujući svoje prijenosno računalo s AIS sustavom dobiva mogućnost praćenja okolnih objekata s instaliranim AIS sustavom na elektroničkoj karti, a osim toga u mogućnosti je dobivanja sljedećih informacija:

- CPA , TCPA
- međunarodni osobni broj broda IMO ID
- imena brodova
- o kursu, brzini odredištu, ETA
- o vrsti tereta.

Pored toga peljar je u mogućnosti da od nadležnih vlasti, bazne peljarske stanice iliVTS centra dobije sljedeće:

- informacije o vrijednostima trenutnih i narednih perioda visoke i niske vode,
- informacije o trenutnom smjeru i jačini morske struje,
- informacije o trenutnom smjeru i jačini vjetra,
- informacije o salinitetu,
- informacije oulazu i izlazu iz loka,
- informacije o poziciji i stanju na pristanu ili doku,
- informacije o očekivanom vremenu dolaska,
- informacije o gustoći prometa,
- obavijesti za pomorce,
- informacijeo navigacijskim opasnostima,
- poziv za pomoć,
- informacije o mjerama zaštite okoliša.

Pomoću prijenosnog peljarskog računala peljar je u mogućnosti predaje sljedećih informacija:

- ime broda,
- međunarodni osobni broj broda IMO ID,
- veličinu broda, kurs, brzinu, odredište, ETA,
- vrsti tereta,
- posebne informacije,
- ime peljara.

Peljar isto tako pomoću prijenosnog peljarskog računala može slati tekstualne poruke i to:

- određenom brodu,
- određenoj grupi brodova,
- svim brodovima u okolini,
- VTS centru.

3. BITNI ELEMENTI PRECIZNOSTI POZICIJE BRODA NA PRIJENOSNOM PELJARSKOM RAČUNALU

Prijenosno peljarsko računalo za dobivanje pozicije koristi GPS i DGPS signal. Preciznost pozicije dobivene preko GPS signala je unutar 15 m.

Preciznija pozicija može se dobiti ukoliko se koriste servisi koji upotpunjuju GPS podatke, a to su:

- Eurofix,
- EGNOS[1].

Jedna od mogućnosti dopune satelitskih navigacijskih sustava je kombiniranje sa zemaljskim navigacijskim sustavima, što omogućuje da se poboljša pouzdanost i dostupnost usluga pozicioniranja korisnicima.

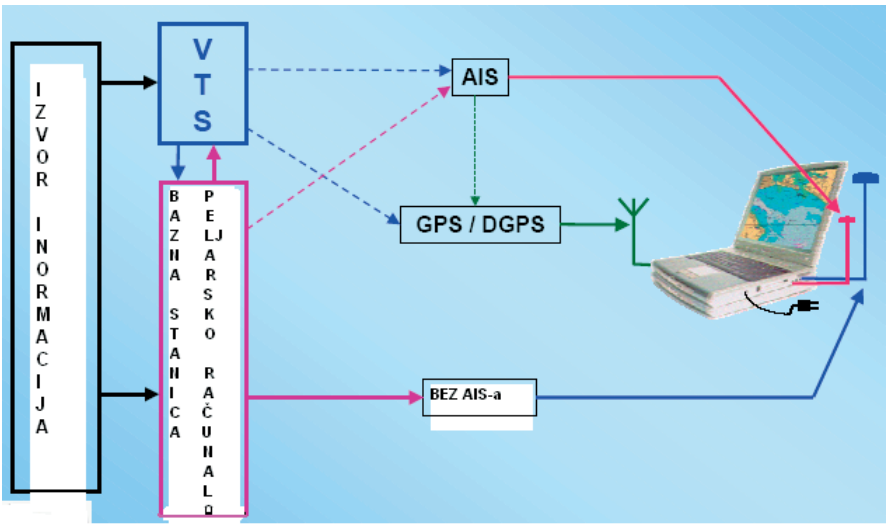
Eurofix kombinira zemaljski i satelitski navigacijski sustav tako da emitira diferencijske korekcije za GPS/GLONASS sustav koristeći se 100 kHz - valom nositeljem LORAN-C lanaca. Eurofix – prijamnik spojen na GPS/GLONASS-prijamnik dekodira signal diferencijske korekcije, čime omogućuje poboljšanu točnost pozicioniranja. Koristeći se postojećom infrastrukturom NELS[2] može se s DGPS-uslugom s vrlo velikom točnošću i pouzdanošću pokriti veliki dio europskog kontinenta.

Najveće poboljšanje pri integraciji Loran-C sustava i GPS-a može se postići Eurofix-signalom i istodobnom kontinuiranom kalibracijom pozicije Loran-C prijamnika s pomoću točnih DGPS pozicija. Kada GPS satelitski navigacijski signali nisu dostupni zbog zaklonjenosti satelita ili smetnji, kalibrirani Loran – prijamnik može dostatno precizno utvrđivati poziciju korisnika zbog vrlo dobre ponovljivosti određivanja pozicije Lorana-C sustava. To znatno poboljšava kontinuitet rada ovako integriranog navigacijskog sustava.

Preciznost pozicije broda i podataka dobivenih prijenosnim peljarskim računalom su sljedeće:

- Pozicija broda 1-2 cm
- Brzina kretanja broda 1 cm/sek. - (0,02 čvora)
- Brzina kretanja pramca/krme1 cm/sek. - (0,02 čvora)
- Pozicija po vertikali 2-3 cm
- Pramčanica 0,05°
- Vrijednost promjene kursa u periodu od jedne minute 0,1°.

1 *European Geostationary Navigation Overlay Service* – Europska geostacionarna navigacijska služba
2 *Norhwest European Loran – C System* – Europski sjeverozapadni Loran-C sustav



Slika 3. Prijenos informacija s obale prijenosnom peljarskom računalu

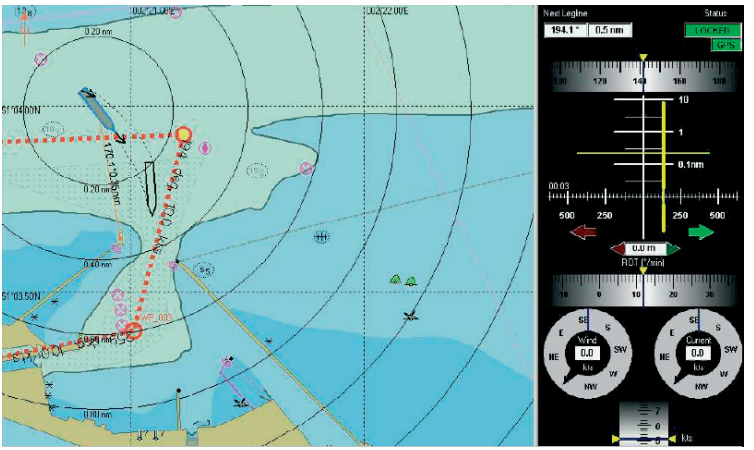
4. FUNKCIONALNI PRIKAZI PELJARSKOG RAČUNALA

Ovisno o području peljarenja, prijenosno peljarsko računalo daje peljaru mogućnost različitih odabira različitih prikaza na zaslonu sa različitim podacima.

Prijenosno peljarsko računalo pruža mogućnost provjere tendencije kretanja broda, dajući peljaru uvid u mogućnost eventualnog sudara ili nasukanja broda. Pravovremenim uvidom potencijalnog problema povećava se stupanj sigurnosti plovidbe, naročito u vrlo ograničenim plovnim područjima.

Tendencija kretanja broda prikazana je konturama trenutne i završne pozicije broda u određenom vremenu. Prilikom prikaza tendencije kretanja broda uzeti su u obzir:

- trenutni kurs broda
- brzina broda
- promjena kursa u vremenu od jedne minuta
- podaci o vjetru i struji, odnosno o vanjskim utjecajima koji djeluju na kretanje broda.

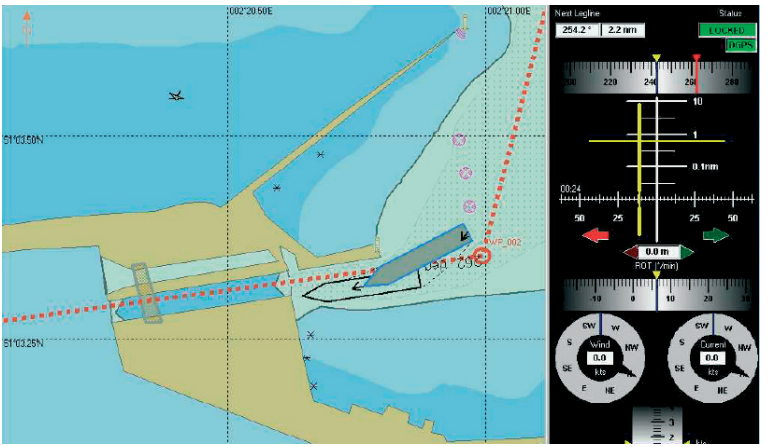


Slika 4.Prikaz tendencije kretanja broda na prijenosnom peljarskom računalu

Prijenosno peljarsko računalo ima mogućnost rada i u dok/priveznom modu pri čemu se za određivanje precizne udaljenosti od doka/pristana koriste instrumenti instalirani na obali.

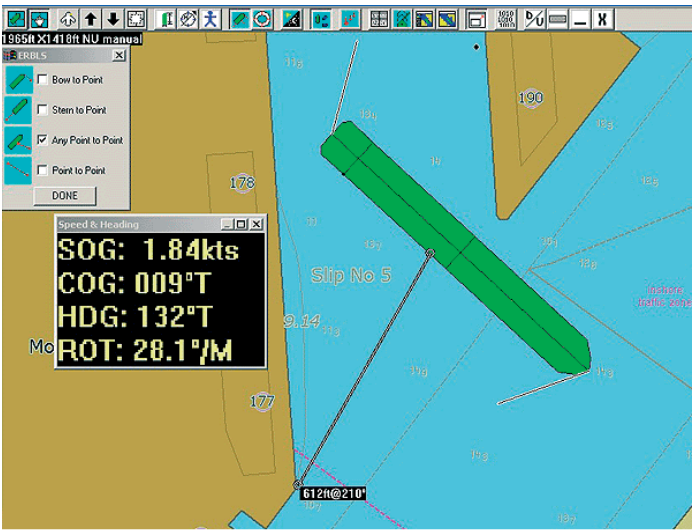
Instrumenti za određivanje precizne udaljenosti postavljeni na kopnu mogu biti:

- laserskog tipa
- radarskog tipa
- na principu Dopplerovog efekta.

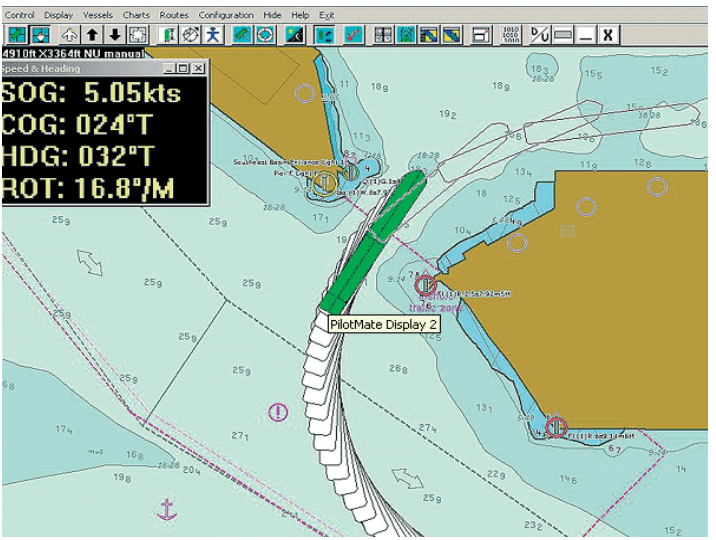


Slika 5. Prikaz peljarskog računala u dok modu

Sljedeća bitna značajka prijenosnog peljarskog računala je mogućnost pripreme i pohrane planova putovanja u skladu s IMO Rezolucijom A817(19) i IMO Rezolucija A893(21) kao i mogućnost pregleda i simulacije plana putovanja, uzimajući u obzir predviđene uvjete i karakteristike broda.



Slika 6. Prikaz očitavanja azimuta i udaljenosti



Slika 7. Prikaz kretnje broda

O važnosti peljarskih računala na sigurnost plovidbe ukazuje činjenica da su neke razvijene zemlje već opremile svoje peljare prijenosnim peljarskim računalima, a neke testiraju uporabu peljarskog računala. Tako se u određenim lukama Italije , Australijetestira uporaba prijenosnog peljarskog računala, a u Norveškoj i Nizozemskoj svi peljari su već opremljeni s peljarskim računalima.

Samo iskustvo i znanje peljara nije dovoljno za pravilan rad i sigurnu uporabu peljarskog računala, stoga je nužno prije uporabe prijenosnog peljarskog računala stručno osposobljavanje u ovlaštenim centrima pri MITAGS[3]-u.

5. ZAKLJUČAK

Sve veći broj brodova kao i sve veći, brži brodovi s većom količinom tereta, a manjim brojem članova posade iziskuju i kod peljara određenu prilagodbu novonastaloj situaciji. Uporaba peljarskog računala prilikom peljarenja pridonosi upravo toj prilagodbi. Sve veći promet u lukama i sve veća količina razmijenjenih informacija prilikom peljarenja iziskuje uporabu peljarskog računala koje pruža mogućnost primanja i praćenja svih relevantnih i manje relevantnih parametara za peljarenje na jednom zaslonu. Većinu podatka koje je peljar kod klasične metode peljarenja, radi nemogućnosti sveopćeg sagledavanja dobivao od članova posade pri grupnom radu na zapovjedničkom mostu, uporabom peljarskog računala, peljar može samostalno pratiti na zaslonu računala, što ga pritom čini, jednim dijelom, manje ovisnim o članovima posade na zapovjedničkom mostu. Prilikom razmjene podataka na zapovjedničkom mostu postoje opasnosti od pogrešaka u komunikaciji i lanaca pogrešaka koje se uporabom peljarskog računala reduciraju u određenoj mjeri. U skladu s raznolikom opremom na brodovima peljarsko računalo kao moderno navigacijsko pomagalo konstruirano je tako da se može povezati s navigacijskom opremom na brodu i očitavati podatke ili može djelovati samostalno bez povezivanja na brodske uređaje. Preciznost pozicije broda na zaslonu peljarskog računala zadovoljavajuća je tim više što se pruža i opciju povećanja preciznosti pozicije broda uporabom različitih sustava ovisno o području peljarenja. Bitna značajka prijenosnog peljarskog računala je i ta što pruža različite mogućnosti komunikacije s ostalim sudionicima u pomorskom prometu. Peljaru će zasigurno biti lakše obavljati peljarenje brodom uz uporabu prijenosnog peljarskog računala koje svakodnevno koristi i koje mu pruža bolji uvid u relevantne parametre za peljarenje brodom, nego pri klasičnoj metodi peljarenja brodom. Sama uporaba peljarskog računala prilikom peljarenja nije dovoljna za povećanje sigurnosti plovidbe, već je isto tako nužno i stručno osposobljavanje za rad na peljarskom računalu. Stručno usavršavanje peljara u ovlaštenim centrima i opremanje peljara određenog područja peljarskim računalima garancija su povećanja sigurnosti plovidbe i zaštita morskog okoliša na tom području. Praćenje, primjena modernih tehnologija i ulaganja u prijenosna peljarska računala kao i osposobljavanje peljara za rad na peljarskim računalima za svaku su pohvalu vladama zemalja koje su promptno reagirale i tako doprinijele povećanju sigurnosti plovidbe i zaštiti morskog okoliša u svojim zemljama.

3 *Maritime Institute of Technology and Graduate Study* – Pomorski institut tehnologije i poslijediplomskih studija

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STRUCTURAL ANALYSIS OF THE PORTABLE PILOT UNIT

SUMMARY

The transport of hazardous cargoes by large ships, evident marine accidents as well as damages caused by these accidents, require the ship to navigate in a much better and safe way. The application of new technologies reduces the probability of accidents, stirring controversies over the efficiency of shipandpilotage control.

The function of pilots is very important for the safety of navigation. The development of new technologies offers a new possibility for pilots – piloting with a portable pilot unit.Portable pilot unitsgive to pilots the possibility to follow relevant piloting data on a screen (monitor) and to communicate with other subjects engaged in maritime traffic,.thus increasing the exactrness, the level of control and the speed of transmitting information and most of all the safety of navigation.

Key words: *pilots,portable pilot unit, pilotage*

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NEW NAVIGATION COMPETENCIES REQUIRED FOR AN UPDATED STCW CONVENTION

IMO started to request uniform international standards for the seafarers in the early 80ties. After fifteen years a revision of the STCW78 Convention was already needed, and an improved STCW 95 Convention was adopted. In the last ten years, the ship bridge change rapidly, a lot of new technologies have been implemented with a declared objective to increase safety of navigation. We think that it is time to update some of the STCW95 requirements regarding competencies regarding navigation at operational and management level and also some of the provisions related to the implementation of the Convention at national level. Our paper intends to underline some of these aspects that in our opinion must be revised and/or supplemented, including enforcement for theoretical training in maritime education institution and extended use of simulators in the training process. We will also state our opinion related to the necessity of cancelling some IMO courses from the compulsory list and make proposals for another IMO courses that had to became essential.

Key words: *STCW, revision, navigation, simulation, training*

1. INTRODUCTION

In the STCW95 the simulator is mentioned in different parts and connections can be drawn to a great number of functions which can be performed in simulation. Within the STCW95 the following parts have to be taken into consideration regarding training and assessment based on simulation:

- In CHAPTER I, Regulation I/6 - Training and assessment, Regulation I/8 - Quality standards, Regulation I/12 - Use of Simulators
- In Part A, Section A-I/6 - Training and assessment, Section A-I/8 - Quality standards, Section A-I/12 - Standards governing the use of simulators
- In Part B, Section B-I/6 - Guidance regarding training and assessment, Qualifications of instructors and assessors, Section B-I/8 - Guidance regarding quality standards,

Section B-I/12 - Guidance regarding the use of simulators

- In CHAPTER II, Reg. II, Section A-II/1 - 4, Reg. III, Section A-III/1 – 4.

In the STCW95 Convention, details regarding the simulators requirements and training objectives were detailed only for radar simulators, these provisions could be considered as the kick-off of the world scale training based on simulation in the maritime education and training (MET).

From the beginning of the 90ties, simulator manufacturers used computer technology on a large scale in order to create virtual navigation equipment and ship handling controls. The main reason for this policy was the reduction of the price for the simulator systems and an easier way to reproduce all the parameters of the ships equipment using full dedicated software. A combination of real equipment and virtual equipment remained an option for the buyer, but the actual trend is a limitation of the real equipment to the steering console and auxiliary panels. This trend is also justified by the new generation of real ships with integrated bridge systems (IBS), where PCs, trackballs, keyboards and monitors replaced many of the traditional knob and push button panels.

Because the number of ships using IBS is still limited, there are many voices among students, deck officers and even instructors, who believe that a good bridge simulator must be a close copy of a traditional merchant ship bridge.

Today, from the manufacturer's point of view, a radar simulator is the cheapest version of a full mission bridge simulator, because, technically speaking, the major difference between these two simulators consists in the visualization system. In other words, a radar simulator with a visualization and projection system could be converted in a full bridge simulator, because the software that generates all the other main tasks is the same. Another important difference between these simulators consists in the complexity of the mathematical model used to generate the ship motion. Most manufacturers offer radar simulators with a 3 degree of freedom (DOF) mathematical model for ships. Ships with a 6 DOF is a compulsory requirement only for Class A FMBS, in order to meet the IMO requirements for the Bridge Team Management Course (DNV, 2000).

The new generation of visual software engine and hardware project the visual scene on a cylindrical screen, where the movement of the image is smoother than on a sided screen. More visual effects have been added (waves whitecaps, sun or moon reflection on the water, stars, different types of clouds, etc.). Another important achievement of the 3D software is the visual generation of the ship movement. This feature contributed to the reduction of the necessary space for simulator installation and offered a much cheaper alternative to the moving platforms.

Realism of the visual scene and realistic ship handling behavior in different environmental conditions are the key aspects for a good FMBS and these requirements are fulfilled by the main simulator manufacturers. These characteristics could be very well assessed by harbor pilots, deck officers and masters that perform voyages on similar ships in the same maritime areas being simulated. Their positive opinions would be the most valuable quality certificate for the ship handling simulator being evaluated.

2. WHAT CAN THE NEW GENERATION OF NAVIGATION SIMULATORS DO?

To answer this question we have to compare the STCW 95 training and professional skill requirements with the objectives and tasks posed to the trainee by a FMBS scenario.

There are at least 140 tasks at operational level and 160 tasks at managerial level that could be taught and assessed using a FMBS class A. These tasks start from the basic navigation and deck watch procedures, include voyage planning and ship maneuvering in confined waters, and end with the communication procedures, use of maritime English, SAR and emergency navigation. As a result it will be easier to discuss *which training task could not be achieved and which competencies could not be demonstrated using a FMBS*.

In accordance with the STCW, examination and assessment of competence for masters, chief mates and officers, regarding navigation at operational and management level (tables AII/1 and AII/2), is based on evidence obtained from one or more of the following:

- approved in-service experience
- approved training ship experience
- approved simulator training, where appropriate
- approved laboratory equipment training.

From the STCW navigation competences category, the following tasks cannot be theoretically carried out using only the capabilities of most FMBS:

1. celestial navigation
2. proper keeping of different kinds of log in port
3. starting of the gyro-compass and the minimization of settling time
4. forecast weather and oceanographic conditions
5. use of an anchor to dredge down with a current.
6. assessment of damage and post- event actions in case of navigational emergencies
7. use of the emergency steering
8. take on board survivors from rescue boats and survival craft
9. general operation techniques of marine power plants.

Of course, other competences imposed by the STCW cannot be achieved by the cadets without a sea service period. These training objectives strictly related to the on board training were included in the following STCW competence categories:

- Monitor the loading, stowage, securing and unloading of cargoes and their care during the voyage
- Ensure compliance with pollution prevention requirements
- Maintain seaworthiness of the ship
- Prevent, control and fight fires on board
- Operate life-saving appliances

One the other hand, most of the training aims from the above list are covered by the mandatory IMO courses that each cadet had to accomplish before he could enlist for the 3rd deck officer certification exam.

Another aspect that has the same importance as the FMBS technical capabilities is the quality and realism of the simulation scenario. You could have the most expensive and up to date simulator on the market, but without well-designed simulation scenarios, the training aims will not be achieved at the desired level of performance.

We must emphasize that in this paper we are discussing the training of students and cadets using the navigation simulators. There is a great difference in terms of design and preparation between a scenario arranged for students and a scenario that must be accomplished by already certified deck officers.

We practice the first contact of the students with the FMBS in the second semester of the second year of study (in accordance with our curricula), after they have finished all the theoretical courses related to seamanship, coastal navigation and piloting, basic navigation equipment, and had a minimal knowledge of the navigation watch procedures.

What can be done in FMBS with so little theoretical knowledge?

The most important thing is familiarization with the real time navigation process. Additionally:

- hand steering of the ship on an imposed track;
- visual identification of navigation landmarks and floating navigation aids;
- taking visual bearings;
- reading gyro, compass, soundings, wind, current data;
- feeling different type of ships behavior on various weather conditions ;
- familiarization with distance perception at sea and day and night conditions;
- are also very important tasks and skills that could be achieved at that beginning stage.

After that, in the third and fourth year of study, all the other objectives and tasks could be performed on the simulator: radar and electronic navigation, passage planning, ship maneuvering, radio communications, bridge procedures, watch team management, etc.

The realism of a scenario is also very important in training students with no previous sea going experience, even considering that they do not have yet a clear scale for comparing the virtual environment with the real one. We could count at least four reasons in support of this statement:

1. Skills and competences achieved during simulator exercises will be more accurate if the simulation environment is realistic.
2. Once on board a ship the student will be more confident in his actions realizing the similarity between the virtual and the real maritime environment.
3. If the student has a chance to be on board a ship that has similar characteristics as one of the simulated models, or if he will pass through a maritime area that was used as simulation area, he will perform his duties very well, based on the déjà-vu feeling.
4. After a sea service period the student/cadet will better appreciate the importance of simulator training and once back in school or training center, he will be more focused and involved in resolving the tasks imposed by the simulation scenarios.

We think that we have the consent of most FMBS instructors, when, in conclusion, we state that based on the new generation of full mission simulators capabilities, we can perform almost all tasks required by the STCW in the navigation competencies chapter for operational level (Barsan E. 2006b).

3. SIMULATION, THE BEST WAY TO CREATE NAVIGATIONAL SKILLS TO CADETS

As we all know, STCW 95 introduced a compulsory 12-month seagoing service for every candidate for certification as deck watch officer (operational level). At least six months of this period the cadet must perform bridge watchkeeping duties under the supervision of a qualified bridge watchkeeping officer (IMO, 1995). The cadet's achievements during onboard training programs must be documented in an approved training record book.

There were two areas where maritime administrations rushed to implement ad-literam the new STCW requirements: seagoing service periods and IMO compulsory courses. From the national Maritime Authorities' point of view these were the easiest task to accomplished, because they do not require manpower or logistic efforts from the Authority.

This one-year sea service period for cadets raised a lot of logistic problems for maritime universities. The first one was a substantial reorganization of curricula, in order to allocate time for on board training. The second main logistic problem lies in finding owners and ships for almost 200-300 cadets each year. This problem is amplified by the lack of national flag ships and in many cases by the non-implication of the national Authority for providing help and support for solving this problem.

More than that, the students lose the contact with the university for several months, and they have major difficulties to re-enter in the teaching programme.

From our 12-year experience, we identified only 7-9 large shipowners that had a coherent onboard training programme with a serious involvement of the cadets in training activities.

In conclusion, after the 12- month sea training period, we assessed great differences between the cadets regarding the competences and professional skills achieved.

In a study undertaken by Warsash Maritime Centre (Habberley et al., 2001) regarding the use of simulators for training in emergency situations, the authors run a questionnaire among various shipping companies, shipping organizations and maritime education institution, regarding different aspects of training using full mission ship simulators. One of the questions was related to the preferred method of training of deck officers for routine watchkeeping situations, that reveals some differences between the opinions of maritime education institutions and the shipping industry.

The shipping companies prefer the onboard training associated with the sea service experience. The maritime training institutions consider FMBS as the primary tool for routine training of deck officers. It is also interesting that:

- apparently, the shipping industry has more confidence in video training tapes than in simulator training;
- maritime education institutions consider lectures and text books less suitable as methods of training, but these methods are suitable for the shipping industry.

In our opinion, the answers given by the maritime training institutions are in accordance with the actual trends in MET and reflect the increasing confidence in simulation and simulator as tools for an efficient training. I think that the opinions expressed by the shipping companies reflect their predisposition to minimize the cost of training. Otherwise we could not explain why an owner could consider that lectures are almost equal in efficiency to FMBS training,

regarding the achievement of practical watchkeeping skills. This assumption is also based on the answers given by the shipping industry to the question regarding the preferred means for training in bridge team management. On this subject, maritime education institutions and the shipping industry share the same opinion concerning onboard and simulator training as methods for working out bridge team management procedures. Because the Bridge Team Management IMO model course became compulsory for deck officers at management level, the shipping companies had to pay for the training of their staff. The IMO standard for this course implies the use of a full mission simulator. The paradox is that at least 60% of this course deals with routine situations, so when you have no alternative for a cheaper training, everyone agrees that simulation is the best way to do it.

With the new generation of FMBS, purchasing and training cost has decreased considerably. On the other hand, the new technical capabilities have increased the flexibility of scenario design allowing the creation of a better tailored scenario for all kind of navigational tasks and teaching objectives.

What is the main role of a cadet during watch hours? He is mostly an observer of what, when and how things happen on the bridge deck.

Has the cadet full access to the radar? In at least 70% of the cases, the answer is no. In most of the situations he could use the radar for:

- measuring bearings and distances in order to determine the ship fix;
- measuring bearings and distances to a target ship;
- plotting target ships on an ARPA.

The cadet is not allowed to:

- change without permission the radar motion or radar display stabilization configuration;
- set up his own Parallel Index or NAVLINES;
- make adjustments to the Gain, Rain and Sea clutter controls;
- use the TRIAL function in order to simulate collision avoidance maneuvers;
- approach the radar when the Master and/or the Pilot are on the bridge.

Has the Cadet the opportunity to make his own collision maneuvers? He has not.

Has the Cadet the opportunity to steer the ship in open waters? In most of the cases, yes.

Has the Cadet the opportunity to steer the ship in confined waters? No.

Has the Cadet the chance to start and setup the electronic navigation equipment? We do not think so.

How many ship's fixes will be determined by the cadet during the watch? Maybe 6 to 8 fixes, if the officer in charge is very focused on the Cadet training.

Has the Cadet access to the VHF radiotelephone? No.

If we are realistic, we could find another page of arguments to demonstrate that the Cadet's role on board a merchant ship is mainly as an observer.

And now the great question. *Can the Cadet perform, by himself, all the watchkeeping tasks and actions of a Third Deck Officer, during a FMBS scenario?* Of course he can and all his actions will be monitored, assessed and rectified by the teacher/instructor. In the above mentioned paragraphs we talked only about routine navigation. Regarding the training for navigation emergency situations there is no doubt that it can be performed using only a

simulated environment (J S Habberley, et al., 2001).

Without any reliable statistical evidence we could only make the following logical assumptions concerning the on board training period:

- in 80% of the cases, a cadet did not spend more than 200 days on the bridge, performing watchkeeping duties;
- because cadets will be embarked on all types of merchant ships, we could consider that from the above mentioned 200 days, only 70% of this period (140 days) could be considered as near coastal voyages;
- a near coastal voyage implies also port arrival and port operations. As a result, a 15% ratio of time spent in ports (21 days) could be applied. Lets also assume that on these near coastal voyages, 40% of the transit time is represented by passing maritime areas with high traffic, confined waters, dangers for navigation, high risk areas;

In conclusion, in a 12-month compulsory sea time period, the cadet carries on watchkeeping duties for 200 days. The ship in this period will perform 140 days of near coastal voyages, including 21 days of port operations. From the remaining 116 days, 47 days will be considered as ship passages through areas dangerous for navigation, meaning that during the 1-year on board training, only 12.8% of that time will be spend by the cadet in a really challenging environment (Barsan E.,2006a),.

In contrast with the real opportunities offered by ship's voyages, all the FMBS scenarios are designed for near coastal navigation and most of the simulated areas are maritime areas difficult for navigation.

The necessity of simulators and simulations as complement of the on board training is also recognized by the big shipping companies. Many of them had different CBT (Computer Based Training) programs implemented on their onboard PCs.

4. PROPOSED UPDATES AND MODIFICATION TO THE EXISTING STCW95 PROVISIONS

In the first place we consider that the new STCW must deliberately encourage training of seafarers and especially of maritime officers in maritime education and training (MET) institutions, certified by the national maritime authorities and periodically assessed by international commissions.

More than that, for the training of maritime officers, the STCW Convention must specify a minimum number of training hours (courses and practical applications) for each main category of competences, at least at operational level. In the actual form, STCW95 encourage the vocational path for officers giving the impression that all the competences could be achieved only by onboard practice and the 8-10 compulsory IMO courses. IMO maintained all these years the IMO courses no.7.01-7.04 containing programs of maritime education and training (MET) for deck and engineers officers at operational and managerial level, but the last edition is the 1999 one, and requires a lot of updates taking into account the evolution of technologies in maritime transport in the last 5 years.

We have also to underline, that IMO did not mentioned that the content of these

courses (7.01-7.04) represents a minimum standard of training as imposed by the STCW95 Convention, so only MET universities adjusted their curricula in order to meet the courses and number of hours recommended by this courses. Because these IMO courses already exist, we think that after a major revision and update of their content, they could be declared as a minimum standard of training for maritime officers. Such documents will also help very much the national maritime authorities in their tasks to standardize the quality of national MET system and to establish the content of the certification exams for their seafarers. Because we are in the 21st century and maritime navigation had evolved and changed very much in the last 10 years from the point of view of acquiring and managing nautical information, an academic level of education for all maritime officers will be a benefit for the maritime world.

A method of signaling that IMO encourages academic training for maritime officers will be the change of order for the achieving methods of the required competences mentioned in column 3 of tables A-II/1, A-II/2, A-II/3 and A-III/1, A-III/2, A-III/3. In STCW95 order of these methods is:

.1 approved in-service experience
.2 approved training ship experience
.3 approved simulator training, where appropriate
.4 approved laboratory equipment training

From our point of view, the new order, at least for the operational level, must be more likely as:

.1 approved course including laboratory equipment training
.2 approved course including use of simulator training (where appropriate)
.3 approved training ship experience
.4 approved in-service experience

This order will clearly suggest that the basis of knowledge for a maritime officer must be created in a MET institution.

In the context of the 21st century and of the abundance of electronic navigation equipment, IMO, using the STCW regulations, must give a clear signal regarding reduction of theoretical knowledge in celestial navigation. Such a message will provide guidance for national maritime authorities in establishing assessment requirements for the certification exams. MET institutions could not take the first step in reducing the hours allotted to the celestial navigation course, because the national maritime authorities are afraid to eliminate from the certification examination the subjects involving deep theoretical knowledge of nautical astronomy. As a MET university, we suggest that the celestial navigation knowledge must be focused on measuring LOP to celestial bodies in order to determine the ship position and compass correction. For the calculation, scientific pocket calculators and even PC software must be accepted as practical means to get the results.

Regarding the IMO model course no.TA107 “Radar Navigation, Plotting and ARPA”, we believe that it is no longer needed as compulsory for deck officers. The history of this course, as a compulsory one, started more then 20 years ago, when the radar plotting techniques were not taught in all maritime schools and when the ARPA radar onboard ships was very rare.

If you remember, 10 years ago, these subjects were divided in two IMO model courses: "Radar plotting" and "Use of ARPA radar", each course lasting for almost two weeks, with a combined number of 88 hours. Nowadays, there is only one course, with a total of 66 hours.

Today, radar plotting, radar navigation, use of ARPA information is a standard compulsory course in every MET institution curricula. This course in the MET curricula has a great extend, much more than the requirements of an actual edition of the IMO model course and includes practical hours that are performed by using radar or full mission simulators. Maintaining the IMO model course no.TA107 "Radar Navigation, Plotting and ARPA" as a compulsory one, could be dangerous, because it can induce the idea that 66 hours are enough for a student/cadet to achieve all the competencies related to the operational use of the radar and ARPA mentioned in Table AI/II.

On the other hand, ARPA radars are a common presence on the ships' bridge, and deck officers are working day by day with this type of equipment. In these circumstances, such a refreshment course with no updates for more then 10 years is useless.

Speaking about radar navigation training and use of simulators for enhancing the theory for radar plotting and the use of ARPA information, we have to mention that in STCW95, the accent was on the qualification requirements for simulator instructors and evaluators.

It is also the time to add in the STCW convention that radar training must (not should) incorporate the use of the radar simulation equipment. It will be also the time to go further on regarding the use of maritime simulation and to include it in the STCW provisions stating that training and assessment in coastal navigation, electronic navigation, including the use of ECDIS and ship handling should incorporate the use of navigation and ship handling simulators.

Continuing the subject related to IMO courses and the use of simulators, we have to mention that the format of the IMO model course TA122 "Ship Simulators and Bridge Teamwork", edition 2002, must be revised and updated, including the title, because today, all courses related to bridge team management or bridge resources management include simulation scenarios and the use of navigation and ship handling simulators.

We think that this course will also have to provide some guidance on the creation of complex navigation and ship piloting scenarios and to provide also some guidance for evaluation methods and scales to be applied for the assessment of the trainees' performances. With such a kind of updates, this course could became a very useful tool for all the simulator instructors all over the world, because it will help the implementation of a common standard for evaluating simulated scenarios achievements.

In the above paragraphs we stated that the IMO model course TA107 "Radar Navigation, Plotting and ARPA" is no longer useful as compulsory. Taking into account the technological realities existing on the bridges of new ships and the expansion of these technologies onboard all other ships, we propose that an IMO model course 1.27 "Operational use of ECDIS" to became compulsory for the next 5-7 years. The STCW have to emphasis the need of training for deck officers in the use of ECDIS at operational and managerial level, because the ECDIS is, for the moment, the most sophisticated and complicated navigational equipment and the graphical display acts as an integrator of information from other very important navigational equipment (ARPA, AIS, etc.). More than that, errors or malfunctions to this equipment could be very hard to detect and solve without appropriate training.

5. CONCLUSIONS

We think that at the beginning of the 21st century, IMO will have to admit the importance of training done in MET academic institutions and the achievements of training in the simulated maritime environment. Consequently, an updated STCW Convention has to specify a minimum number of hours for theoretically training that must be performed in MET certified institutions.

An intensive use of radar, navigation and ship handling simulators (to use the same classification of simulators as in STCW95) must be also requested in the new STCW. Complexity of scenarios that could be performed on navigation and ship handling simulators must be recognized and for the deck cadets two out of the 12 months of compulsory seagoing service period can be an equivalent with the approved simulated training hours on a Full Mission Bridge Simulator, using a 1 to 6 ratio.

The IMO model course no.TA107 "Radar Navigation, Plotting and ARPA" must be cancelled from the compulsory IMO courses for deck officers and all the competencies regarding radar navigation, radar plotting and the use of ARPA radars shall be gained during the basic educational stages in MET institutions. The use of radar simulation during lab hours for these courses must be compulsory.

The IMO course "Operational use of ECDIS" must be declared as compulsory for deck officers.

The use of navigation and ship handling simulators for the training of students and cadets must be stipulated by the STCW for all the competencies related to navigation, watchkeeping and shiphandling.

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NOVA OVLAŠTENJA O OSPOSOBLJENOSTI ZA OBAVLJANJE DUŽNOSTI ČASNIKA PALUBE POTREBNA PORADI AŽURIRANJA STCW KONVENCIJE

SAŽETAK

IMO je početkom 1980. godine zatražio jedinstvene međunarodne standarde za osposobljenost pomoraca. Nakon 15 godina bilo je potrebno revidirati STCW konvenciju iz 1978. godine, pa je 1995. godine usvojena nova STCW konvencija. U posljednjih 15 godina zapovjednički je most na brodu doživio promjene, došlo je do primjene novih tehnologija s ciljem da se poveća sigurnost plovidbe. Mislimo da je sada došlo vrijeme da se revidiraju i neki od zahtjeva STCW konvencije iz 1995. godine, a koji se odnose na osposobljenost za obavljanje poslova na razini rukovanja uređajima i upravljanja, kao i neke odredbe koje se odnose na provedbu Konvencije na nacionalnoj razini. U našem se radu želi istaknuti neke od značajki koje se, po našem mišljenju, moraju revidirati i/ili nadopuniti, uključujući tu i provođenje teoretskog obrazovanja u pomorsko-obrazovnim institucijama te veće korištenje simulatora u procesu izobrazbe. Navodi se i naše mišljenje o nužnosti ukidanja nekih od IMO tečajeva s popisa obvezatnih, kao i prijedlozi drugih IMO tečajeva koji bi morali postati bitnima.

Ključne riječi: *STCW, revizija, plovidba, simulacija, izobrazba*

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KOOPERACIJE MEĐU BRODARIMA

U radu se obrazlažu potrebe za velikim kapitalnim ulaganjima u pokretanje linijskog kontejnerskog servisa. Jedan od mogućih načina smanjivanja troškova kontejnerskog linijskog servisa, a da se pritom kvalitetom i vozarinama odgovori na zahtjeve krcatelja je ulazak brodara u razne vrste kooperacija. Obrazlaže se integracijski razvoj kooperacija kroz zemljopisni djelokrug, opseg sredstava kooperacije, tipove kooperacija i moguće trajanje. Detaljno se navode različiti tipovi ugovora o kooperaciji, te se opisuju sinergijski efekti koji se ostvaruju putem kooperacija. Tabelarno se prikazuju današnje najveće globalne kooperacije među brodarima, kao i izračun cijene slota.

Ključne riječi: *kontejnerizacija, brodari, kooperacija, slot, linijski servis*

UVOD

Kontejnerizacija je snažno djelovala na promjene u tehnologiji, ekonomiji i organizaciji pomorskih linijskih prijevoza. Gledajući zasebno te promjene, ukratko se može reći da u tehnološkom smislu to znači gradnju posve novih tipova brodova, a time i novih sredstava za prekrcaj i manipulaciju kontejnerima na novim kontejnerskim lučkim i kopnenim terminalima. U ekonomskom smislu to znači znatno veća kapitalna ulaganja u brodove, terminale, kontejnersku opremu i sredstva za manipulaciju, kao i u sredstva kopnenog i riječnog prijevoza kontejnera, a u organizacijskom smislu to znači potrebu usklađivanja interesa svih sudionika u logističkom sustavu prijevoza kontejnera *od vrata do vrata (door to door).*

S jedne strane potreba za ogromnim ulaganjima u kompletno novu tehnologiju, a s druge strane stalni zahtjevi krcatelja da imaju učestale, brze i jeftine linijske servise te također iznalaženje mogućnosti za smanjenje troškova poslovanja, primorala je brodare na razne vidove međusobne kooperacije.

1. RAZLOZI ULASKA BRODARA U KOOPERACIJE

1.1. Velika kapitalna ulaganja

Koliko su velika kapitalna ulaganja u jedan kontejnerski linijski servis s tjednom frekvencijom na pravcu Sjeverna Europa – Daleki istok može se vidjeti iz sljedećeg primjera (podaci vrijede za 1997. godinu) [1]:

		USD
Brodovi:	9 brodova x 4000 TEUa po cijeni USD 70 mil.	630 mil.
Kontejneri:	54.000 standardnih kontejnera po cijeni USD 2.000	108 mil.
Kontejneri:	6.000 frigo kontejnera po cijeni USD 28.000	168 mil.
Ukupno kapitalna ulaganja:		906 mil.

Kada se na gornje ulaganje pribroje i drugi neizostavni troškovi „kopnene organizacije“, onda je posve jasno da ovakvo ulaganje teško može podnijeti samo jedan brodar i da su kooperacije među brodarima nužnost.

Od kada je *Sea Land* započeo svoj prvi kontejnerski linijski servis preko Atlantika 1966. godine, a *Matson* godinu dana kasnije preko Pacifika, bilo je očito da razvoj kontejnerizacije zahtijeva ogromna kapitalna ulaganja te napuštanje tradicionalnog poimanja brodarstva. Brodari su se počeli udruživati sa svojim konkurentima kako bi zajednički dijelili resurse i djelatnost proširili na kompletnu prijevoznu uslugu *od vrata do vrata*. Već 1966. kompaniju *Atlantic Container Line* zajednički osnivaju: *Cunard Line*, *CGM, Holand America*, *Swedish America Line, Transatlantic Steamship* i *Wallenius Lines* s ciljem kontejnerizacije linijskog servisa između Sjeverne Europe i Sjeverne Amerike i namjenske gradnje brodova za taj servis.

Slična nastojanja događala su se i na pravcu Sjeverna Europa – Daleki istok i Australija *(OCL, Ben Line, Blue Star Line, Cunard, Elerman Lines* i *T&J Harrison*) s ciljem kontejnerizacije toga pravca, usklađivanja zajedničkog djelovanja i dijeljenja resursa [2].

Kooperacije među brodarima s obzirom na broj partnera i zemljopisni djelokrug mogu se podijeliti u tri vrste:

- kooperacije na globalnoj razini (svi pomorski pravci) samo između 2 brodara (npr. *Maersk* i *Sea Land* u razdoblju prije spajanja)
- kooperacije na globalnoj razini (svi pomorski pravci) između više brodara (npr. *Grand Allianc* i dr.)
- kooperacije jednog brodara s više različitih brodara na različitim linijskim servisima (tzv. „webs of slot exchanges“, odnosno mreža različitih kooperacija) [3].

Sredinom 1990-tih osnivaju se nove globalne kooperacije (tzv. alijanse) pod imenima: *Global Alliance*, *Grand Alliance* i *Hanjin & Trident Group* (*Cosco*, *K Line, Yangming).* Tijekom godina mijenjali su se članovi – brodari kao i nazivi kooperacija.

Iz tablice 1. može se uočiti veličina globalnih kooperacija između više brodara: koliko tjednih servisa zajednički pružaju, koliko brodova udružuju i s kolikim kontejnerskim kapacitetima raspolažu (podaci za 2006. godinu).

Tablica 1. Prikaz najvećih globalnih kooperacija

CHKY Alliance				
Članovi alijanse: Coscon, Hanjin / Senator, K Line, Yang Ming				
Područje servisa	tjedni broj servisa	broj brodova	ukupni TEU kapacitet	prosječan broj TEU po brodu
Transpacific (USWC & EC)	18	101	468.000	4.600
Europe / Med - Far East	13	101	478.000	4.700
Transatlantic	2	8	19.000	2.350
Total	33	210	965.000	4.600
GRAND Alliance				
Članovi alijanse: Hapag Lloyd, MISC, NYK, OOCL				
Područje servisa	tjedni broj servisa	broj brodova	ukupni TEU kapacitet	prosječan broj TEU po brodu
Transpacific (USWC & EC)	11	65	326.000	5.000
Europe / Med - Far East	5	41	271.000	6.600
Transatlantic	5	27	108.000	4.000
Total	21	133	705.000	5.300
NEW WORLD Alliance				
Članovi alijanse: APL, Hyunday, MOL				
Područje servisa	tjedni broj servisa	broj brodova	ukupni TEU kapacitet	prosječan broj TEU po brodu
Transpacific (USWC & EC)	11	58	281.000	4.800
Europe / Med - Far East	4	31	181.000	5.900
Transatlantic	1	5	21.000	4.200
Total	16	94	483.000	5.200

Izvor: DynaLiners Trades Review, Dynamar B.V., Alkmaar, 2007., str. 8

1.2. Zahtjevi krcatelja

Veliki krcatelji koji kontroliraju najveće količine tereta, multinacionalne kompanije koje imaju razgranatu proizvodnju u više različitih država, a također i NVOCC-i (*Non Vessel Operating Common Carriers*, npr. *Kuhne & Nagel* ostvario je u 2006. godini promet od 2.300.000 TEU-a, *DHL* promet od 1.650.000 TEU-a, *Panalpina* promet od 1.250.000 TEU-a, *Schenker* promet od 1.200.000 TEU-a itd.) [4], djeluju globalno, tj. kontroliraju

terete za sva svjetska prekomorska tržišta i prvenstveno žele poslovati s brodarima koji su u mogućnosti ponuditi globalne kontejnerske linijske servise.

To je i rezultiralo time da su danas najveći kontejnerski brodari postali *global carriers-i* (u praksi to znači da imaju razgranate linijske servise na najznačajnijim pomorskim *East – West* pravcima/tržištima: Sjeverna Europa – istočna obala Sjeverne Amerike, Azija – zapadna obala Sjeverne Amerike i Europa – Daleki istok, te *North – South* pravcima/tržištima: Sjeverna Europa – Južna Amerika, Sjeverna Amerika – Južna Amerika, Azija – Australija) i da mogu ponuditi tzv. *worldwide* prijevoznu uslugu).

Ostali zahtjevi krcatelja koji se postavljaju pred brodare su [5]:

- tjedna frekvencija linijskih servisa s fiksnim danom ticanja u pojedinoj luci,
- raspoloživost kontejnerske opreme na lučkim terminalima i kopnenim depoima,
- razvijen informatički sustav na način da se u svakom trenutku zna pozicija kontejnera i budući *routing* do krajnjeg odredišta,
- mogućnost pružanja *door to door* prijevozne usluge,
- brzi *transit time*.

1.3. Veliki operativni troškovi

Osim velikih kapitalnih ulaganja, brodari su opterećeni i velikim operativnim troškovima koji su u konvencionalnom brodarstvu bili nepoznati. Naime, osim brodova osnovna sredstva brodara su i pripadajući setovi kontejnera koji se nalaze na različitim lokacijama (izvan luka) i u različitim statusima.

Jedna od većih troškovnih stavki u poslovanju kontejnerskih brodara su troškovi repozicioniranja praznih kontejnera.

Opće je poznato da su prekomorska tržišta u različitim regijama (kontinentima) u imbalansu. To znači da je, na primjer, tržište na kraju jednog servisa (A) pretežno izvozno, a manje uvozno. Tržište na drugom kraju servisa (B) u obrnutoj je situaciji, tj. više uvozno, a manje izvozno. U tom slučaju brodar je u situaciji da mora repozicionirati prazne kontejnere što predstavlja čisti trošak. Međutim, postoji i imbalans po tipu kontejnerske opreme, kao izravna posljedica poznata pod nazivom *cargo mix,* npr. izvoz iz Europe u Aziju uglavnom predstavljaju sirovine i razni teški tereti koji se krcaju u 20` kontejnerima, dok je izvoz iz Azije u pretežno gotovim proizvodima koji su lakši i voluminozniji te se uglavnom krcaju u 40` kontejnerima.

2. INTEGRACIJSKI RAZVOJ KOOPERACIJA

Integracijski razvoj kooperacija među brodarima možemo razvrstati prema zemljopisnom području (broju linijskih servisa) koje obuhvaćaju, prema djelokrugu s obzirom na sredstva koja obuhvaćaju te prema tipu kooperacije i trajanju [6]:

Zemljopisni djelokrug kooperacije:
- 1 linijski servis
- 1 linijski servis i feederi
- više linijskih servisa i feederi
- globalna kooperacija.

Djelokrug kooperacija s obzirom na sredstva:
- brodovi
- brodovi i terminali
- brodovi, terminali, kontejnerska oprema, kopneni depoi/terminali
- sva osnovna sredstva, kopnena organizacija i zajednički uredi
- sva osnovna sredstva, kopnena organizacija, zajednički uredi, prodaja i marketing.

Tipovi kooperacija:
- najam slotova, izmjena slotova
- podjela troškova
- zajedničko vlasništvo osnovnih sredstava
- zajedničko vođenje kompanija
- spajanje kompanija.

Trajanje kooperacija:
- ad hoc
- 3 – 4 godine
- 5 – 10 godina
- trajno.

3. TIPOVI UGOVORA O KOOPERACIJI

Najvažniji tipovi ugovora o kooperaciji su:

1. Joint Scheduling Agreement
2. Connecting Carrier Agreement
3. Vessel Sharing Agreement (VSA)
4. Space/Slot Sharter Agreement
5. Space/Slot Exchange Agreement
   - u okviru VSA
   - izvan VSA, izmjena/prebijanje slotova s dva različita linijska servisa.

3.1. Joint Scheduling Agreement

Najstariji oblik kooperacije među brodarima je Joint Scheduling Agreement koji podrazumijeva operativni sporazum dva ili više različitih brodara na istom linijskom servisu za koordinirane polaske brodova (frekvenciju servisa), redoslijed luka ticanja i kapacitet brodova u servisu. Svaki brodar zadržava svoj potpuni identitet. Suradnja nastaje kako bi se spriječila nepotrebna preklapanja, npr. polazak istog ili sličnog servisa iz iste luke isti dan, s ciljem da se krcateljima osigura točna periodičnost polaska linijskih servisa. Ovaj početni oblik kooperacije kasnije se razvijao u druge tipove kooperacija.

3.2. Connecting Carrier Agreement

Ugovor se sklapa između *Publishing Carrier-a* i *Connecting Carrier-a*.

Publishing Carrier ugovara prijevoz s krcateljem i izdaje direktnu teretnicu za cijeli prijevozni put od ishodišne do konačne luke iskrcaja, a prevozi kontejnere od ishodišne luke do dogovorene prekrcajne luke. Odatle se kontejneri prekrcavaju na drugog prevozitelja – *Connecting Carrier-a* koji prevozi kontejnere od prekrcajne luke do konačne luke iskrcaja.

Ovaj tip sporazuma ne treba poistovjećivati s klasičnim *feedering-om* (razvoz kontejnera od *Hub* luke do krajnjeg odredišta ili obrnuto), jer se njime, najčešće, ugovaraju međukontinentalni prijevozi.

Npr. brodar A *Publishing Carrier* ugovara prijevoze i izdaje direktne teretnice krcateljima iz Južne Amerike za Jugoistočnu Aziju. Linijski servis brodara A povezuje zapadnu obalu Južne Amerike i zapadnu obalu Sjeverne Amerike. U prekrcajnoj luci Los Angeles obavlja se prekrcaj na servis brodara B *Connecting Carrier*-a koji povezuje zapadnu obalu Sjeverne Amerike i Jugoistočnu Aziju [7].

3.3. Vessel Sharing Agreement

Prema ovom tipu sporazuma dva ili više brodara dogovaraju obavljanje zajedničkog linijskog servisa na način da svaki brodar sudjeluje s određenim brojem brodova u zajedničkom

servisu. Temeljem izračuna o udjelu vlastitog kapaciteta u ukupnom kapacitetu servisa *(share contribution),* svaki brodar ima pravo na svakom pojedinom brodu (vlastitom i od partnera) u zajedničkom servisu koristiti kapacitet (slotove) proporcionalno kapacitetu/slotovima kojim kontribuira u zajedničkom servisu. Ovakav princip poznat je i pod nazivom „slot exchange", i među partnerima se slotovi prebijaju pa su novčane transakcije minimalne. Svaki brodar zadržava vlastiti identitet i za svoje kontejnere izdaje krcateljima vlastitu teretnicu. Po općim načelima ovakvog tipa sporazuma svaki brodar plaća štivadorske i agencijske troškove samo za svoje kontejnere, a lučke troškove broda plaća samo onaj brodar koji je vlasnik (ili unajmitelj) broda i koji također snosi sve fiksne i varijabilne troškove broda. Zajednički troškovi, kao npr. prekovremeni rad, zastoji u lukama, premještaj kontejnera *(shiftings)* i slično plaćaju se opet proporcionalno. Partneri mogu dodatno kupiti slot (povrh svog *contribution share-a*) ako se drugi partner složi, i za to se plaća tzv. *slot release price.* Stoga je sastavni dio sporazuma i *Slot Cost Calculation,* odnosno izračun cijene troškova 1 slota (vidi tablicu 2.).

U ovakvom tipu kooperacije brodari međusobno potpisuju još nekoliko različitih ugovora i radnih procedura, kao npr. Cross Space Charter Party, Container Sublease Agreement, Chassis Sublease Agreement, Vessel Operational Agreement, Working Procedure Agreement, Claim Procedure i dr.

Tablica 2. Izračun cijene 1 slota

SLOT COST CALCULATION						
A) TROŠKOVI NAJMA BRODA: Broj ukupnih dana putovanja x dnevna cijena najma broda (A1 + A2)						USD
A1) Dnevna cijena najma:						USD
B) TROŠKOVI GORIVA (B1 + B2)						USD
Dnevna potrošnja MFO uplovidbi (MFO t/dan)						
Dnevna potrošnja MDO u stajanju (MDO t/dan)						
B1) Dani plovidbe x potrošnja MFO t/dan x USD t/MFO						USD
B2) Dani stajanja (u lukama) x potrošnja MDO t/dan x USD t/MDO						USD
C) LUČKI I KANALSKI TROŠKOVI						USD
Luke ticanja	Lučki troškovi	Milje između luka	Vrijeme plovidbe između luka	Vrijeme stajanja u luci	Ukupno trajanje putovanja	
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
UKUPNO	**C** USD	NM	dani plovidbe	dani stajanja	ukupni dani put. **A2**	
D) UKUPNI TROŠKOVI PUTOVANJA (A+B+C)						USD
E) KAPACITET BRODA						TEU
F) JEDINIČNI TROŠAK - SLOT COST(D / E)						USD

Izvor: Autor

3.4. Space/Slot Charter Agreement

Brodar koji obavlja linijski servis svojim brodovima, prodaje određeni brodski prostor/slotove drugoj stranci.

Jedna stranka sporazuma je brodar koji obavlja linijski servis, a druga stranka može biti brodar ili NVOCC (Non Vessel Operating Common Carrier). U tom slučaju naplata se obavlja isključivo novčano.

Prednost ovakvog sporazuma je da brodar A koji obavlja linijski servis i prodaje slotove može osigurati optimalnu iskoristivost i naplatu svojih brodskih kapaciteta, a brodar B koji kupuje slotove može osigurati svoju prisutnost na pojedinom pravcu/tržištima bez svojih vlastitih kapaciteta.

3.5. Space/Slot Exchange Agreement

Ovaj sporazum je u osnovi ukorporiran u Vessel Sharing Agreement, ali brodari često dogovaraju i izmjenu slotova na različitim linijskim servisima koji nisu uključeni u zajednički servis temeljen na Vessel Sharing Agreement-u.

Prednost ovakvog načina kooperiranja među brodarima je da svaki brodar koji obavlja linijski servis osigurava optimalnu iskoristivost svojih brodskih kapaciteta i istovremeno izmjenom slotova na servisu drugog brodara povećava broj luka i time nudi krcateljima šire prijevozne mogućnosti, a bez vlastitih ulaganja – brodova.

4. SINERGIJSKI EFEKTI KOOPERACIJA

Prednosti kooperacija koje su polučile sinergijske efekte bile su za brodare evidentne već od samog početka kontejnerizacije. Tako na primjer:

- Omogućava se jednom brodaru da poveća frekvenciju linijskog servisa bez dodavanja svojeg broda *(Vessel Sharing Agreement*):
- Na primjer: Brodar A održava 12-to dnevnu frekvenciju određenog linijskog servisa s 4 broda, a za postizanje 7-dnevne frekvencije potrebno je imati 6 brodova. Kooperacijom s drugim brodarom na osnovi *Vessel Sharing Agreement-a*, brodar A smanjuje vlastitu flotu na 3 broda, a brodar B ulaže u zajednički servis svoja 3 broda. S ukupno 6 brodova održavaju zajednički tjedni servis.
- Omogućava se brodaru povećanje frekvencije servisa s manjim brojem brodova:
- U gornjem primjeru brodar A će jedan brod povući iz dotadašnjeg samostalnog servisa, tako da će sa svoja 3 broda i partnerova 3 broda imati zajednički 7-dnevni servis. Četvrti brod povlači iz predmetnog servisa te ga ili daje u najam čime ostvaruje dodatni prihod ili ulazi u neku drugu kooperaciju gdje će temeljem *contribution share-a* imati ekvivalentan broj slotova na nekom drugom linijskom servisu gdje dotada možda uopće nije bio prisutan.
- Omogućava se bolja iskoristivost brodskih kapaciteta s manjim brojem brodova u zajedničkom servisu *(Vessel Sharing Agreement* u okviru međusobnog dogovora za

smanjenjem kapaciteta na tržištu tzv. *Tonnage rationalisation*):

- Primjer su dva odvojena linijska servisa na pravcu između sjeverne Europe i istočne obale Južne Amerike, koji su imali veoma slabu iskoristivost brodskog prostora te su odlučili dijeliti resurse na sljedeći način: umjesto 23 broda s 2 odvojena servisa dogovorili su zajednički servis s 18 brodova. Na taj su način znatno umanjili troškove poslovanja, omogućili optimalnu popunjenost kapaciteta te omogućili da 5 brodova bude uposleno na drugim linijskim servisima [8].
- Proširuje se zemljopisno područje pružanja linijskog servisa (nove luke ukrcaja i iskrcaja), a bez vlastitih brodova *(Slot Exchange Agreement).*
- Na primjer, brodar A je dogovorio recipročnu izmjenu slotova s brodarom B, na sljedeći način: brodar A koristi slotove na linijskom servisu brodara B između Dalekog istoka i istočnog Mediterana i Jadrana, a brodar B identičan broj slotova na linijskom servisu brodara A iz Dalekog istoka za zapadni Mediteran [9].
- Razvoj globalnih servisa u okviru kooperacija omogućava da se smanje troškovi repozicioniranja praznih kontejnera.
- Kada brodar ima razgranate globalne kontejnerske servise onda je u situaciji da ima više mogućnosti u kombiniranju, jeftinijih, repozicioniranja praznih kontejnera (s tržišta A i B na tržišta C, D, E...) ili pak ima mogućnost minimiziranja repozicioniranja praznih kontejnera (jer npr. iz tržišta B postoji razvijen prekomorski izvoz na tržište C).
- U razvoju globalnih kontejnerskih servisa važnu ulogu ima i podrška postojeće infrastrukture na jednom tržištu koja može podjednako servisirati više različitih linijskih servisa.
- Na primjer, ako brodar održava transatlantski linijski servis on već ima razvijenu kompletnu kopnenu infrastrukturu u Sjevernoj Americi: agencijsku mrežu, ugovore s raznim dobavljačima: terminalima, leasing kompanijama, željezničkim i kamionskim operatorima itd., razgranatu mrežu kopnenih depoa s radionicama za popravak kontejnera itd., te ako razvija transpacifički linijski servis onda ta ista infrastruktura može preuzeti dodatni promet s time da će se povećanjem prometa ponovno pregovarati svi ugovori s dobavljačima i postići još bolji uvjeti tj. jeftinije tarife.
- U okviru kooperacija znatno jača pregovaračka pozicija naspram raznih dobavljača (lučki terminali, kopneni depoi, radionice za popravak kontejnera, leasing kompanije, cestovni prijevoznici, željeznički operatori, riječni operatori, feeder operatori...), obzirom da svi članovi kooperacije pregovaraju s zajedničkim, ukupnim, prometom. Ishodovanjem jeftinijih tarifa smanjuju se troškovi poslovanja.
- Postizanje pozitivnih efekata kooperacija mogući su i na drugim područjima poslovanja: na području internog iznajmljivanja kontejnera *(interchange of empty containers),* u elektroničkoj izmjeni podataka *(EDI system*), zajedničkom oglašavanju, organizaciji prekrcaja kontejnera *(transhipments*), dobrovoljnom usuglašavanju vozarina i dr.

ZAKLJUČAK

Kooperacije među brodarima razvijaju se od samog početka kontejnerizacije 60-tih godina 20. stoljeća. One su najbolji odgovor na velika kapitalna ulaganja u novu tehnologiju, velike operativne troškove kao i na zahtjeve krcatelja za učestalim linijskim servisima. Djelokrug kooperacija ne odnosi se samo na brodske linijske servise nego i na puno šire područje: na lučke terminale, kopnene depoe, radionice za popravak kontejnera, interni najam kontejnerske opreme, pregovaranje s operatorima kopnenog transporta i sl., čime brodari ostvaruju različite sinergijske efekte. Brodari koji su dobro ovladali praksom kooperacija u mogućosti su pružiti *worldwide* prijevoznu uslugu s minimalnim brojem vlastitih kapaciteta, bilo s vlastitim ili unajmljenim brodovima.

Tijekom zadnjih 40 godina kontejnerizacija se stalno razvija: povećava se promet i grade se sve veći brodovi te su kooperacije postale nužnost u organizaciji linijskih servisa. Danas su vrlo rijetki linijski servisi samo jednog brodara čime se najbolje dokazuje da su kooperacije opravdale svoje ciljeve. Sveobuhvatni razvoj kontejnerizacije i razvoj kooperacija među brodarima tendiraju spajanjima i preuzimanjem brodara te stvaranjem mega-brodara.

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ALLIANCES AMONG SHIPOWNERS

SUMMARY

The paper aims at analysing the needs for large capital investments in starting a liner container service. One of the possible way for the shipowner to reduce the costs of a container liner service, and in doing so to meet the requirements of a shipper by offering a high quality service and reasonable freight rates, is to join alliances of any type. The integrational development of alliancesis is analyzed through the geographical sphere, scope of alliance means, types of alliances and possible duration. Different types of joint agreements are elaborated in detail, and the synergetic effects realized through alliances are described too. The current world largest global alliances among shipowners are shown in tables as well as the slot cost calculation.

Key words: *containerization, shipowners, alliances, slot, liner service.*

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RAČUNALNI PROGRAM ZA ODREĐIVANJE GEOMETRIJSKIH I HIDRODINAMIČKIH ZNAČAJKI BRODSKOG VIJKA

U radu se razmatra izbor i optimizacija brodskog vijka te je prikazan računalni program za određivanje geometrijskih i hidrodinamičkih značajki brodskog vijka. Brodski vijak mora biti vrlo učinkovit, ne bi smio stvarati neželjene vibracije i buku te se naposljetku ne bi smjelo dopustiti erozijsko oštećenje uslijed kavitacije na krilima. Glavni zadatak projektanta jest pronaći ravnotežu između ovih zahtjeva. Početni pristup kod projekta brodskog vijka uobičajeno se temelji na rezultatima ispitivanja slobodne vožnje sustavno mijenjanih nizova modela brodskih vijaka. Time su obuhvaćene promjene u nizu projektnih parametara kao što su broj krila, omjer uspona, površina krila i oblici presjeka. Brodski vijak koji odgovara značajkama određenog niza može se brzo projektirati kako bi odgovarao zahtijevanim projektnim uvjetima. Na temelju dobro poznatih polinoma B-sustavnog niza brodskih vijaka razvijen je računalni program «BroVi». Program se može uspješno koristiti za optimizaciju brodskog vijka kao i za određivanje radne točke (broj okretaja, poriv, moment, snaga).

Ključne riječi: *brodski vijak, B-sustavni niz modela vijaka, računalni program*

1. UVOD

Brodski vijak spada među izuzetno važne dijelove broda te stoga projekt i izrada brodskog vijka predstavlja vrlo odgovoran i zahtjevan zadatak. Projektant koji rješava problem brodskog vijka odlučuje o obliku brodskog vijka na način da vijak pri zadanom broju okretaja apsorbira određenu snagu i proizvodi poriv potreban da se brod kreće zahtijevanom brzinom. Brodski vijci moraju biti što učinkovitiji što znači da se snaga koju porivni stroj predaje vijku mora pretvoriti u snagu poriva uz što manje gubitaka. Uz to, vijak ne bi smio stvarati neželjene vibracije i buku. Naposljetku, potrebno je izbjegavati mogućnost oštećenja vijka zbog pojave kavitacije na krilima. Glavni zadatak projektanta jest pronaći ravnotežu između svih tih zahtjeva, te postići optimum oblika i dimenzija brodskog vijka.

Podaci temeljeni na ispitivanju sustavnih nizova brodskih vijaka imaju izuzetnu vrijednost i predstavljaju osnovno sredstvo za projektiranje vijaka. Tijekom 20. stoljeća

osnovan je i ispitan veći broj nizova konvencionalnih brodskih vijaka, od kojih su najpoznatiji nizovi Froudea, Schaffrana, Taylora, Schoenherra, Gawna te Troosta [1]. Kasnije su osnovani i obrađeni nizovi tzv. nekonvencionalnih propulzora kao što su kontrarotirajući vijci, vijci u sapnici, vijci s krilima upravljivog uspona, cikloidni propulzori i dr.

Dijagrami slobodne vožnje proizašli iz ovih ispitivanja pružaju mogućnost relativno jednostavnog projektiranja brodskih vijaka uz manje napora uloženog u proračun. Zbog jednostavnosti korištenja njihova je važnost naročito velika pri preliminarnom određivanju glavnih značajki vijka (promjer, uspon, broj krila, omjer površina), dok se kasnije uvijek mogu provesti detaljniji proračuni u cilju bolje optimizacije projekta vijka.

2. ODREĐIVANJE ZNAČAJKI BRODSKOG VIJKA

Pojam odabira optimalnog vijka zapravo predstavlja problem odabira geometrijskih značajki vijka za koje će vijak imati najveći stupanj djelovanja η_o kod zadanih uvjeta rada [2]. Kod problema određivanja geometrijskih i hidrodinamičkih značajki brodskog vijka u praksi se u osnovi razlikuju optimizacija vijka kod koje postoje dva različita pristupa te analiza rada odabranog vijka:

- optimizacija vijka s tzv. «stajališta stroja», kada je zadana vrijednost momenta Q (odnosno snaga predana vijku P_D) te broj okretaja vijka n ili promjer D,
- optimizacija vijka s tzv. «stajališta broda», kada je zadana vrijednost poriva T te promjer D ili broj okretaja n,
- analiza rada odabranog vijka (zadana je geometrija: promjer D, uspon P, omjer površina A_E/A_O) pri čemu se određuju potrebne veličine n, P_D i stupanj djelovanja vijka η_o na način da vijak daje dovoljan poriv T potreban za savladavanje ukupnog otpora broda pri plovidbi zadanom brzinom.

Prethodno je potrebno izabrati broja krila vijka Z te na odgovarajući način odrediti vrijednosti brzine pritjecanja vode V_A i omjera površina A_E/A_O. Vrijednost omjera površina A_E/A_O ovisi o pojavi kavitacije na krilima vijka, a najmanji potrebni omjer raširene površine radi izbjegavanja kavitacije može se približno odrediti primjenom Kellerove metode [3]. Ova je metoda pogodna za primjenu za sve sustavne nizove vijaka, premda su za pojedine nizove razvijene zasebne metode za provjeru kavitacije.

3. SUSTAVNI NIZ MODELA BRODSKIH VIJAKA INSTITUTA MARIN

Jedan od najpoznatijih i najobimnije razrađenih sustavnih nizova brodskih vijaka predstavlja B-sustavni niz vijaka osnovan u institutu MARIN (Maritime Research Institute Netherlands) u Nizozemskoj [5]. Niz se sastoji od 120 modela vijaka koji se međusobno razlikuju prema broju krila, omjeru površina i omjeru uspona. Ruzultati ispitanog niza

omogućavaju preliminarno određivanje geometrijskih i hidrodinamičkih značajki brodskih vijaka za veliki broj projektnih zahtjeva koji se pojavljuju u praksi.

Tijekom proteklih desetljeća, budući da je postojalo više različitih izvora podataka i dijagrama slobodne vožnje B-sustavnog niza te zbog primjećenih odstupanja vrijednosti među njima, pojavila se potreba za utvrđivanjem njihovih točnih vrijednosti. Usklađivanje je obavljeno primjenom metode višestruke regresijske analize. Proračunate vrijednosti poslužile su kao osnova za razvoj regresijskih polinoma koeficijenta poriva K_T i koeficijenta momenta K_Q [4]. Koeficijenti K_T i K_Q izraženi su u polinomnom obliku u ovisnosti od koeficijentu napredovanja J, omjeru uspona P/D, omjeru površina A_E/A_O, i broju krila Z. Osnovne vrijednosti dane su za vrijednosti Reynoldsovog broja od $2x10^6$, a kasnije su obavljene korekcije i za Reynoldsove brojeve od $2x10^7$, $2x10^8$ i $2x10^9$. Polinomni izrazi dani su u obliku:

$$K_T=\Sigma[C_{s,t,u,v}.(J)^s.(P/D)^t.(A_E/A_O)^u.(Z)^v]$$

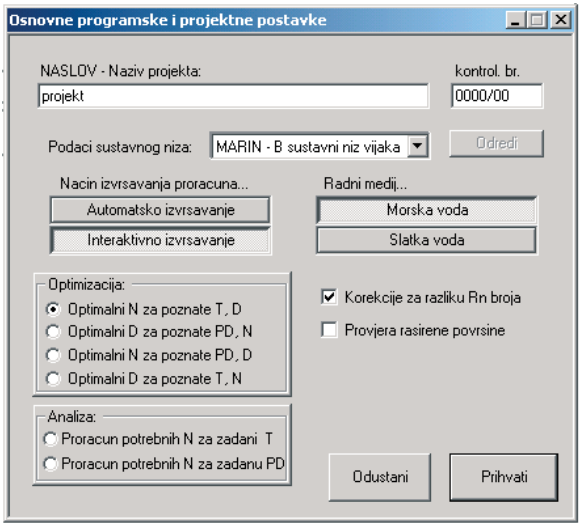
$$K_Q=\Sigma[C_{s,t,u,v}.(J)^s.(P/D)^t.(A_E/A_O)^u.(Z)^v].$$

Relevantni koeficijenti dani su u [4]. Polinomni izrazi omogućavaju numerički izračun vrijednosti tih koeficijenata.

4. RAČUNALNI PROGRAM «BroVi»

4.1. Općenito

Glavne zadaće računalnog programa «BroVi» sastoje se u određivanju geometrijskih i hidrodinamičkih značajki vijka grupiranih pod zajedničkim pojmom «Optimizacija», te određivanju hidrodinamičkih značajki brodskog vijka grupiranih pod pojmom «Analiza». Proračun se odnosi na konkretan projekt plovnog objekta, stoga je program koncipiran na način da su ponajprije definirane neke općenite značajke projekta broda, npr. naziv projekta, karakteristike vode i dr. (Slika 1.).



Slika 1. Obrazac za određivanje osnovnih programskih i projektnih postavki

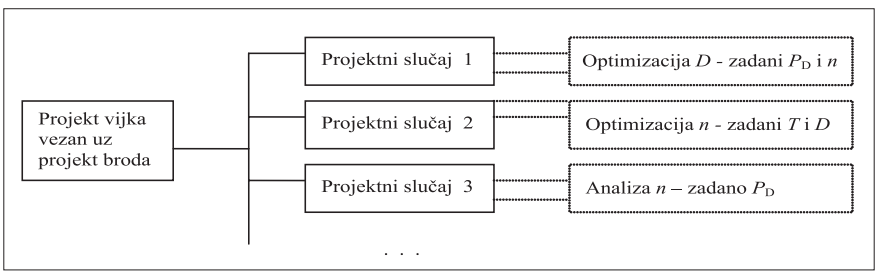
Računalni program uključuje mogućnost odabira jednog od četiri mogućih pristupa optimizaciji:

- proračun optimalnog D za zadane vrijednosti P_D i n,
- proračun optimalnih n za zadane vrijednosti P_D i D,
- proračun optimalnog D za zadane vrijednosti T i n,
- proračun optimalnih n za zadane vrijednosti T i D,

te jednog od dva moguća pristupa analizi:

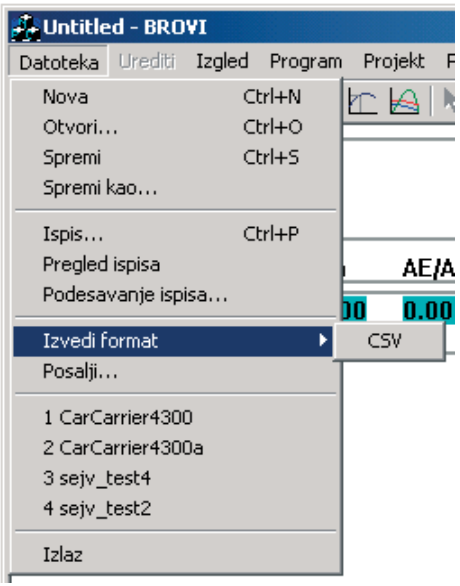
- proračun potrebnih n te odgovarajuće vrijednosti P_D za zadanu vrijednost T,
- proračun potrebnih n te odgovarajuće vrijednosti T za zadanu vrijednost P_D.

U programu je pružena mogućnost definiranja različitih varijacija ulaznih veličina za pojedine projektne slučajeve kojih može po potrebi biti stvoren proizvoljan broj (Slika 2.). Kroz projektne slučajeve pružena je mogućnost jednostavne naknadne usporedbe rezultata proračuna bilo koje vrste u sklopu jedne projektne datoteke.



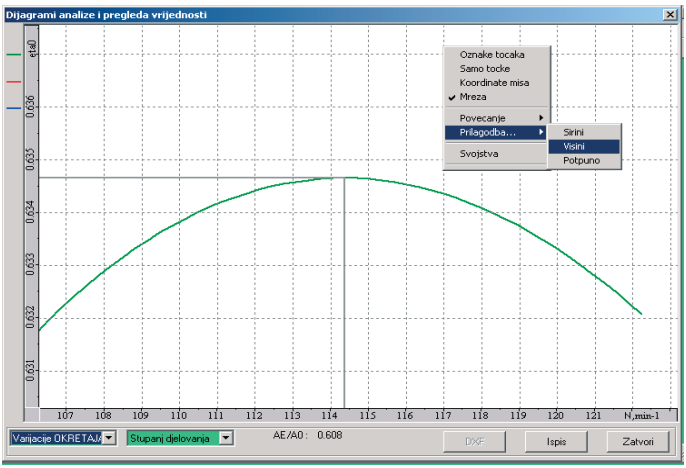
Slika 2. Shematski primjer strukture projektnih slučajeva unutar jednog projekta

Radi općnite primjenljivosti, računalni program ima i određene druge mogućnosti koje nisu izravno vezane uz sam proračun. Datotečne funkcije osnovne su funkcije gotovo svakog računalnog programa, a nalaze se sve u sklopu izbornika «Datoteka» koji je prikazan na slici 3. U padajućem izborniku «Datoteka» nalaze se sve prethodno navedene funkcije, kao i prečaci za otvaranje projektnih datoteka s kojima se radilo u posljednje vrijeme. Funkcije ispisa na pisač odnose se na ispis rezultata proračuna projektnih slučajeva u obliku sličnom onomu na radnom prostoru programa na ekranu. Funkcija ispisa liste projektnih slučajeva u neki od standardnih oblika u informatici omogućava kasniju obradu rezultata proračuna korištenjem bilo kojeg programskog alata (npr. Excel) koji prihvaća taj standardni oblik ispisa.

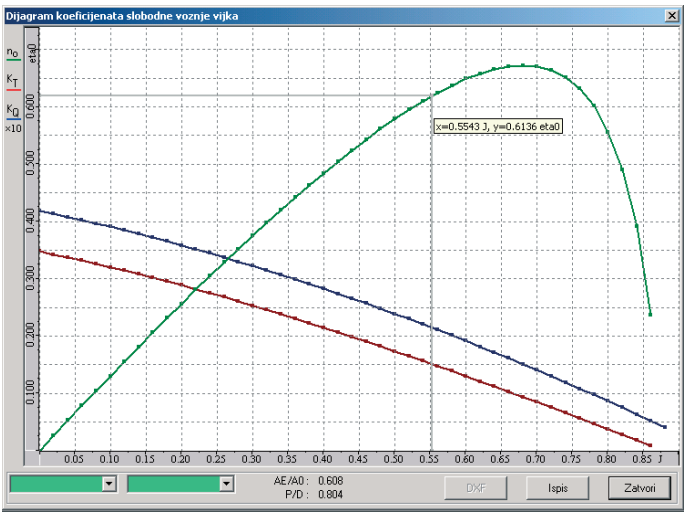


Slika 3. Izbornik «Datoteka»

Iz praktičnih razloga rezultati se mogu prikazati i dijagramski. Na raspolaganju je više dijagrama s rezultatima iz analize rada vijka kao što su η_o, T, P_D, η_o u funkciji n (Slika 4.) i P/D, η_o u funkciji D i omjera P/D te dijagram slobodne vožnje vijka (Slika 5.). Dodatno je ostavljena i mogućnost formiranja standardne, tj. «DXF» datoteke kojom je omogućena daljnja grafička obrada dijagrama.



Slika 4. Primjer dijagrama - stupanj djelovanja η_o u funkciji različitih brzina vrtnje vijka n

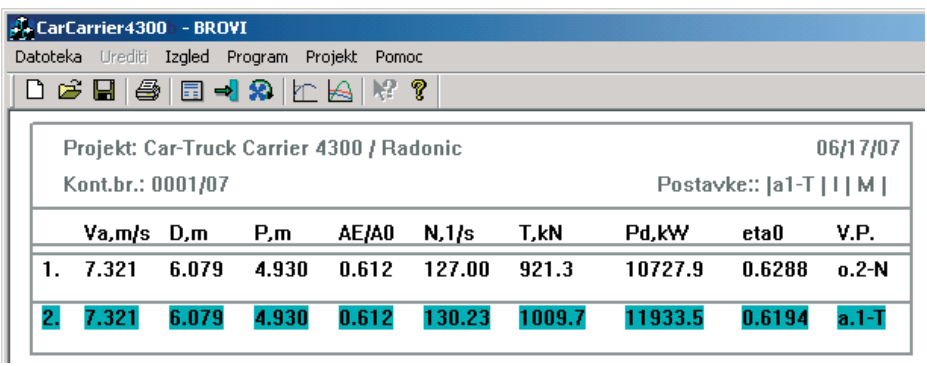


Slika 5. Dijagram slobodne vožnje vijka

4.2. Optimizacija vijka za zadane uvjete

Optimizacija vijka jedna je od glavnih funkcija računalnog programa. Optimizacija predstavlja određivanje geometrijskih i hidrodinamičkih veličina vijka od kojih promjer vijka D može u pojedinim optimizacijskim pristupima biti i zadan, te ostalih veličina koje tada u potpunosti definiraju rad vijka (n, P_D, T). U tu svrhu se unutar programa variraju koeficijent napredovanja J te omjer uspona P/D. Posebnim se algoritmom (metoda bisekcije) vrši ubrzano približavanje što točnijoj vrijednosti za dane uvjete, ali tek u dovoljno kratkim

intervalima – toliko da se može očekivati dovoljna linearnost funkcije radi sigurnog konvergiranja konačnom rješenju. Odabire se, naposljetku, ona kombinacija veličina za koje je proračunati stupanj djelovanja vijka η_o najveći. Na slici 6. prikazan je izgled obrasca s vrijednostima ulaznih i izlaznih veličina proračuna optimizacije vijka. Optimizacija se može izvršavati na dva različita načina: automatski ili interaktivno. Način na koji će se odvijati proračuni optimizacije odabire se u obrascu «Postavke» zajedno s ostalim općenitim projektnim postavkama. Ovi se načini odnose na razinu utjecaja korisnika na tok proračuna vezano uz određivanje brzine napredovanja vijka V_A, odnosno minimalnog omjera površina A_E/A_O. Vrijednosti ovih dviju ulaznih veličina ujedno ovise o izračunatim vrijednostima nekih od ostalih veličina (npr. D) koje se nakon pojedinog proračuna mogu izmijeniti – što dovodi do iterativnog postupka pronalaženja približnog podudaranja vrijednosti svih ulaznih i proračunatih veličina. U automatskom načinu rada izračuni V_A i A_E/A_O, ukoliko nisu zadani, provode se nekom od ponuđenih empirijskih numeričkih metoda proračuna, a sam postupak je jednostavniji što se tiče korisnika. Interaktivni način rada nudi slobodu proračuna bilo kojem korisniku poznatom metodom ili unošenje iskustvene vrijednosti, što može dati točnije ukupne rezultate proračuna, ali je time postupak naravno nešto složeniji budući da zahtijeva više intervencija korisnika.

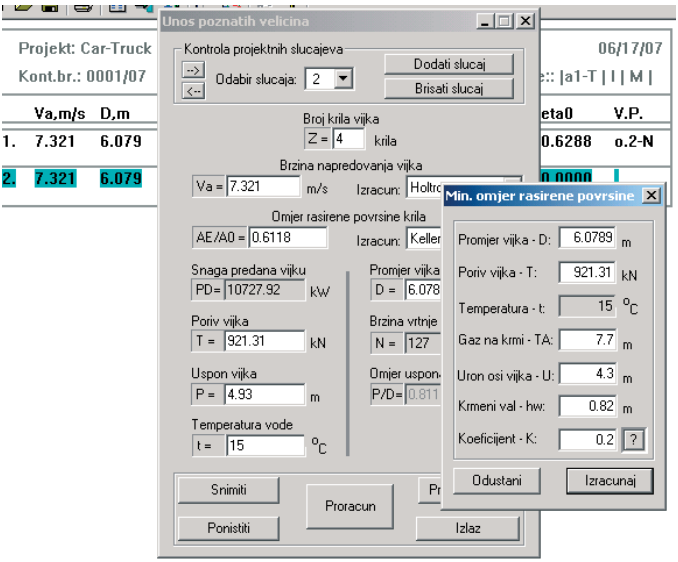


Slika 6. Tablični prikaz proračunatih vrijednosti iz optimizacije

4.3. Analiza rada odabranog vijka

Postupak analize rada vijka provodi se s poznatim vrijednostima svih veličina koje u potpunosti određuju geometriju vijka, te ostalih veličina ovisno o pojedinom pristupu proračunu analize. Manipulacija projektnim slučajevima jednaka je kao i za optimizaciju, te se jednako tako može provesti analiza za slučaj u kojem su vrijednosti veličina prethodno određene nekim od postupka optimizacije i obrnuto. Analiza rada vijka provodi se jednodimenzijskim pretraživanjem u petlji varijacije vrijednosti koeficijenta napredovanja J, dok je vrijednost omjera uspona P/D u ovom slučaju jednoznačno određena budući da je geometrija vijka zadana. Ta se činjenica očituje u osjetno većoj brzini proračuna u odnosu na postupke optimizacije. Druga se razlika sastoji u tome što postupci analize rade jedino u interaktivnom načinu rada budući da je omjer površina zadan kao jedna od geometrijskih značajki vijka pa automatski način rada nema smisla kod analize. Projektant pomoću vrijednosti dobivenih

proračunom analize (Slika 7.), može ocijeniti da li projekt vijka zadovoljava zahtjevane uvjete, da li motor ima dovoljno rezerve snage i sl. Daljnji uvid i analize rada vijka mogući su uz pomoć dijagrama kojima se pristupa putem izbornika «Projekt» ili jednostavnije iz alatne trake (,).



Slika 7. Tablični prikaz proračunatih vrijednosti iz analize

5. ZAKLJUČAK

Na tržištu danas postoje razni programski paketi koji pružaju djelomičnu ili cjelovitu pomoć kod određivanja geometrijskih i hidrodinamičkih značajki brodskog vijka. Ti su usko specijalizirani programi relativno skupi, budući da su namijenjeni ograničenom krugu korisnika tako da se nerijetko korisnik, ukoliko ima dovoljno znanja iz programiranja računala, odlučuje za samostalnu izradu računalnog programa, proizvoljne složenosti i mogućnosti u skladu s vlastitim potrebama.

Računalni program «BroVi» je univerzalno primjenjivo programsko rješenje za određivanje geometrijskih i hidrodinamičkih značajki uobičajenih vijaka plovnih objekata. Uz osnovne mogućnosti definirane njegovom namjenom, program sadrži i nekoliko sporednih funkcija. One su uvedene kako bi se olakšao rad i dao bolji uvid u rezultate proračuna (npr. različite vrste dijagrama) kako bi se pokušalo što bolje zaokružiti cjelovitost programskog rješenja za projektiranje brodskog vijka. Naravno, brojne se još mogućnosti otvaraju za eventualno proširenje funkcionalnosti programa.

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COMPUTER-BASED PROGRAMME FOR DEFINING THE GEOMETRIC AND HYDRODYNAMIC CHARACTERISTICS OF A MARINE PROPELLER

SUMMARY

The paper aims at analyzing the selection and optimization of a marine propeller and at presenting the computer-based programme for defining the geometric and hydrodynamic characteristics of a marine propeller. A marine propeller must be efficient, should not cause unintended vibrations and noise, and the erosive damage due to cavitation on wings should not be tolerated as well. The main task of a designer is to keep the balance between these requirements. The initial approach to the marine propeller design is usually based on the results obtained from the B-screw series free run tests. This includes the changes in a number of design parameters such as the number of wings, the propeller pitch ratio, the wing area and the section types. The marine propeller that meets the characteristics of the particular screw series can be easily designed in order to meet the demanding design standards. Based on the well known B-screw series polynomials, a computer-based programme „BroVi" has been created. This programme can be successfully used for the marine propeller optimization and in determining the working point (revolution number, propeller thrust, propeller torque, propulsive power).

Key words: *marine propeller, B-screw series, computer-based programme*

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THE NEW PROFILE OF TOWN PORTS IN THE DEVELOPMENT OF NAUTICAL TOURISM

Maritime ports are an integral part of the large towns, their most attractive, and at the same time, their most profitable area. The development of ports in Croatia and in the Mediterranean has proceeded alongside the development of maritime towns. Their age parallels the age of the towns. Throughout history, town ports have changed their economic role and profile adapting to the needs of the market and towns. The development of nautical tourism has placed great pressure on the old ports changing their existing profile. Over the centuries, town ports of large and medium-size towns have performed the function of maritime traffic, transportation of persons and cargo, and trade. For nautical tourism to achieve good development results and a consistently high development rate, it is necessary to change the classical profile of town ports by transforming them from maritime ports into ports for nautical tourism. What types of changes are involved? What do these changes bring? The answers to these questions and others shall be given in this article.

Key words: *old town ports, nautical tourism, marinas, great world cruising, Croatian old timers.*

1. INTRODUCTION

Nautical tourism around the world and in Europe is a phenomenon and a tourism and economic activity which has registered a high rate of steady growth in the last decades. Its development can be scientifically observed through three fundamental forms: ports of nautical tourism, charter and cruises. All these nautical tourism branches are reciprocally and closely linked to the destination, with its scenic spots and cultural heritage. In pursuing visits to scenic spots and learning about the cultures of the destinations, arrivals of nautical tourists, either by personal or rented yachts, as well as the arrivals of cruise ships are focused

on old town ports. In accordance with the greater requirements imposed by nautical tourism, and especially by great world cruising, the profiles of old town ports in Croatia, the Mediterranean and Europe are changing more and more dynamically every day. What are these changes about? How do these changes reflect on the domicile inhabitants? How can long-term sustainable development be secured? How should port resources be managed? The answers to these questions and others or guidelines for future consideration and solutions of this problem shall be given in this article.

2. NAUTICAL TOURISM AND ITS BASIC FACTORS

Nautical tourism is a phenomenon that has, over the past three decades registered a continuously high rate of growth in all its forms. The attractiveness of waters and the sea has fostered the development of the most important forms of water-related tourism. Therefore, with reference to previous technical and scientific definitions of the concept of nautical tourism[1], nautical tourism can be defined as follows: Nautical tourism is a multifunctional tourist activity with pronounced maritime components.[2]

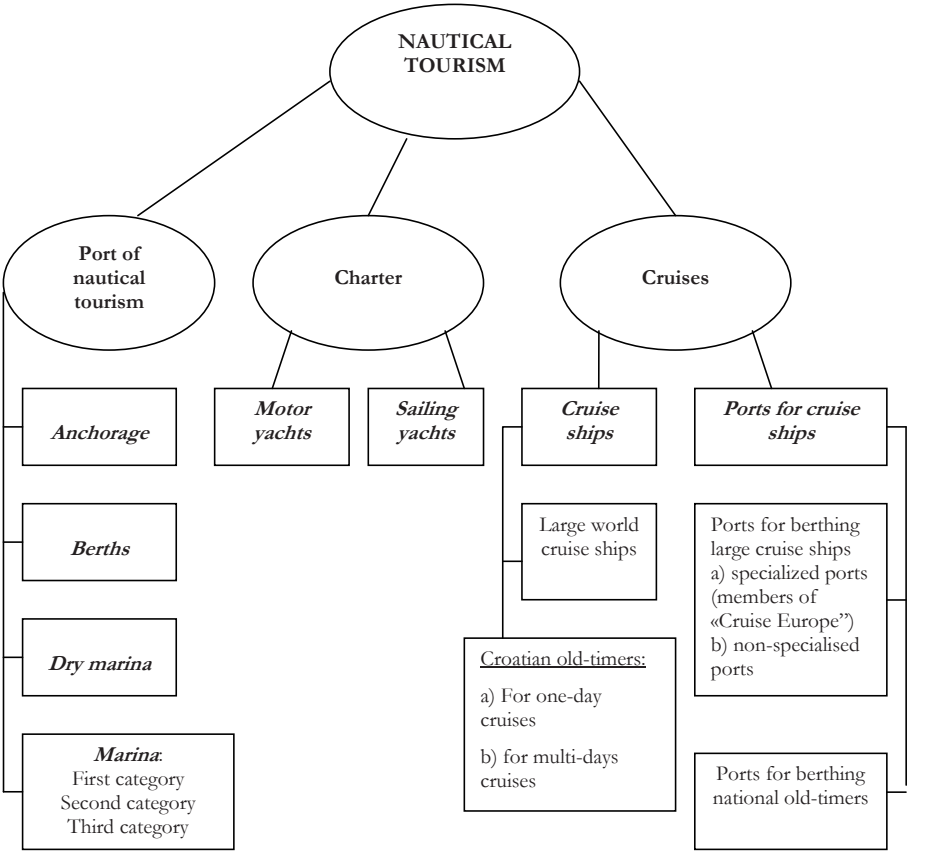
In compliance with scientific, research, legislative and statistical sources, nautical tourism can be classified into three basic forms: *port of nautical tourism, charter and cruises*, and other associated tourism branches closely linked to water, but which have not developed into independent forms of selective tourism, such as surfing tourism, diving tourism, fishing tourism, rafting and so on.

This classification needs to be integrated with the increasingly topical classification of nautical tourism from the viewpoint of boater and tourist motivation, developed by the so-called Humanistic School of the University of Zadar[3]. In the very beginning of the development of nautical tourism, thought and scientific research, the scholars of that period contributed to the classification of nautical tourism by presenting a classification predominantly based on motivation[4].

Graphically, nautical tourism can be classified as follows:

1 Luković, T., Nautički turizam – definicije i dileme, Naše more, 54 (2007) 1-2, 22-31.
2 Luković, T., Nautički turizam – definicije i dileme, Naše more, 54 (2007) 1-2, 28.
3 Jadrešić, V., Turizam i interdisciplinarnoj teoriji i primjeni, Zagreb, Školska knjiga, 2001., 299.
4 Razvrstavanju su pridonijeli radovi nekoliko hrvatskih znanstvenika, primjerice: Alfiera, D., Apolonia, A. i Bombardelija, V.

Graph 1. Model of classification of nautical tourism in Croatia

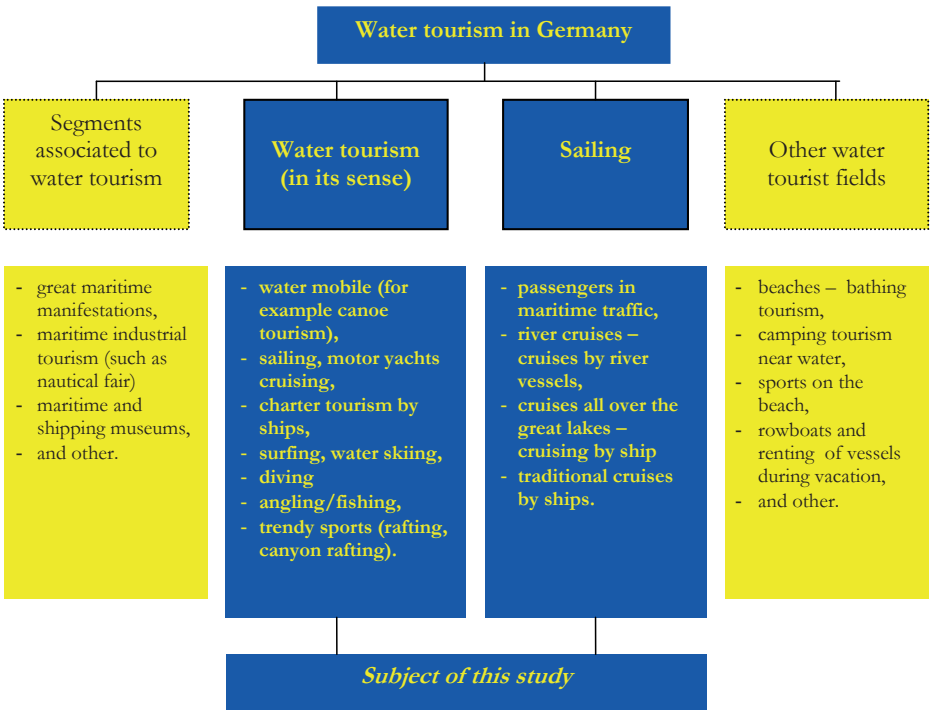


Source: Drawn up by the author T. Luković

This model of the classification of nautical tourism is present also in European tourist generating countries and during research of the German nautical tourism, the German Government commissioned a survey in 2003 to be conducted by two research agencies, *dwif* consulting GmbH Berlin[5] and BTE Tourismusmanagement, Regionalentwicklung Berlin[6]. In this survey, nautical tourism is defined as water-related tourism, and its classification is illustrated in its original version (Graph 2).

5 Internet, www.dwif.de, info-berlin@dwif.de
6 Internet, www.bte-tourismus.de , berlin@bte-tourismus.de

Graph 2. Water-related tourism as defined in Germany (translation of table Abb 1. «Definition Wassertourismus und im Sinne der vorliegenden Studie»)



Source: Study dwif / BTE 2002

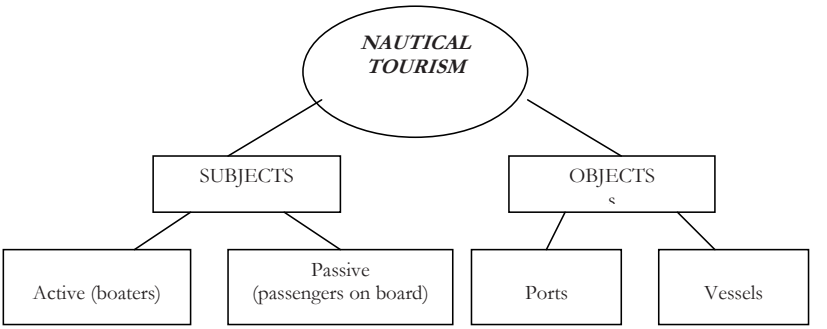
In comparing our classification model of nautical tourism with the German one, it can be noted that there is no difference; nevertheless, for the purpose of our analysis, it is important to establish the basic factors of nautical tourism according to the *criterion of its existence*[7] as follows:

1. factors conditioning the emergence of nautical tourism (factors of initiations),
2. developing factors of nautical tourism (maintenance factors).

In analysing and integrating these factors with their basic practical factors, we reach this model (Graph 3).

7 Luković, T., Gržetić, Z., Nautičko turističko tržište u teoriji i praksi Hrvatske i europskog dijela Mediterana, Hrvatski hidrografski institut Split, Split/Dubrovnik 2007., str. 26.

Graph 3. Basic practical factors for the existence of nautical tourism



Source: Drawn up by the author T. Luković

As indicated in the graph, the basic and conditional factors of nautical tourism are objects *and* subjects. The basic objects are ports and vessels. The subject matter of this analysis are ports[8], in particular, old town ports, which Graph 1 classified as :

a) specialised ports (members of «Cruise Europe") and

b) non-specialised ports.

Both cases involve old town ports of large and small towns that are the destination ports of boaters and cruise passengers.

3. TOWN PORTS AND THEIR ECONOMICAL IMPORTANCE

In analysing nautical tourism according to sailing motivations of navigation, some groups of boaters and passengers on board vessels can be distinguished. According to a basic classification, they can be distinguished as follows:

a) subjects desiring adventures in nature outside urban centres and

b) subjects desiring new perceptions and cultural experiences of unknown towns and cultures.

8 Ports as a concept can be classified from different aspect. According to their destination, ports are divided into war, commercial, industrial, supplying and special (fishery), sport, sport-nautical and other ports. According to their geographical position, ports can be classified as sea, lake, river, canal, lagoon and combined ports. According to their way of construction, ports can be natural and artificial. According to their berthing and anchoring and water area, ports can be open, closed or dock. Ports can be classified according to other criteria, as per example, according to their dimension, importance in goods exchange, administrative criteria, destination and so on. Rule on classification and categorisation of ports for nautical tourism (Official Gazette, no. 142/99) defines the special kind of ports and port ports for nautical tourism.

With regard to these two basic sailing motivations motives of navigation, it is necessary to explain in greater detail the branches of nautical tourism.

The subjects of the first group - subjects experiencing nature far from urban centres - include boaters and tourists using their personal yachts or sailing on chartered vessel, who sometimes desire to experience nature far from towns and organized ports.

The subjects of the second group include passengers on board great world cruise ships, as well as on board our old-timers and boaters sailing on chartered or personal yachts. In our analysis, we shall focus the second group.

The subjects of the second group wish to learn about the cultures that once existed on the seashores of the Mediterranean Sea and Croatia, and which left visible cultural backgrounds. This motivation driving boaters to sail the seas is statistically more dominant. According to the TOMAS-nautika 2004 survey, all boaters have expressed their interest in landing on the Croatian coast of the Adriatic Sea to experienced old and present culture of living on our shores. As the TOMAS- nautika 2004 survey includes only navigation by personal or chartered vessel, this number has to be increased by the number of cruise passengers. Similar to TOMAS-nautika 2004, TOMAS-cruising 2004 has indicated the same interest of tourists on board of cruise ships. In this way, it can be established that the basic motive of boaters and tourists on board cruise ship are visiting and getting to know our cultural heritage, concentrated inside the nucleuses of old towns and town ports. This figure is the result of the special beauty characterizing all larger towns alongside Mediterranean Sea and in which historical events and life took place in the ports. Even after some thousands of years, these ports have not lost their beauty and values of the town to which they belong. Therefore it can be established that town ports are the most profitable part of all towns not only along the Mediterranean coast, but also in Croatia. In these towns and around them, the most profitable economy, especially traffic and trade, are taking place and developing took place and developed. They are the centres of all events going on in the towns alongside the Mediterranean Sea as well the focus of all most profitable activities, while prices of real estate facing the ports are ten times higher than prices inland. This image of the current situation and significance of old town ports is dynamically changing and at present, we are witnesses of new trends. Under the pressure of developing nautical tourism, old town ports are becoming a matter of interest for great cruise ships and nautical tourism in its broader meaning. Thanks to its exceptional results, nautical tourism is increasingly supplanting the existing traditional activities within town ports, forming a new profile of town ports.

4. EXAMPLES OF CHANGES AND ADAPTATIONS OF OLD TOWN PORTS

Even if the profiles of town ports, which are more or less similar in all old ports, do change, they are in any case specific for any port. Each port has developed its own profile according to its long-term interests. Even though in the scientificliterature of strategic management there are not many papers dealing with the long-term management of local development, the management of town ports has, in practise, been performed in a controlled way. Local authorities have had a significant impact on the existing profile of old ports and this development has been over the centuries been submitted to the local management.

4.1. Port of Split and Port of Dubrovnik

The Port of Split is one of the largest and oldest ports on the Croatian coast of the Adriatic Sea. The port, which dates back to approximately two thousand years, has passed through numerous developing phases and performed many roles for the town, from providing protection from enemies from the sea, to being a trade and traffic centre and ideal area in which, in recent years, the Split Boat Show, the largest business and exhibition convention of such a kind in Southern Europe and one of the largest tent nautical shows in the world takes place.

Less than fifty years ago, railway, maritime and bus transportation, later followed by air transportation intersected in the town port. Transhipment of cargo from vessels into railway trucks was performed on the seashore, only a few meters from the sea. The port was subjected to all branches of traffic. By developing maritime traffic and strengthening the town as transit tourist town, passenger and tourist traffic gradually supplanted the transhipment of bulk and heavy cargo from the town port. In order to disencumber the old town port, the new transhipment Northern Port with equipment for transhipment was built and in this a way it drawn abreast of the Port of Rijeka paving the way for the new development of the old town port; all such activities have been carried out by town authorities in their plans. The Port of Split has transformed into the largest passenger port, in which catering and city tourism prevail. Today, in the town port, various activities exist, which do not belong to this space and are incompatible with the port area from the viewpoint of work, economy, ecology, town-planning and aesthetics.

Of the total 101.634 square meters of business premises,, business activities (offices with 18,014 square meters) and traffic activities (7,750 square meters) account for the greatest area, while, according to the number of employees, the first place is occupied by business, followed by trade, tertiary, catering, traffic and international forwarding. The conventional wisdom of an exclusive transit junction or distribution destination towards the inlands (in fact, approx. 2,400,000 passengers and approx. 330,000 vehicles transited the town port in 1989) as well as its lack of recognition of the tourist potential and resources of the town and its metropolitan surroundings, produced the most adverse development effects on the water front of the port. During the 2007 tourist season, 65,000 passengers and 6,000 vehicles passed through the Port of Split in a period of only two weekend days. According to statistical

indexes on the intensity of traffic communications, the Port of Split in considered one of the busier ports on the Mediterranean Sea. The specific refractive point of transit centre of goods, and partially of passenger traffic (maritime, railway, bus, suburban, regional and long-distance bus lines) needs to be dispersed and developed on the area of the Northern Port and Kopilica as these areas dispose of ideal urban and infrastructure preconditions[9].

Thanks to the great interest of the large cruise corporations for the Croatian coast after the Patriotic War, the Port of Split, together with the ports of Šibenik Zadar and Poreč, has applied for joining the «Cruise Europe» group of cruise ports. Joining this corporation calls for significant change in the profile of the port, especially in its technical equipment and infrastructure, but on the other side, it provides the town with the opportunity of accepting a great number of tourists from cruise ships. It remains to be seen if the local authorities are aware of all effects to which the town will be exposed by the arrival of a great number of cruise ships. Ship-building is today able to build the co-called maxi-voyager cruise ships having a length of over 450 meters and a capacity of over 5,000 thousand tourists. In the tourist season, the organised ports for great cruise ships receive many cruise ships with thousands of tourists interested to visit the town. Revenues from the cruise business are significant and continuously in growth; but on the other side, this is a tourist activity that aggressively encumbers town life calls for great efforts to secure the sustainability of town life.

Photo 1. Port of Split before the Second World War

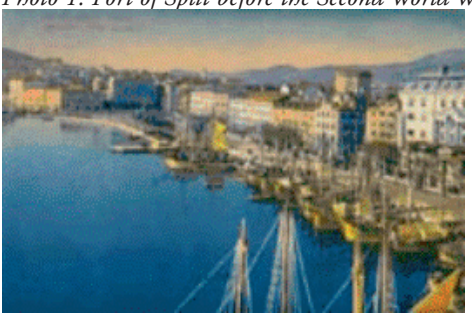


Photo 2. Port of Split after Patriotic War

Source: Internet, www.ak-split.hr

The Port of Dubrovnik, similar to the Port of Split, has a dynamic, but specific development. The old port is part of the three-thousand-year-old boundary walls, with a red lantern on Porporela indicating the entrance to the port. For a great number of years, passenger traffic with Dubrovnik took place in the old town port, while the Port of Gruž developed as a transhipment port because of its links by railway with inland region. Influenced by the tourist orientation of Dubrovnik, maritime traffic in the old port has ceded its role to tourist pleasure boats, which organise one-day excursions from the old town to tourist resorts of the Dubrovačko-neretvanska County. The development of the cruise industry worldwide has had a great impact on Dubrovnik, enabling the town, thanks to tourism as its main economic activity, to join «Cruise Europe» association. The Port of Dubrovnik, as the sole Croatian port present in this association on the eastern coast of the Adriatic Sea, has organised itself for the

9 Internet, http://www.nacional.hr

qualitative acceptance of tourists arriving on cruise vessels.. The organisation of the Port of Dubrovnik[10] is carried out through two port facilities, that is, the Old Port and the Port of Gruž, both of which represent the Port of Dubrovnik, owned by the Town. The Old Port is utilised as a water area between the Lokrum inland and seaside for berthing of cruise ships, from where, tourists by shuttle boats land directly at the old town nucleus, while tourists arriving at the Port of Gruž are transported by buses to the town nucleus representing the main destination in Dubrovnik. Parallel to the cruise business activity of these two ports, the activities of many tourist agencies and other connected subjects take place. Revenues of the Port of Dubrovnik in 2006 amounted to HRK 23,224,224, while in 2007, they should reach approx. HRK 40 million . Such financial results are the crown of many years of steady growth in the cruise industry worldwide, in the Mediterranean and in Dubrovnik. The Port of Dubrovnik is developing its facilities in the Port of Gruž, where today work is being undertaken to enlarge the quays for berthing large cruise ships; such an enlargement of the quay will allow the number of 601,726 passengers from cruise ships registered in 2006 to grow to 865 thousand passengers as forecasted for 2010. This 130 million € investment is financed by the financial means of the Port and by loan of the European Bank. Such an investment is clearly profitable, as the port's annual revenues are expected to amount to 70 million €. The cruise industry has pushed passenger traffic from the foreground; it is gradually being relocated, leaving its area to the needs of nautical tourism. In the port of Gruž, a great marina near the operative quay for cruise ships is under construction. Consequently, nautical tourism occupies the greater area of port facilities, thus changing the profile of the port. This change gives rise to new problems which will be addressed in the following section.

Photo 3. Port of Gruž,

Source: Internet, www.mmtpr.hr

Photo 4. MSC Armonia, at anchorage in the Port of Old Town

Source: Internet, www.dubrovnik.hr

4.2. Town Port of Warnemünde

Changes to the profiles of town ports do not characterise only Croatian or Mediterranean ports; rather, this is a phenomenon characteristic of all ports going through dynamic development. In analysing the nautical tourist market according to a geographical criterion, it can be divided into the outbound and inbound nautical tourist market. The

10 Internet, www.portdubrovnik.hr

development of tourism is gradually making this division of the market irrelevant; with tourism in all countries undergoing very intense development in the last decades. Tourism is a new development opportunity for all countries, while coastal areas being particularly important for tourism development. For this reason we shall analyse a port, the development of which could, at first glance, be evaluated as being contrary to the development of Croatian and Mediterranean ports. Nevertheless, such evaluation is incorrect.

Warnemünde is a German sea resort situated on the cold waters of Ostsee, on the Baltic Sea. Warnemünde is a small tourist town, which is, at the same time, an important maritime port, important harbour for cruise ships, a tourist port, a port of nautical tourism and a fishing port. According to a typical German system, all activities are separately regulated, with development evolving in such a way that one branch of the port activity develops with a little impact on the other one. All port activities make an integrated offering that now has a predominantly tourist character. Although the spatial distances between these activities enable their autonomous development, they are, nevertheless, closely linked by a well-organised traffic infrastructure.

Photo 5. Old port of Rostok, 1894

Photo 6. Tourist port/town on Ostsee

Source: Internet, www.fotocommunity.de

Fishing port is situated on a particularly chosen location in which local and regional fishing industry is located, fishing boats, a service area for vessels and equipment, a fishing factory, large cold storage plants, a fishing industry school and sea security school, a Fishing Institute, and traffic and trade infrastructure linking this port with market. Fishing boats situated in the area of the tourist port are becoming part of the tourist, catering and local excursion cruise offer. Big cruise ships linking cruise destinations of the Baltic Sea and North Sea integrate and complete the overall offer.

Photo 7. Tourist port of Warnemünde

Photo 8. Fishing port of Warnemünde

Source: Photo by the author T. Luković taken in 2007

From the presented courses of development of the town ports of Split, Dubrovnik and the port of Warnemünde, it can be established that changes in the profiles of these ports reflect the way of life and dynamics of living in the towns to which they belong. Changes in the profile and function of the town port have been made as a response of the local and regional administration to market stimulation, requirements and demand. The town ports have always depended always upon the development of the town, and this development is been profiled in consideration to the development concept and model established by the immediate and the extended community. For example, the town ports on the Croatian coast have been developed in such a way that one dominant activity is superseded by another one, with the previously dominant activity being relocated to a new and less attractive location and substituted by the new activity in the town port area. According to the German model of town-port development, long-term location-related benefits are previously assessed and, then development is focused on the given location, which does not change for decades or even centuries. The Spanish model of town-port development has been developing on an extremely well-designed model of sustainable development, especially in its social part. This model is based on a high-grade development and organisation of town municipal ports in the management of which, competent subjects cooperate efficiently. Such a model has been adapted to the cultural and sociological profile of subjects and Spanish coastal inhabitants. Therefore, every nation-based area has formed its specific model of town-port development. This means that changes in the profiles of town ports are not disputable; what is disputable is the model according to which its development shall occur and how its development shall be managed. The arising question is: Is the coastal Croatian model of town-port development of town ports an optimal model and sustainable in the long run?

5. MANAGEMENT OF SUSTAINABLE DEVELOPMENT OF TOWN PORTS

As the above stated clearly shows, town ports condition the development of towns, and towns at the local and regional level focus their development with regard to market changes, as well as their own needs. The Croatian model of town-port development points to the dynamic changes occurring on a limited area of the port in which the domination of one activity is superseded by another. The problem of location value and valorisation remains, in the long term, is strictly determined by the fact that there is no other alternative to the location of the town/port nucleus.. This development model does not provide for the diversification and dispersion of the offer and location. Is such model in the long-term period sustainable from the viewpoint of its development and what does this imply in today's circumstances?

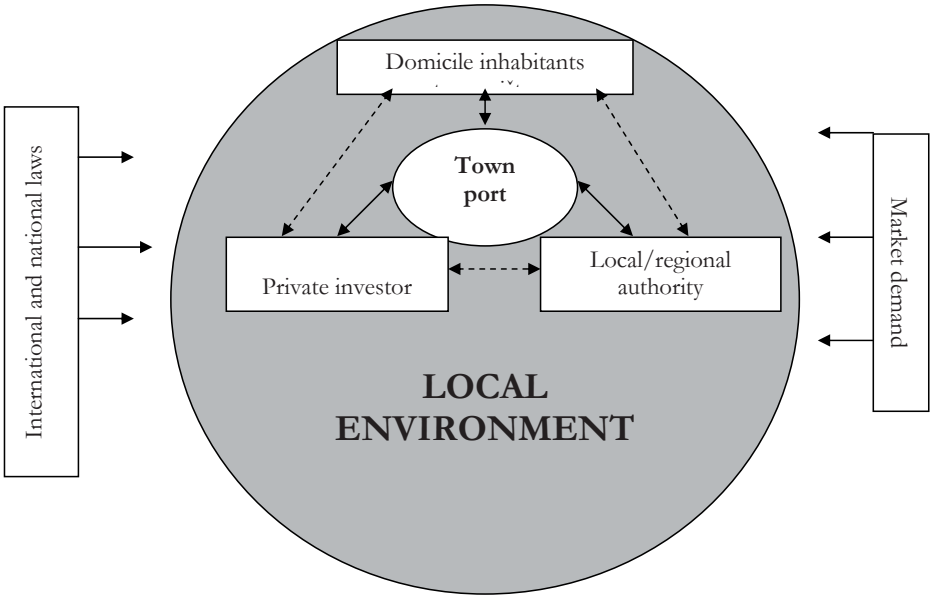
5.1. Theoretical analysis of the factor of sustainable development of old town ports

Today's outbound pulses of markets and demand that are focused on the town ports on the Croatian coast indicate that nautical tourism is very interested in the Croatian town ports. This interest is registered in all branches of nautical tourism and the more aggressive demands are coming from the cruise market. Berthing and illegal anchorage in the town ports have became a general practise. Port authorities still fail to act accordingly The value of the water area[11] and the seashore of old town ports on the Croatian Adriatic on the one hand, and the growing demand for nautical tourism, in particular cruise tourism, on the other hand underline the necessity to responsibly manage the ports as an economic resource. The classical form of management has to be substituted by new local and regional strategic management which shall ensure long-term sustainable development not only of the ports, but also of all directly or indirectly linked subjects.

The new management model should be based partner relationships of interest-linked partners. One of the more recent, simple, as well as efficient models of this relationship is the so-called *private and public partnership* linking private capital of an interested investor and local, regional and State administration in this investment partnership. The first good results of this model still do not indicate that this is a largely applied model. Where town ports are concerned, it is necessary first to define the competent subjects of the development model of sustainable development. The development model needs to be adapted to these subjects and their targets and it should be used to develop a quality communication and long-life education of subjects in order to accomplished the expected results and secure the long-term sustainable development of ports. Such development is illustrated in the following graphs (Graph 4).

11 5,800 km long Croatian costline is very jagged and has 750 gulfs, ports and small ports. It is estimated that the 104,000 boats, registered in 2006 in Croatia, use for their seasonal or annual berthing approx. 300 ports or small ports. At present, this potential is not being managed in anyorganised way, aggravating the problem of the sustainable and controlled use of natural resources and their management.

Graph 4. Relationship of the competent subjects of sustainable development of ports on local level

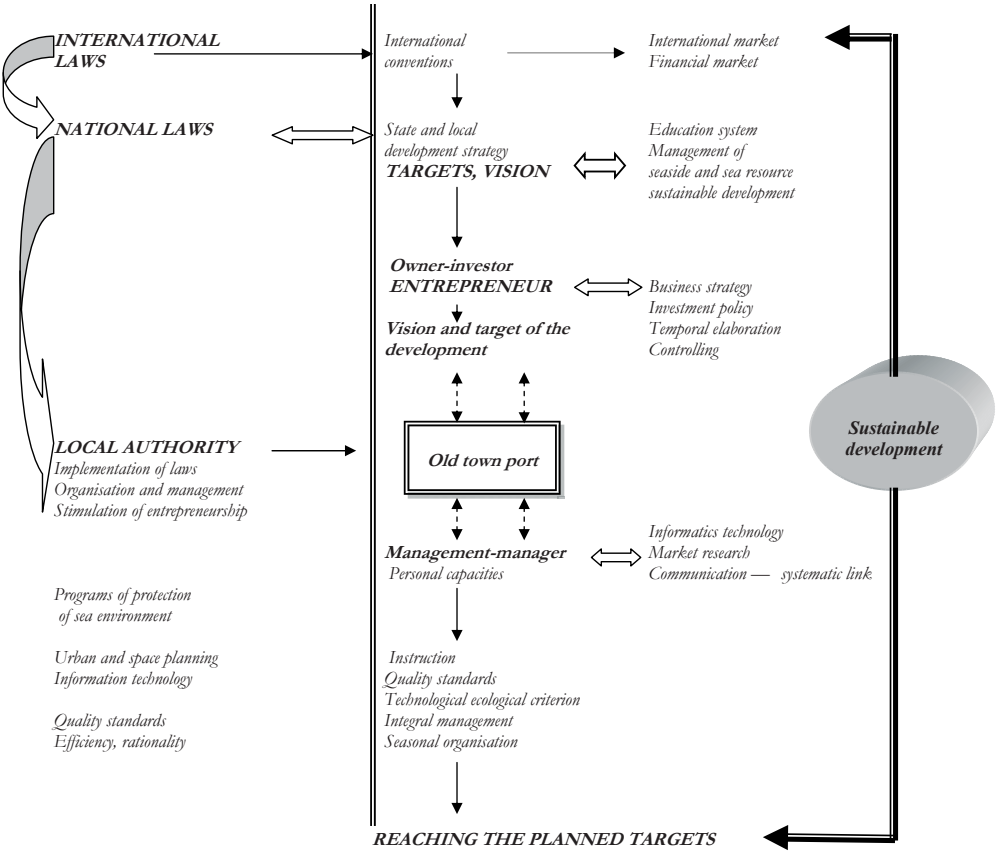


Source: Drawn up by the author T.Luković

This global model illustrates the relationship of the possible competent subjects in managing the sustainable long-term development of a town port at the local and regional level. In order to develop this model it is necessary to define its competent subject and regulate transparent relationships and competence. The reciprocally established relations have to be standardised. The development of local standards in these relationships contributes to the better functioning of the overall model. Researches carried out in Wales in 2006 by The University of Glamorgan Business School in order to develop regional management of the seaside belt and ports are based on defining competent subjects and development of standards of action among the involved subjects on the entire area.[12]. In order to optimise their functioning, these models require a very sophisticated and qualitative controlling, what is, in our conditions, an illusion. As this is about new relations, new management and highly valuable resource that carry a generational burden of use and development, the basic elements of the relationship shall be illustrated in the next model (Graph 5).

12 Luković, T., Šamanović, J., Menadžment i ekonomika nautičkog turizma, Split, HHI, 2007., str. 259.

Graph 5. Model of strategic management of town-port resources at the local and regional level



Source: Drawn out by the author M. Kovačić

As we can see, this model illustrates local and regional strategic management which is now being developed in advanced countries; this is an indication of the complexity of the entire system.

Every element of this model, from well chosen competent subjects, their personal educational and psycho-physical levels, across adequate legislation to controlling and an auditing and internal control system, is important for the successful functioning of the model. Are the subjects and the Croatian community capable of making and implementing such development decisions and solutions that can be sustainable in a long-term? Current examples clearly show that great efforts are still required. *Diversification* is an indispensable ancillary system for enabling town ports to make appropriate development decisions; such a concept is, in Croatian conditions, still an uncertainty and in conflict with Croatian mentality, especially the coastal mentality. In Croatia, the *concentration model* is deeply rooted in development methods and in the mentality; this model resists diversification making it difficult to find the appropriate solutions. What does this means for the problems of old

Croatian town ports in today conditions?[13]. Split was visited in 2006 by 183 cruise ships, and the town port achieved a turnover of 3,5 million passengers and 700,000 vehicles with a very high coefficient of seasonality. Considering that the Port of Split contributes with 40% of the town revenues, at present, activities are being undertaken to enlarge the quay and to build new ones. By 2010, the planned facilities should be able to handle twice this turnover Considering that Split is greater than Dubrovnik, and that its growth is still limited by sustainable development, the question arises: What is the situation of Dubrovnik? In 2006, the Port of Dubrovnik was visited by 574 cruise vessels and 603,047 tourists from cruise ships were transported to the town centre. The port achieved a total revenue of HRK 14.402.983 million , and profit was double that of 2005. In addition to the very profitable traffic with cruise ships, this amount was also due to 545,000 passengers in the domestic and international maritime passenger traffic. Investments in the enlargement of port facilities, primarily the Port of Gruž, should make it possible for 10,000 passengers to embark and disembark at the same time and its quay shall be able to moor three big cruise ships. If ship accommodation in the old town port are added to these figures, as well as tourists visiting Dubrovnik within other tourist arrangements, it is estimated that more than 20,000 tourists visit Dubrovnik daily. Dubrovnik is the more poorly supplied, has the smallest spatial area, but possesses the most beautiful town centre. This means that according to these figures, during the high season, 20,000 tourists wish to visit Stradun. Stradun is acceptably full only once a year, that is, on its world--known New Year Open-Air Party, when there is approx. 15,000 people, representing the maximum acceptance number. This disproportion between accommodation and demand creates indescribable crushes, chaos and nervous sensation in the town. Where is the solution? How is it possible to accommodate the 20,000 people who want to come to Stradun?

This topical problem has been the subject of many discussions. Some solutions are in favour of breaking through another gate in the wall, while others attempt to solve the problem in a similar way. All solutions start from the need to permit the arrival of a great number of tourists to the old town nucleus. Solutions based on the diversification of the offering, in which the key to the problem lies, have still not been excepted.. Until a solution is reached, town administration has decided to set an acceptable limit, that is, a coefficient of saturation limiting cruise ships traffic[14]. The problem of Dubrovnik is not only a municipal and regional problem, but it is a state problem, as well, in which the State should take a greater part than it does today.

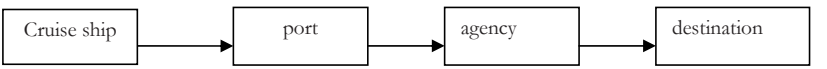
5.2. What kind of approach for solving the problem?

The fact is that nautical tourism, and especially cruise tourism, with its demand, good financial results and capital of great corporations, leaves little space for the following question: are we in favour of cruise tourism and new facilities of nautical tourism in the old ports or not? Nautical tourism as well as cruise tourism, as its strongest branch from the viewpoint of capital, are developing very fast and dynamically, while the cruise industry,

13 Internet, www.mmtpr.hr
14 Internet, www.dubrovnik.hr

within corporations, has become one of the greatest world-wide corporative form of business activity.

Within the activity of ports of nautical tourism and charters, nautical tourism and domestic cruises with typical old-timers are adapting as best as possible to locations, destinations and old ports. Their activity has a seasonal character and from the functional point of view, it is connected to the destination forming sustainable development on an appropriate way. Unfortunately, this is not the case with the world cruise industry. Great world cruise industry, as a great world-wide corporative business, is undergoing a dynamical development using developed and attractive destinations, and primarily, old town ports. The fundamental form of organisation of this activity is as follows:



According to this basic model, the tourist route of cruise ships on the world market is formed. Routes are the basic form of the offering of cruise ships located in all world seas. The schedule of cruise ship routes, analysed according to mega-cruise destinations, is at present in favour of the American continent (Table 1).

Table 1. Ranking of cruise destination in 2005

rank	destination	%
1	Caribbean	46
2	Mediterranean	11
3	Alaska	9
4	Northern Europe	8
5=	West Mexico	6
5=	Panama Canal	6
7=	South Pacific	2
7=	South America	2
9	Other	10
	Total	100

Source: Ross K., Dowling: «Cruise Ship Tourism», CAB International Cambridge, Cambridge, 2006, page 11

This table shows that the Caribbean Sea, followed by the Mediterranean Sea, are the most important world cruise mega-destination. Considering the seasonality of utilised cruise ships' capacity, it can be established that cruise tourism has a seasonal character, but with the lowest rate of seasonality in tourism. Now, taking into consideration statistical methodology, the quarterly performed research proves that, unlike the other branches of tourism and nautical tourism, the cruise industry is not characterised by seasonality (Table 2).

Table 2. Quarterly distribution of capacity of cruise ships according to world mega-regions in 2004 (in 000 bed/day)

	First quarter	Second quarter	Third quarter	Fourth quarter	Whole year
North/Central America	**15,767**	**14,430**	**14,454**	**16,287**	**60,938**
Caribbean/Bahamas	13,582	8,888	7,155	12,974	42,599
Mexican Riviera/Panama	2,182	1,586	1,246	2,549	7,563
Alaska	0	3,190	4,091	12	7,293
North-east Atlantic	3	766	1,962	752	3,483
Europe	**1,433**	**8,395**	**10,644**	**5,012**	**25,484**
Mediterranean	1,419	5,847	6,579	5,012	18,857
North-west Europe/Transatlantic	14	2,548	4,065	0	6,627
Rest of the world	**6,251**	**3,183**	**2,425**	**5,112**	**16,971**
South-east Asia and Far-east	1,269	1,384	1,340	1,579	5,572
South Pacific and Hawaii	1,745	936	890	1,992	5,563
Other submarkets	3,237	863	195	1,541	5,836
Subtotal active fleet	**23,451**	**26,008**	**27,523**	**26,411**	**103,393**
Laid-up vessels (temporarily)	1,382	456	137	871	2,846
Grand total world cruise fleet	**24,833**	**26,464**	**27,660**	**27,282**	**106,239**

Source : Own database adapted from Brogen (2004).

Source: Ross K., Dowling: «Cruise Ship Tourism», CAB International Cambridge, Cambridge, 2006., p. 20.

As it can be established by this table of utilised cruise ships' capacities, North and Central America, thanks to their geographical position, have no seasonal character and this is the reason why these areas occupy the first positions in ranking of world cruise mega-destinations. The greatest seasonality is reached in Europe, particularly in North Europe, where cruise tourism has reached a very high level of organisation and accommodation in the specialised ports for large cruise ships berthing.

Table 3. Structural distribution of the capacities of world cruise tourism per quarter in 2004

	First quarter	Second quarter	Third quarter	Fourth quarter	Whole year
North and Central America	63.30	54.31	52.03	59.51	57.15
Europe (incl. Transatlantic)	5.80	31.88	38.66	18.46	24.10
Rest of the world	25.30	12.08	8.81	18.83	16.05
Idle vessels	5.60	1.73	0.50	3.20	2.70
Grand total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

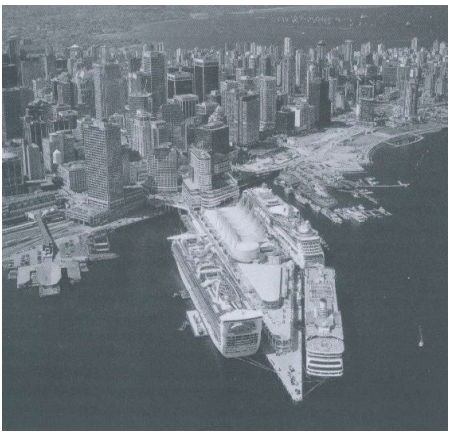
Source : Own database adapted from Brogen (2004).

Source: Ross K. Dowling «Cruise Ship Tourism», CAB International, Cambridge UK, Cambridge 2006, page 20

From this structural view of the engaged cruise tourism capacities, it emerges that Europe occupies the second position on the world cruise-tourism market. On the European cruise-tourism market, seasonality is most expressed, but with better cruise tourism development on this market, this region should have in the future a more dynamic growth than the other world markets.

Therefore, it can be concluded that great corporative cruise tourism does not take part in the problems of town ports and that ports have to solve their problem of sustainable development. The management of port resources is increasingly becoming a topical problem and practise together with science has to approach this problem in organising and shaping the sustainable development of ports, which are a vital part of all old Mediterranean and Croatian towns. In these terms, it is necessary to point out the importance of diversification. Considering their specificities and heritage, every town and port needs to draw up their own development model of sustainable development based on diversification of the offering and destination in term of tourist accommodation. The arrival of cruise ships with a thousand passengers (and during the tourist season several thousand tourists come on shore) represents a shock for the destination, which by its organisation and development model, has to amortise and reduce this impact to the level of sustainable development. Every location and port/town which has subordinated its long-term development to cruise tourism, has to draw up a development model of the port on the principles of diversification respecting at the same time specificities of the town, port and the broader location. In this, controlling plays a particular role in optimising all the process.

Photos 9 and 10: Cruise port of Vancouver 2002 and port of Canaveral, which is according to cruise traffic, the second biggest world cruise port



Source: Ross K., Dowling: «Cruise Ship Tourism», CAB International Cambridge, Cambridge, 2006, pages 154 and 280

Through these illustrations, it is apparent that diversification in port construction can be performed in many ways. For example, in the port of Vancouver a special quay has been built with all facilities for the acceptance and accommodation of cruise ships. Contrary to this expensive model, when US Congress adopted the construction of Canaveral Port in 1945, nobody expected that it would become the second largest port for the accommodation of big cruise ships. Canaveral Port is located outside the town, and tourist development of the town, which depends upon the port, is carried out through the close cooperation of the regional economy and science of Orlando, Florida with the town development of infrastructure, particularly of the infrastructure under the competence of the Port Authority. Diversification is never uniform, but has to be adapted to the location and targets of the local and regional administration.

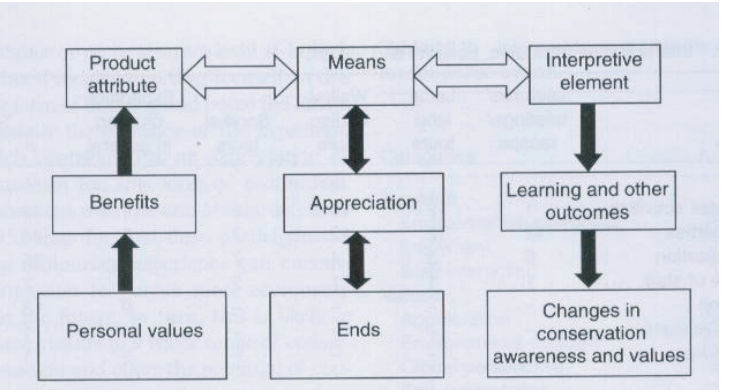
5.3. Reaction of the cruise tourism market (T. Luković)

The problem of the sustainable development of ports for cruise ship accommodation varies greatly from that of ports connected to the location in a different way, that is, by a long-term sustainability. Ports for the accommodation of old-timers develop business partnership relations, and their business results directly depend upon the quality of the port, town and destination. The offering of domestic old timers is shaped according to the attractiveness of the destination. A similar relationship between a port and a destination is present in the port of nautical tourism. For example, marinas, while using their facilities to encourage consumption within the marina, nevertheless depend upon the scenic beauty of the location in which they have been built.

In world cruise tourism, the relation between the cruise ship and the destination is purely business-linked without the cruise ship having any concerns for the location. In fact, the location is simply an attraction and it is based on this factor that cruise tourism corporations develop their routes. Nevertheless, the question arises as to whether a purely capitalis relationship can react to the simulations of sustainable business activities? Market always reacts, but in a specific way that is based on market interest. The reactions of the marketplace are subject to the market interest, the interest of capital and profits. Classical market considerations were not of a long-term character. The world market crisis, in terms of a crisis of ideas for profitable business activity, has caused the marketing concept to be developed on a long-term basis. Such a development concept is increasingly becoming to be accepted even by the large world cruising companies.

Large cruising corporations permanently survey the marketplace, focusing their attention to the potential cruise tourist/passenger to whom the attractiveness of a destination is the basic target of the trip.

Graph 6. Decision-making model in the relationship: potential cruise passenger – cruise ship – perception of the destination



Source: Ross K., Dowling: «Cruise Ship Tourism», CAB International Cambridge, Cambridge, 2006, p 109.

Concern for the destination becomes an issue of cruise corporations, that is, of cruise vessels; in any case, the initial base is quite different. This indicates the development of a new partnership in the cruise business, which shall be increasingly directed towards the sustainable development of the destination. In this way, the construction and development of cruise ships is directed and harmonised according to the location. This means that cruise construction is being harmonised to the Adriatic Sea, in which big cruise vessels appear to be like a bull in a china shop. The beautiful sites of many Croatian destinations, in particular Trogir, Bol, Hvar and Kornati, remain inaccessible to passengers of great cruise ships. This is the reason why large cruise corporations, joined by less strong private capital, are building small cruise ships with 250 beds, adapted to the facilities of smaller destinations. For the time being, these are good indications that contribute to the development of all town ports; otherwise, in the near future, the coast shall become saturated withfacilities and shall lose its characteristics, which have been the basic motivating factor for the arrival of tourists and boaters.

New small luxurious cruise vessels shall become rivals to the fleet of domestic cruise ships – old timers, resulting in changes in the offerings, improved quality of the domestic offering, and lower prices, as well as in other types of change that can at present only be foreseen.

Photos 11 and 12. Croatian cruise ship MB Sagena in navigation and small cruise ship Le Ponant in front of Dubrovnik

Source: Internet: www.jedrenjak.com and www.dubrovnik.hr

6. CONCLUSION

Nautical tourism in Croatia, Europe and the world is developing in the form of ports of nautical tourism, charters and cruise tourism. Ports of nautical tourism have the characteristics of "non-movable" activity and are tied to an area. For valorising space, they have to be joined also by national cruise vessels, that is, by old-timers and small cruise ships. Charter as an economic activity is strictly linked to the ports of nautical tourism and natural, urban destinations that are of interest to boaters/tourists.

Unlike the ports of nautical tourism and charter, the world cruise industry is a movable activity, which is not functionally conditioned by the sustainable development of a location. This problem has been left to the location, that is, to the old town ports. The good financial results, achieved by ports for cruise ships accommodation, are directing large town ports

to change their classical profile and organise themselves as ports for receiving cruise ships. This change of profile of ports occurs, on the one hand, in accordance with the conditions influenced by «Cruise Europe», as association of ports that can receive large world cruise ships, and on the other side, by the long-term sustainable development of the town. The model of sustainable development depends upon the location, spatial and urban local and regional planning, and upon the investment means available.

Croatian development models for town ports are subjected to the traditional demand for centralising the offerings and they focus on the town port. This model, in collision with sustainable development and lacking a long-term character, is opposed by a model based on diversification. This model has to be developed in Croatia in the same way it has been developed in other parts of the world; however, every port/town has to adapt its development to its natural environment and long-term planning. In this respect, this article represents a specific contribution to this process.

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1. Introduction (M. Kovačić)
2. Nautical Tourism and its Basic Factors (T. Luković)
3. Town ports and their economical importance (T. Luković)
4. Examples of changes and adaptations of old town ports (T. Luković)
5. Management of sustainable development of town ports (T. Luković and M. Kovačić)
   5.1. Theoretical analysis of the factor of sustainable development of old town ports (T. Luković and M. Kovačić)
   5.2. What kind of approach for solving the problem? (T. Luković and M. Kovačić)
   5.3. Reaction of the cruise tourism market (T. Luković)
6. Conclusion (T. Luković)

NOVI PROFIL GRADSKIH LUKA U RAZVOJU NAUTIČKOG TURIZMA

SAŽETAK

Pomorske luke dio su velikih gradova i njihova najatraktivnija i najvrjednija područja. Razvoj luka u Hrvatskoj i na Mediteranu išao je u korak s razvojem gradova na obali. Njihova starost jednaka je starosti grada. Tijekom povijesti, gradske su luke mijenjale svoju gospodarsku ulogu i profil, prilagođavajući se potrebama tržišta i grada.

Razvoj nautičkog turizma izvršio je na stare luke veliki pritisak, u smislu promjene njihovog postojećeg profila. Gradske luke velikih i srednje velikih gradova vjekovima su u funkciji pomorskog prometa, prijevoza ljudi i tereta i trgovine. Dobri razvojni rezultat nautičkog turizma i kontinuirano visoke razvojne stope, zahtijevaju promjenu klasičnog profila gradskih luka na način da se luke za pomorski promet transformiraju u luke nautičkog turizma.

O kakvim se promjenama radi? Što donose te promjene? Na ova i druga pitanja nastoji se odgovoriti u ovom tekstu.

Ključne riječi: *stare gradske luke, nautički turizam, marine, veliki svjetski cruising, hrvatski old timeri*

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TEMELJNE DIMENZIJE KVALITETE LUČKE USLUGE

Brze promjene potaknute tehnološkim unapređenjima i intenziviranje korištenja luka kao logističkih središta u cjelokupnom transportnom i logističkom lancu potaknulo je sve veću konkurenciju između luka. Kvaliteta lučkih usluga uz cijenu postala je ključnim čimbenikom funkcioniranja luka i održavanja njezinog položaja na zahtjevnom i promjenjivom tržištu lučkih usluga. Istraživanja na temu kvalitete lučke usluge čija je svrha mjerenje kvalitete u skladu s potrebama i zahtjevima korisnika vrlo su rijetka, što je razvidno na temelju dostupne domaće i strane znanstvene literature.

Cilj ovoga rada je ukazati na važnost utvrđivanja kvalitete lučke usluge, kao pretpostavke uspješnog razvoja lučke industrije i prometnog sustava u cjelini, koja prije svega zahtjeva definiranje dimenzija kvalitete. Kompleksnost luke s obzirom na veliki broj zainteresiranih skupina i usluga koje pružaju, otežava definiranje jedinstvenog seta dimenzija. Iako se kvaliteta može analizirati s različitih aspekata, u ovome radu predloženi set dimenzija kvalitete lučke usluge identificirat će se prema potrebama i zahtjevima korisnika lučke usluge.

Ključne riječi: *kvaliteta usluge, lučka usluga, dimenzije kvalitete*

1. UVOD

Usluge prožimaju svaki aspekt našega života. Njihova složenost i raznolikost dramatično su porasle tijekom prošlog stoljeća. Suprotno uvriježenom mišljenju, usluge su, a ne opipljivi proizvodi, poticale moderni gospodarski rast [2, str. 6].

Usluge zauzimaju gotovo dvije trećine ukupnog svjetskog outputa. Trgovina uslugama raste brže od bilo kojeg drugog područja i pokriva jednu petinu svjetske trgovine [23, str. 332]. Globalna trgovina u uslužnom sektoru rasla je brže od trgovine proizvodima u prošlom desetljeću.

Kvaliteta usluga česta je tema istraživanja stručnjaka i znanstvenika, što je promaknulo odnos između poslovnih uspjeha, smanjenja cijena, zadovoljstva korisnika i profitabilnosti, te dalje motiviralo i znanstvenike i stručnjake u istraživanju ovoga područja.

Iako je razvidno ubrzano ulaganje i porast trgovine uslugama, znanstvena istraživanja i literatura u području kvalitete lučke usluge je vrlo siromašna. Provedena istraživanja najčešće

se odnose na definiranje dimenzija[1*] kvalitete usluge, a vrlo rijetko istraživanja uključuju koncept i metode za mjerenje kvalitete i zadovoljstva korisnika dobivenom lučkom uslugom što bi trebao biti krajnji cilj ovih istraživanja.

Prema Juranu [10, str. 7], usluga predstavlja rad izvršen za nekog drugog. Po istom autoru definicija uslužne aktivnosti obično isključuje industriju, poljoprivredu, rudarstvo i građevinarstvo, a najčešće sadrži: javni transport, telefonske komunikacije, energetske usluge, medicinske usluge, prodaju svih vrsta roba, sve vrste financijskih usluga, medije, javne informacije, osobne usluge (pranje, čišćenje, friziranje i sl.), stručne usluge, državne usluge, itd.

Kontinuirane promjene u međunarodnom prometnom sustavu, osobito u posljednjih dvadesetak godina, doprinijele su razvoju integriranog koncepta transporta s ciljem zadovoljenja potreba i zahtjeva[2*] korisnika. Prihvaćanje koncepta u kojem korisnik nameće razinu kvalitete usluge koju plaća, rezultira povećanim pritiskom na luke i potrebu prilagodbe prihvaćanju novih funkcija. Luke su prisiljene prihvatiti nove nacionalne i međunarodne strategije razvoja, kao i brojne reforme u zakonodavstvu i regulativi te tržišnom okruženju u kojem djeluju.

Kvalitetnim i efikasnim lučkim uslugama povećava se uslužnost cjelokupne transportne djelatnosti što je od iznimne važnosti za razvoj nacionalnog i međunarodnog prometnog sustava i gospodarstva. Pružanje kvalitetnih lučkih usluga s obzirom na zahtjeve tržišta, transportnu mrežu, zaštitu okoliša, sigurnost i zahtjeve korisnika, temelji se na jasno definiranim funkcijama, procesima, aktivnostima luke i zainteresiranim skupinama koje koordinirano sudjeluju u proizvodnji lučkih usluga.

2. POJMOVNO ODREĐIVANJE KVALITETE USLUGE

Kvaliteta se u svijetu, po mnogima, smatra najznačajnijim fenomenom našeg vremena s trajnim trendom njegovog naglašavanja. Porast značaja kvalitete je došao kao potpuni civilizacijski odgovor na posljedice industrijskog razvoja. Smatra se da je kvaliteta ključ japanskog poslovnog uspjeha. Japanski poslovni *bum* dugo je šokirao Zapad i trebalo je dosta vremena da se pronikne u tajne njegovog uspjeha, u čijoj je osnovi bila nova filozofija kvalitete [10, str. 3].

Sve do pedesetih godina 20. stoljeća kvaliteta je smatrana sastavnim dijelom drugih umjetnosti, vještina, znanja i struka, a tek od toga perioda može se reći da istraživanje kvalitete postaje potpuno samostalna znanost sa svim pripadajućim atributima.

Riječ kvaliteta potječe od latinske riječi *qualitas*, što u prijevodu znači *kakav*.

U Rječniku stranih riječi Bratoljuba Klaića, kvaliteta je definirana kao svojstvo, vrsnoća neke stvari, vrednota, odlika, značajka ili sposobnost.

Prema Općoj enciklopediji Leksikografskog zavoda, tumačenje riječi kvaliteta dato je na stranici 707., svezak III: „Svojstvo, osobina, kakvoća; ono što označuje (obilježava, određuje) neki predmet ili pojavu i razlikuje ih od ostalih predmeta ili pojava“.

1 * dimenzije su najvažniji parametri kvalitete usluge koji se mjere setom atributa

2 * zahtjev je specifičan slučaj korisničke potrebe ili želje, zahtjevi oblikuju kvalitativne standarde

Autor Nenad Injac definira kvalitetu kao mjeru ili pokazatelj koji pokazuje obujam, odnosno iznos uporabne vrijednosti nekog proizvoda ili usluge za zadovoljenje točno određene potrebe na određenom mjestu i u određenom trenutku – onda kad se taj proizvod i usluga kroz društveni proces razmjene potvrđuju kao roba. Cilj je svakog proizvođača da mu se proizvod ili usluga potvrde kao roba i upravo tu na scenu stupa kvaliteta kao presudan faktor u procesu razmjene i kupoprodaje.

Općenito se može reći da kvaliteta označava vrijednost, valjanost neke stvari, njenu primjerenost određenim uzorima, zahtjevima, normama (kvaliteta prirodnih materijala, kvaliteta industrijskih proizvoda, kvaliteta trgovačke robe te kvaliteta tehničkih i umjetničkih radova) [10, str. 6].

Engleska literatura često ističe da ciljevi kvalitete moraju biti [7, str. 103]:

- takvi da su temeljeni na politici kvalitete
- prilagođeni različitim razinama organizacije
- **S**pecific (specifični odnosno određeni)
- **M**easurable (mjerljivi)
- **A**chievable (dostižni)
- **R**elevant (relevantni, svrsishodni, suvisli) i
- **T**imebound (vremenski ograničeni).

Početna slova daju englesku riječ SMART (oštrouman, bistar) čime je jednoznačno određeno kakvi bi, idealno, ciljevi kvalitete u organizaciji uvijek morali biti.

Literatura koja se bavi problematikom kvalitete daje osnovnu definiciju usluge i objašnjava pojam kvalitete usluge ističući pritom razliku s pojmom kvalitete proizvoda.

Razumijevanje kvalitete proizvoda i usluge bitno je različito.

Usluga je aktivnost ili korist koju jedna strana može ponuditi drugoj, uglavnom je neopipljiva i ne rezultira vlasništvom bilo čega. Njezina proizvodnja može, ali i ne mora, biti povezana s opipljivim, fizičkim proizvodom [11, str. 603].

Usluga je neopipljiv proizvod, čija je vrijednost definirana tržištem, odnosno potrošačem – korisnikom.

Grönross je pokušao objediniti definicije većeg broja autora, pa usluge definira na sljedeći način: „Usluga je aktivnost ili niz aktivnosti, u većoj ili manjoj mjeri neopipljive prirode, što se obično, ali ne i nužno, odvija u interakciji korisnika s osobom koja pruža uslugu i/ili s fizičkim resursima odnosno sustavima onog tko pruža uslugu, a koja se pruža kao rješenje problema korisnika“[5, str. 27].

Za razliku od materijalnih proizvoda, proizvodnja i potrošnja usluga ostvaruje se istodobno, zbog čega je nemoguće prosuđivati o kvaliteti usluge prije nego se ponudi tržištu, odnosno korisniku. Korisnikovo prosuđivanje kvalitete usluge najvažniji je pokazatelj stvarne vrijednosti usluge što potvrđuje veliki broj definicija.

Juran kao jedan od najpoznatijih stručnjaka, kvalitetu definira na dva načina [10, str. 6]:
„Kvaliteta je zadovoljstvo kupca“,
„Kvaliteta je prikladnost za upotrebu“.

Johston G. W. također ističe važnost kvalitete s aspekta korisnika tvrdeći: „Kupac je kralj na tržištu i zadovoljenje njegovih potreba znači istinsku kvalitetu proizvoda i usluga“ [1, str. 1].

Pružanje usluga znači ostvarivanje koristi za klijenta koji plaća dobivenu uslugu. Usluge su danas vrlo često zastupljene u gospodarstvu, a s obzirom na specifičnosti, mogu se izdvojiti sljedeće značajke [21, str. 101]:

1. *neopipljivost* – usluge se ne mogu vidjeti, opipati, probati ili dodirnuti prije kupovine
2. *kvarljivost* – neiskorištenost kapaciteta znači izostajanje usluge, jer usluge ne mogu biti predmet skladištenja
3. *heterogenost* - usluge mogu biti različite kvalitete s obzirom na davatelja usluga
4. *odsutnost vlasništva* – korisnik može imati samo pristup ili korištenje kapaciteta tako da plaća samo uporabu, pristup ili zakup
5. *simultanost procesa proizvodnje i potrošnje* – usluge imaju kratke ili uopće nemaju distribucijske kanale. Potrošač mora putovati da bi dobio uslugu ili će to uraditi onaj tko pruža uslugu.

Kvaliteta usluge predstavlja skup aktivnosti kojima se djeluje na zadovoljenje potreba čovjeka (kvaliteta usluga za čovjeka) i na vraćanje kvalitete proizvoda u tražene granice za njegovo daljnje funkcioniranje (kvaliteta usluga za proizvod).

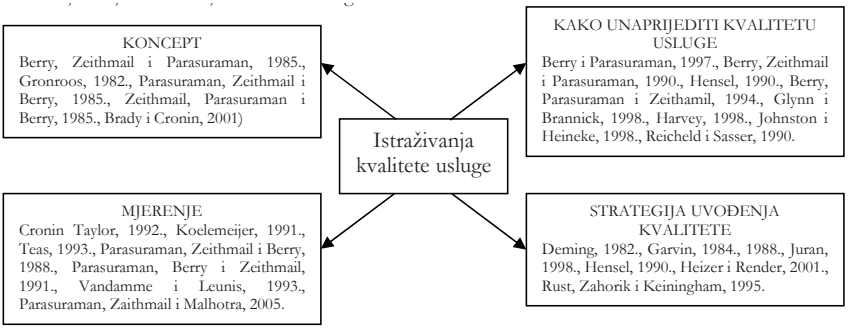
Sve prethodno izneseno može se primijeniti i na istraživanje kvalitete lučke usluge.

3. DOSADAŠNJA ISTRAŽIVANJA MODELA KVALITETE USLUGE

Tijekom posljednja dva desetljeća kvalitetom usluge bavili su se stručnjaci, menadžeri i istraživači zbog činjenice da ima veliki utjecaj na poslovni uspjeh, snižavanje cijena, zadovoljstvo korisnika, lojalnost korisnika i profitabilnost. U tome periodu postoje kontinuirana istraživanja s ciljem utvrđivanja definicije kvalitete usluge, postavljanja koncepta dimenzija kvalitete radi mjerenja kvalitete usluge, utvrđivanja procedura za prikupljanje podataka itd.

Shema 1. prikazuje najvažnija područja u sklopu kojih su provedena istraživanja na temu kvalitete usluge. Istaknuti istraživači u najvećoj su mjeri doprinijeli postavljanju koncepta kvalitete usluge, utvrđivanju modela za mjerenje usluge kao i razvoju metoda i alata potrebnih za unapređenje kvalitete usluge u nekoj organizaciji.

Shema 1. Najvažnija istraživanja o kvaliteti usluge



Izvor: Effects of Service Quality Dimensions on Behavioural Purchase Intentions, A Study in Public-sector Transport, Managing Service Quality, 17(2007), 2, str. 137.

Istraživanja fokusirana na implementaciju kvalitete usluge u organizacijama ukazuju na činjenicu da se unapređenje kvalitete može mjeriti zadovoljstvom korisnika, pozicijom na tržištu i profitabilnošću.

S obzirom da je u ovome radu naglasak dat na dimenzije kvalitete lučke usluge radi definiranja koncepta na temelju kojeg se može izvršiti mjerenje usluge u luci, navode se i ukratko opisuju neki modeli.

Utvrđivanju koncepta kvalitete usluge može se prići s dva stajališta:

- s europskog stajališta
- sa sjevernoameričkog stajališta.

Prva istraživanja kvalitete usluge u Europi zabilježena su u Skandinaviji i sjevernoj Europi (Gronroos, 1991). Lehtinen i Lehtinen (1982) definirali su kvalitetu usluge kroz:

- fizičku kvalitetu (dodirljivi aspekt usluge)
- interaktivnu kvalitetu (interakcija između korisnika i davatelja usluge)
- korporativnu (imidž) kvalitetu (doživljaj postojećih i potencijalnih korisnika).

Prema europskom stajalištu, kvaliteta usluge je razlika između očekivanja korisnika o usluzi koju trebaju i percepcije korisnika o dobivenoj usluzi. (Gronsoos, 1984).

Gronroos je 1984. godine razvio tehnički i funkcionalni model kvalitete. Ovaj model bazira se na razlici između očekivane i percipirane kvalitete usluge od strane korisnika. Kvaliteta je rezultat tehničke kvalitete *what* (odnosi se na tehničku sposobnost ili *know how* organizacije, objektivna je) i funkcionalne kvalitete *how* (funkcionalna kvaliteta podrazumijeva kakvi su procesi koji su doveli do funkcionalne kvalitete).

Dabholkar je 1996. godine prezentirao model tehnološke potpore self-service mogućnosti. Santos (2003) razvio je model e-quality, radi zadržavanja korisnika, korisnikova zadovoljenja i profitabilnosti za organizacije u e-poslovanju.

Sjevernoamerički pristup naglašava činjenicu da postoji nekoliko dodirljivih elemenata u ponuđenoj usluzi, zbog čega je potrebno istraživanja usmjeriti na nedodirljive elemente. U skladu s tim, Parasuraman et al. (1988) razvili su SERVQUAL skalu, koja uključuje pet dimenzija i 22 atributa kvalitete usluge. Dimenzije su:

(1) dodirljivost
(2) pouzdanost
(3) poistovjećivanje
(4) povjerenje
(5) susretljivost.

Za mjerenje kvalitete usluge koristi se SERVQUAL upitnik, podijeljen u dva dijela: u prvom dijelu mjeri se očekivanje usluge, a u drugom dijelu percepcija dobivene usluge.

U području mjerenja kvalitete usluge, veliki broj istraživanja može se prikazati kroz nekoliko najznačajnijih modela:

- Parasuraman et al. (1988) razvili su SERVQUAL skalu;
- Cronin i Taylor (1992) prezentirali su SERVPERF skalu;
- Parasuraman et al. (1991) i Vandamme i Leunis (1993) proveli su reviziju SERVQUAL;
- Koelemeijer (1991) je razvio Q skalu kao ekvivalent SERVQUAL;
- Teas (1993) razvio je model percipirane kvalitete kao alternativu na Gronroosovom modelu tehničke i funkcionalne kvalitete (1984);
- Parasuraman et al. (2005) razvili su E-S-QUAL skalu za mjerenje kvalitete u kontekstu elektroničke usluge.

Istraživanja provedena projektom ISIC [19] ukazuju na probleme u lukama Europske unije, u kojima nepostojanje baze podataka otežava proces utvrđivanja kvalitete usluge što ujedno predstavlja i prepreku utvrđivanju konkurentskih prednosti pojedine luke s aspekta kvalitete usluge.

U sljedećoj su tablici komparirani modeli u različitim istraživanjima i istaknute značajne različitosti pojedinog modela. Važnost dimenzije kvalitete u modelu procijenjena je brojevima od 1 do 10, gdje 1 označava najveću vrijednost, a 10 najmanju vrijednost.

Tablica 1. Komparacija modela kvalitete usluge

Redni broj	Atributi kvalitete	Model						
		A	B	C	D	E	F	G
1.	Brzina	1						
2.	Dobrota (valjanost)	2						
3.	Cijena	3					10	
4.	Ponašanje, držanje, funkcioniranje, način rad)		1					
5.	Uglađenost, otmjenost, pristojnost, uljudnost		2		5			
6.	Kooperacija		3					
7.	Pažljivost		4					
8.	Ugled, čast		5					
9.	Pouzdanost		6	3	1	1	5	3
10.	Blagonaklonost, prijateljstvo		7					
11.	Ispunjavanje, provođenje			1			3	
12.	Specijalnost/posebne značajke			2			4	
13.	Usklađenost			4				
14.	Trajnost, postojanost			5				
15.	Upotrebljivost, korisnost			6			7	
16.	Estetski, profinjen			7			8	
17.	Opažati, razumjeti kvalitetu			8			9	
18.	Opipljivi čimbenici				10			
19.	Prilagodljivost, snalažljivost				2			
20.	Iskusnost, stručnost, spretnost				3			5
21.	Korisnost/ raspoloživost/ pristupačnost				4		1	2
22.	Komunikativnost				6			8
23.	Izvornost, vjerodostojnost				7			6
24.	Sigurnost, zaštita				7			4
25.	Razumijevanje				9	4		7
26.	Povjerenje, pouzdanje					2		
27.	Udobnost, lagodnost						2	
28.	Standardizirano						6	
29.	Fleksibilnost							1
30.	Stil							9

A: Tenner-DeToro, 1997., str. 65.
B: Tenner-DeToro, 1997., str. 71.
C: Garvin, 1987., str. 69.
D: Berry Zeithmal-Parasuraman, 1985., Tenner-DeToro, 1997., str. 68.
E: Berry Zeithmal-Parasuraman, 1990., Tenner-DeToro, 1997., str. 69.
F: Tenner-DeToro, 1997., str. 69.
G: Tenner-DeToro, 1997., str. 69.
Izvor: Rixer, A., I. Toth, L. Duma, Management-Concept and Quality-Strategic Elements of Transport-Logistics Services, Periodica Polytechnica, 9(2001), 2, str. 166.

Analizirajući tablicu, razvidno je da su različiti autori uzeli u obzir različite dimenzije i atribute kvalitete usluge. Takav zaključak proizlazi iz činjenice da 7 različitih modela kvalitete usluge kompariranih u ovoj tablici, definira čak 30 različitih atributa. Osim različitosti u poimanju relevantnih atributa kvalitete usluge, razvidna je i razlika u poimanju važnosti pojedine dimenzije i atributa kao npr. pouzdanost u nekim modelima ima najveću važnost, dok je u drugim modelima njegova važnost tek na šestom mjestu. Uz pouzdanost u više modela još se javlja samo razumijevanje i pristupačnost iako s relativno velikim razlikama u poimanju njihove važnosti u odnosu na ostale dimenzije i atribute.

Može se zaključiti, da istraživanja o kvaliteti usluge ukazuju na vrlo različita shvaćanja pojma kvalitete usluge što prije svega proizlazi iz značajki usluge i različitosti organizacija koje pružaju usluge, a najvećim dijelom radi subjektivnosti u percepciji kvalitete usluge zbog čega znanstvenici, istraživači, menadžeri i korisnici različito prezentiraju svoja stajališta.

4. KONCEPT KVALITETE LUČKE USLUGE

Porast lučke industrije potaknut je globalnim *ekonomskim bumom* koji je doveo do kontinuiranog rasta međunarodne trgovine, a time i do povećanja konkurencije među lukama. Konkurencija u prekomorskom prijevozu tereta također je porasla, zbog čega danas kvaliteta usluga koje luka nudi svojim korisnicima dolazi do izražaja. Luke su pokretači svjetskog gospodarstva, jer pokrivaju 90% svjetske trgovine s obzirom na ukupnu količinu roba u međunarodnim robnim tokovima [23, str. 488].

Važnost istraživanja kvalitete lučke usluge ističe i Europska komisija. U dokumentu nazvanom „Očvršćivanje kvalitete usluge u lukama: ključ europskog transporta" zvanom i „Lučki paket", Europska komisija je prvi puta ponudila smjernice za pristup tržištu lučkih usluga. Temeljni cilj strategije razvoja luka od strane Europske komisije je utvrđivanje pravila koja će postaviti visoke standarde na tržištu lučkih usluga radi ostvarivanja transparentnih procedura i visoke kvalitete.

Parasuraman et al. (1985) istakli su da je kvaliteta usluge profitabilna strategija koja zbog minimiziranja pogrešaka pri isporuci tražene usluge rezultira povećanjem broja potencijalnih korisnika, smanjenjem broja izgubljenih korisnika, te povećanjem konkurencije. Ovakvo se mišljenje o kvaliteti usluge pokazalo istinitim pogotovo u lučkoj industriji, čiji je porast izuzetno velik u posljednjem desetljeću.

Koncept kvalitete usluge je kompleksan i apstraktan što proizlazi iz osnovnih značajki usluge (nedodirljivost, heterogenost i nedjeljivost proizvodnje od potrošnje). Ukoliko se kvaliteta usluge analizira sa stajališta korisnika, uglavnom se vezuje uz razinu korisnikova zadovoljstva dobivenom uslugom što je subjektivno poimanje kvalitete (percipirana kvaliteta) u odnosu na očekivanu kvalitetu. U skladu s tim, Parasuraman et al. (1988) definirali su percipiranu kvalitetu usluge kao „globalnu procjenu ili stav povezan sa stupnjem izvrsnosti usluge".

Istraživanje kvalitete usluge složen je proces iz sljedećih razloga [25, str. 30]:

1. Teško je znati kada je korisnik zadovoljan. Postojeće tehnike marketinga osiguravaju znanje o korisnicima, njihovim potrebama i očekivanjima, ali profesionalci su bespomoćni u zamjećivanju što je to što korisnici žele ili ne žele i što su spremni prihvatiti.

2. Korisnici uvijek žele više i njihovo očekivanje kvalitete različito je od one što im se nudi. Samo praksa, osluškivanje i pozornost može dovesti do više ili manje istinite ideje.

Razvoj usluga ukazao je na potrebu mjerenja kvalitete usluge s aspekta organizacije, s aspekta zainteresiranih skupina koje sudjeluju u proizvodnji usluge i s aspekta korisnika usluge. Najveći problem u utvrđivanju kvalitete usluga u lukama jest nepostojanje jedinstvenog modela i alata za mjerenje kvalitete, odnosno utvrđivanja zadovoljstva korisnika dobivenom uslugom. Zbog toga potreba utvrđivanja dimenzija kvalitete lučke usluge mjerenih setom atributa i podatributa zahtjeva velike napore, ali isto tako jamči značajan stupanj znanstvene signifikantnosti.

„Lučke usluge" su usluge komercijalne prirode, koje luke pružaju svojim korisnicima, a oni ih plaćaju...[4, str. 3].

Svrha i cilj procesa proizvodnje lučke usluge je ukrcaj, iskrcaj, prekrcaj tereta i putnika, skladištenje i manipuliranje teretom, privez i odvez brodova i druge logističke aktivnosti (opskrba brodova, pružanje usluga putnicima, tegljenje...) [26, str. 128].

Proizvodnja lučke usluge temelji se na odvijanju niza lučkih djelatnosti i procesa (koje proizlaze iz funkcija luke - prometna, trgovačka, industrijska) uporabom lučke infrastrukture, suprastrukture i ljudskog potencijala.

Potreba za proizvodnjom lučke usluge definirana je odnosom ponude i potražnje na nekom području i njezino tržište može biti lokalnog, nacionalnog i međunarodnog karaktera. Proces proizvodnje i proces potrošnje lučke usluge je jedinstven proces, jer se istovremeno obavlja lučka djelatnost i proces proizvodnje i isporuke lučke usluge. Prema projektu ADVANCES, osigurati kvalitetnu lučku uslugu znači na konkurentan, pouzdan, siguran i za okolinu prihvatljiv način osigurati uslugu zadovoljavajući zahtjevima korisnika.

Koncept kvalitete lučke usluge temelji se na jasno definiranom pojmu kvalitete, utvrđivanju zahtjeva kojima luka mora udovoljiti na tržištu, utvrđivanju osnovnih funkcija luke (područja djelovanja), identifikaciji interesnih skupina i njihovih zahtjeva, te utvrđivanju uskih grla i najčešćih problema u funkcioniranju luka.

Osnovni zahtjevi koje moderna luka mora zadovoljiti jesu [3, str. 21]:

- porast kvalitete usluge
- visoka razina fleksibilnosti i prilagodljivosti
- zatvorena integracija sa svim transportnim granama
- bolja menadžment strategija
- veća efikasnost poslovne mobilnosti i angažmana u optimalnom funkcioniranju prometnog sustava.

Razvoj gospodarstva u svijetu, povećane količine tereta koje se javljaju u pomorskom prometu, neophodno doticanje luka u međunarodnim robnim tokovima, te pojava globalizacije tržišta, značajno je utjecala na tržište lučkih usluga. Korisnici (kupci) usluga u lukama teže za kvalitetnijom logističkom uslugom koja zahtijeva specifične komunikacijske strategije na operacionalizacijskoj i funkcionalnoj razini. Luke su primorane prilagođavati se zahtjevima korisnika prihvaćajući nove strategije u kreiranju, proizvodnji i isporuci vrijednosti svojih usluga. Vrijednost usluge zasniva se na izgradnji kvalitetnog odnosa između zainteresiranih skupina i koordinaciji njihovih aktivnosti i procesa s ciljem povećanja

uslužnosti i profitabilnosti, te smanjenja cijena usluga koje nude.

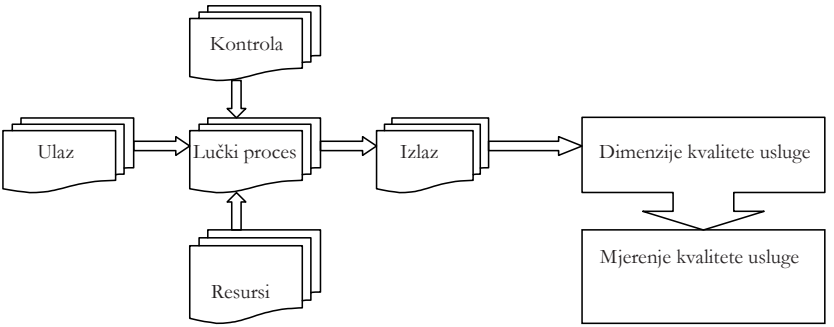
U skladu s funkcijama luke, jasno je da je temeljna svrha i cilj procesa proizvodnje lučke usluge pružanje usluga prema brodu i teretu, obavljanje administrativnih formalnosti te pružanje *value added usluga*.

Tipičan proces u luci na kontejnerskom terminalu može se prikazati kroz sljedeće grupe procesa:

- dolazak – proces dolaska pokriva čekiranje dokumenata i pripremu terminala radi organizacije procesa iskrcaja koji slijedi
- iskrcaj – proces pokriva fizičko kretanje tereta s broda na područje terminala uporabom prijevozno-prekrcajnih sredstava
- skladištenje – proces pokriva slaganje kontejnera, skladištenja, pražnjenje i punjenje kontejnera
- prekrcaj – proces pokriva dolazak vlaka i postavljanje vagona na ukracjnu traku i unatarnji transport kontejnera sa skladišnog prostora radi ukracaja u vagone
- odlazak – proces pokriva čekiranje dokumenata i pripremu vlaka za odlazak.

Shema 2. prikazuje proces nastajanja lučke usluge kroz čembenike koji predstavljaju ulaz, resurse koji sudjeluju u cjelokupnom procesu radi ostvarivanja izlaza, kontrolu i krajnji cilj lučkog procesa – kvalitetnu lučku uslugu koju je potrebno mjeriti radi osiguranja zadovoljavajuće razine kvalitete usluge.

Shema 2. Mjerenje kvalitete lučke usluge



Izvor: Sastavila autorica prema: Marlow, P.B., C. A. Paixao, Measuring Lean Ports Performance, International Journal of Transport Management 1(2003), str. 194.

U tablici 2. pojašnjava se shematski prikaz kroz opis procesa nastajanja lučke usluge.

Tablica 2. Opis procesa nastajanja lučke usluge

Ulaz	Teret i prijevozna sredstva
Izlaz	Izvršena usluga prema teretu i prijevoznim sredstvima
Kontrola	Poštivanje lučkih procedura i radnih instrukcija Poštivanje međunarodne regulative uključivši aspekte kao što je onečišćenje Adekvatno rukovanje opasnim teretom Poštivanje zahtjeva korisnika
Resursi	Ljudski resursi Informacijske tehnologije/informacijski sustavi Oprema za rukovanje teretom Infrastrukturni i suprastrukturni objekti terminala
Dimenzije kvalitete usluge	Frekventnost – vrijeme potrebno za dobivanje usluge... Pouzdanost – usluga je izvršena pravovremeno…. Fleksibilnost – prilagodljivost zahtjevima pri izvršavanju usluga … Dostupnost – jednostavan pristup prometnicama i informacijama… Kontrola – posjedovanje informacija o statusu i poziciji tereta… Sigurnost – izvršavanje usluge bez oštećenja ili gubitka tereta …

Izvor: Sastavila autorica prema: Marlow, P.B., C. A. Paixao, Measuring Lean Ports Performance, International Journal of Transport Management 1(2003), str. 195.

Zahtjevi za kvalitetom usluge mogu se definirati s obzirom na operacijska područja obavljanja osnovnih lučkih procesa. Operacijska područja podrazumijevaju zone obavljanja lučkih aktivnosti i procesa, te protok dokumenata i informacija vezanih uz prihvat broda i tereta. Tablica 3. prikazuje matricu zahtjeva koji proizlaze iz odnosa osnovnih elemenata koji sudjeluju u proizvodnji lučke usluge, te aktivnosti i procesa s obzirom na područje njihovog odvijanja.

Tablica 3. Zahtjevi kvalitete lučke usluge s obzirom na operacijsko područje i elemente proizvodnje

Elementi proizvodnje lučke usluge	**Operacijska područja**				
	Pristup s mora	Ukrcaj / iskrcaj / prekrcaj tereta	Prihvat tereta i skladištenje	Dokumentacija/ administracija	Pristup s kopna
Infrastruktura					
Suprastruktura					
Informacijsko/ komunikacijske tehnologije					
Ljudski resursi					

Izvor: Projekt Sphere, 1999., str. 12.

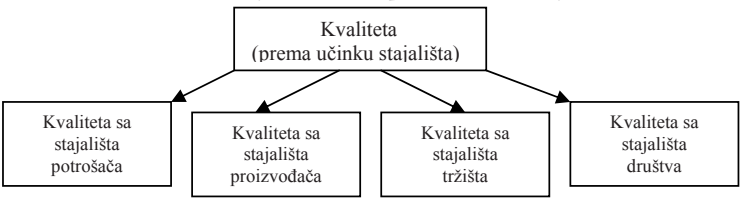
U skladu s tablicom 3. i prethodno opisanim značajkama lučke djelatnosti, te potrebama usmjeravanja kvalitete usluge na krajnje korisnike u sustavu, zahtjeve se može razvrstati i na sljedeći način:

- zahtjeve korisnika sustava – razlikuju se s obzirom na orijentiranost korisnika u sustavu. Korisnici lučkog sustava mogu biti kupci (osobe koje plaćaju dobivenu uslugu) i davatelji usluga (osobe čija se usluga plaća)
- zahtjeve na tehničko-tehnološkoj i organizacijskoj razini – djelovanje luke potrebno je temeljiti na činjenicama o tehničko-tehnološkim značajkama luke, uskim grlima i specifičnim zahtjevima organizacije
- zahtjeve za primjenu i razvoj adekvatnih informacijsko-komunikacijskih tehnologija
- zahtjeve nametnute od okoline – najčešće se odnose na pravna i institucionalna ograničenja.

Subjekti koji sudjeluju u proizvodnji usluga svoje aktivnosti provode i unapređuju u skladu s interesnim područjima usmjerenim na implementiranje zakonskih normi i međunarodnih standarda kvalitete, obrazovanje kadrova, kontinuirano investiranje u organizaciju i uspostavu konkurentnog tarifnog sustava, marketing prema konkurenciji, razvoj informacijske i komunikacijske podrške procesima (funkcijama) u sustavu.

Različiti subjekti u procesu nastanka, razmjene i isporuke usluge imaju različita stajališta u pogledu kvalitete te iste usluge zbog čega se može govoriti o kvaliteti prema učinku stajališta (Shema 3.).

Shema 3. Podjela kvalitete prema učinku stajališta



Izvor: Lazibat, T., M. Kolaković, Međunarodno poslovanje u uvjetima globalizacije, Zagreb, Sinergija, 2004., str. 149.

Kvaliteta sa stajališta potrošača (kupca ili korisnika) je razina ugrađene uporabne vrijednosti proizvoda ili usluge do koje ona zadovoljava određenu potrebu. Kvaliteta sa stajališta proizvođača je mjera koja pokazuje koliko određena usluga zadovoljava u pogledu koncepcije i isporuke. Kvaliteta sa stajališta tržišta je stupanj do kojeg određena usluga zadovoljava određenog kupca u odnosu na istovrsnu uslugu konkurencije. Kvaliteta sa stajališta društva je stupanj do kojeg su određene usluge prošle kao akt kupoprodaje i potvrdile se kao roba, ostvarivši pritom, obvezno, profit.

Kvalitetu usluge u lukama može se sagledati s tri aspekta:

1. s aspekta korisnika usluge – brodarske kompanije, vlasnici tereta, otpremnici, logistički operatori, poduzetnici multimodalnog transporta
2. s aspekta tržišta – financijski pokazatelji, tržišna pozicija
3. s aspekta društvene zajednice – stupanj ostvarivanja misije.

Prema projektu ADVANCES korisnici lučke usluge mogu se podijeliti u četiri skupine:

1. subjekti koji plaćaju uslugu: brodari, primatelji, vlasnici tereta
2. subjekti koji djeluju kao organizatori: otpremnici, agenti, logistički operatori, poduzetnici multimodalnog transporta
3. subjekti koji djeluju kao izvršitelji: transportni operatori, prekrcajni operatori
4. vlast: carina, lučka vlast.

Subjekti koji plaćaju uslugu rijetko koriste usluge luke posredno, odnosno najčešće za dobivanje usluge u luci angažiraju subjekte koji su organizatori cjelokupnog prijevoznog procesa kao što su međunarodni otpremnici ili logistički operatori.

Čimbenici koji mogu činiti prepreku uspostavljanju kvalitetnih usluga jesu [24, str. 19]:

- infrastruktura i tehnologija
- sigurnost i zaštita okoliša
- sposobnost kadra
- zakonski (pravni) čimbenici
- dostupnost tržišta.

U skladu s ovim skupinama čimbenika koji uglavnom predstavljaju uska grla funkcioniranja luke, mogu se utvrditi problemi specifični za lučke terminale. Definirani problemi predstavljaju temelj za utvrđivanje potencijalnih zahtjeva korisnika, te dimenzija i atributa kvalitete lučke usluge, a mogu se podijeliti u tri skupine:

- Organizacijski problemi - neprihvatljiv oblik organizacije terminala, razlike između operacionalizacijskog koncepta željezničkog transporta i dizajna terminala, nedostatna kooperacija između različitih sudionika, nedovoljan broj pilota,…
- Problemi menadžmenta i operacionalizacijski problemi - ograničeno vrijeme rada terminala, predugo vrijeme zadržavanja broda na pristanu, niska razina informacijske integracije, zakašnjenja zbog carinskih kontrola, nedostatni sustavi menadžmenta zaduženog za sigurnost...
- Infrastrukturni problemi - fizička ograničenost plovnog puta, nedostatan prostor za vezivanje, nedostatak prostora za spremanje i skladištenje, nedostatak parkirnih prostora, loša željeznička povezanost luke, zastoj u radu opreme terminala…

5. DEFINIRANJE DIMENZIJA KVALITETE LUČKE USLUGE

Istraživanja kvalitete usluge ukazuju na veliki broj različitih dimenzija koje mogu biti temelj za mjerenje kvalitete. Kao što je već naglašeno, poput činjenice da ne postoji jedinstvena definicija usluge niti jedinstvena definicija kvalitete usluge, jasno je da ne postoji niti jedinstveni koncept dimenzija koji bi se koristio kao temelj za utvrđivanje kvalitete lučke usluge.

U odnosu na definiranje dimenzija kvalitete usluge u putničkim lukama, dimenzije kvalitete usluge u teretnim lukama mnogo je teže definirati. Upravo zbog toga takva istraživanja dobivaju sve više na važnosti koristeći se pritom spoznajama, iskustvom i logičnim prosuđivanjem istraživača. Autori često ističu subjektivnost takvih istraživanja, definirajući set dimenzija kvalitete koji se uglavnom bazira na anketiranju korisnika usluge.

Prvi korak u identificiranju kvalitete usluge je determiniranje stupnja kvalitete koji

zadovoljava tržište. Berry, Zeithaml i Parasuraman identificirali su deset determinanti kvalitete usluga:

- pouzdanost: dosljednost (nepromjenjivost) performansi i ovisnosti, nema greški ili zakašnjenja
- pristupačnost: dragovoljnost ili spremnost namještenika za osiguranje usluge
- sposobnost (mjerodavnost): znanje i vještine kontaktnog osoblja
- pristup (dohvat): pristupačnost i jednostavnost u kontaktu
- ljubaznost (uljudnost): pristojnost, kolegijalnost, obzirnost, respektivnost službenog osoblja
- komunikacija: informiranje korisnika i slušanje korisnika
- vjerodostojnost (podržavanje): pouzdanost, iskrenost
- sigurnost: izostajanje opasnosti i rizika
- odnos (veza) razumijevanje pojedinačnih korisnikovih potreba
- nastup (izgled): doživljaj usluge , opreme i zaposlenika.

Intermodalni terminali u Europi ne podliježu niti jednoj specifičnoj procjeni kvalitete i kontrole zbog ne postojanja kriterija kvalitete i standarda. Da bi se unaprijedila kvaliteta usluge i efikasnost terminala, postoji velika potreba za razvojem dimenzija kvalitete [19, str. 87].

Dimenzije kvalitete moraju pokriti sve usluge i procese na terminalima. Uzevši u obzir sve subjekte koji imaju ulogu u procesu proizvodnje, isporuke i primanja lučke usluge, mogu se izdvojiti sljedeće dimenzije lučke usluge:

Tablica 4. Osnovne dimenzije kvalitete usluge u luci u odnosu na zainteresiranu skupinu

Dimenzija	Korisnik	Društvo	Organizacija
Pouzdanost			
Frekventnost			
Fleksibilnost			
Dostupnost			
Kontrola			
Sigurnost			
Društveni aspekt			

Izvor: Projekt ISIC, 2005., str. 79.

Pouzdanost kao dimenzija kvalitete usluge vrlo je signifikantna u evoluciji transporta tereta. Pouzdanost za korisnika podrazumijeva dobivanje prave usluge u prvom pokušaju, bez odstupanja od planiranog vremenskog okvira. Provedene ankete pokazuju da korisnici pouzdanom uslugom ne smatraju samo uslugu dobivenu na vrijeme već i uslugu koja u potpunosti slijedi i zadovoljava uvjete iz ugovora, te da pri tome raspolažu potrebnim informacijama i imaju zadovoljavajuću razinu komunikacije kod potrebe brzih odgovora na neki problem.

Usko vezano uz pouzdanost neki autori ističu i povjerenje kao dimenziju kvalitete s obzirom da je teret u cjelokupnom protoku od pošiljatelja do primatelja najčešće povjeren trećim osobama. Otpremnik kao organizator transporta tereta svoju djelatnost temelji na

informacijama dobivenim od trećih osoba i odgovoran je za sva eventualna zakašnjenja, zbog čega dobivena informacija mora biti točna i pravovremena.

Frekventnost kao dimenzija kvalitete usluge najčešće se odnosi na vrijeme utrošeno na dobivanje usluge u luci, dok fleksibilnost podrazumijeva mogućnost prilagođavanja zahtjevima s aspekta procedura, načina plaćanja ili mogućnosti promptnog odgovora na logističke zahtjeve.

Dostupnost kao dimenzija kvalitete može se sagledati kroz poslovnu dostupnost, koja podrazumijeva jednostavnost komuniciranja korisnika s lukom i fizičku dostupnost koja se ogleda u dostupnosti infrastrukturnih i suprastrukturnih objekata terminala.

Kontrola je proces važan i na ulazu u sustav i na izlazu iz sustava, uključujući i resurse koji sudjeluju u proizvodnji usluge, a uglavnom podrazumijeva nadgledanje pozicije i statusa tereta i točnog vremena isporuke tereta.

Društveni aspekt kvalitete usluge uključuje veći broj atributa od kojih su najvažnije odgovornost (pravovremeni odgovor na zahtjeve i pritužbe korisnika), kompetencija (posjedovanje znanja i vještina radi pružanja kvalitetnih usluga), komunikacija (osiguranje detaljnih i kompleksnih informacija), dodirljivost (fizički aspekt pružene usluge koji se odnosi na doživljaj zaposlenika, alata ili opreme, fizičkog doživljaja usluge).

Sigurnost kao dimenzija kvalitete važne su i za luku i za korisnike. Zbog velikog broja ukrcajnih i iskrcajnih operacija s teretom i operacija premještanja tereta na području terminala, sigurnost se ogleda u smanjenju rizika od oštećenja tereta što za posljedicu može imati i negativan utjecaj na okoliš (ukoliko se radi o opasnom teretu). S aspekta luke, sigurnost je od velikog značaja jer doprinosi imidžu luke.

6. ZAKLJUČAK

Na tržištima, kao što je lučko, usluge koje pružaju luke razlikuju se svojom kvalitetom, koja se mijenja u određenom vremenu što utječe na promjenu cijene ostvarene usluge. Kontinuirane promjene kvalitete i cijene usluga uvjetuju mogućnost izbora za korisnike i potrebu prilagođavanja davatelja usluga novonastalim situacijama zbog čega je neophodno postojanje dinamičkog sustava kvalitete. Uspostavljanje dinamičkog sustava kvalitete osigurava prednosti i za davatelje usluga i za korisnike: davatelji usluga mogu optimizirati korištenje svojih resursa, korisnici usluga mogu birati koliko žele platiti za dobivene usluge za što davatelji usluga moraju ponuditi zagarantiranu razinu kvalitete.

Luka je sustav čije funkcioniranje zahtijeva potpunu integraciju u logistički lanac da bi u potpunosti ostvarivala svoju funkciju. Efikasnost i kvaliteta usluge koju pruža luka zahtijeva adekvatnu infrastrukturu, suprastrukturu i opremu, adekvatne veze s ostalim transportnim granama, motivirani menadžment i kvalificirane zaposlenike.

Kvaliteta, efikasnost i cijena lučkih usluga čimbenici su o kojima ovisi konkurentnost luke. Prepoznavanje i priznavanje kvalitete kao univerzalne i istovremeno specifične značajke pružene usluge, doprinosi boljoj poziciji luke na tržištu lučkih usluga te stvaranju bitne pretpostavke integracije i konkurentnosti luke u nacionalnim i međunarodnim okvirima.

Zadovoljstvo korisnika dobivenom uslugom u luci neposredno je vezano uz njihove potrebe i zahtjeve, a percepcija usluge najznačajniji je pokazatelj koji se koristi za mjerenje

kvalitete usluge. Utvrđivanje stupnja zadovoljstva korisnika dobivenom uslugom u luci prilično je složeno zbog činjenice da je luka sustav koji čini veliki broj subjekata koji zbog intenzivnih tehnoloških promjena i sve većim zahtjevima koje pred njih postavlja korisnik, odnosno tržište moraju djelovati kvalitetno, uz potrebu povećanja ekološke svijesti i održivog razvoja.

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BASIC PORT SERVICE QUALITY DIMENSIONS

SUMMARY

Rapid changes induced by technological improvements and the intensified use of ports as logistics centers in the whole transport and logistics service chain have initiated an increasing port service competition. The port service quality, together with the costs of, has become the key factor in the functioning of ports and in maintaining their position on the demanding and fluctuating port services market. Researches into the port service quality and aiming at measuring the service quality according to the needs and demands of the port users are very rarely carried out, the evidence of which is based on the existing Croatian and foreign scientific literature.

The paper aims at pointing out the importance of determining the port service quality, being a prerequisite for a successful development of the port industry and the transport system as a whole, and to begin with the quality dimension needs to be clearly defined. The complexities of a port, as regards the large number of port users interested in such a port and of the services offered, make the identification of a unique set of dimensions more difficult. Although quality can be analyzed from various aspects, the paper aims at identifying the suggested set of port service quality dimensions according to the needs and demands of the port users.

Key words: *service quality, port service, quality dimensions*

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PRIKAZI KNJIGA, DOKTORSKIH DISERTACIJA I MAGISTARSKIH RADOVA

REVIEWS OF BOOKS, PH.D. AND M.SC. THESES

Renato Filjar

POGREŠKA SATELITSKOG ODREĐIVANJA POLOŽAJA ZBOG EKSTREMNIH IONOSFERNIH POREMEĆAJA

Doktorska disertacija mr. sc. Renata Filjara, dipl.ing., pod naslovom "POGREŠKA SATELITSKOG ODREĐIVANJA POLOŽAJA ZBOG EKSTREMNIH IONOSFERNIH POREMEĆAJA", izrađena pod mentorstvom prof. dr. sc. Tomislava Kosa, obranjena je 02. ožujka 2007. na Fakultetu elektrotehnike i računarstva u Zagrebu. Povjerenstvo za obranu bilo je u sastavu: prof. dr. sc. Boris Kviz - predsjednik, prof. dr. sc. Tomislav Kos - mentor, prof. dr. sc. Ivan Markežić s Fakulteta prometnih znanosti u Zagrebu, prof. dr. sc. Borivoj Modlic i prof. dr. sc. Serđo Kos s Pomorskog fakulteta u Rijeci.

Doktorska disertacija sadrži 113 stranica teksta, s 80 slika i 5 tablica, popis literature od 139 referencija, popis internetskih adresa, popis oznaka, 83 lista priloga vremenskih dijagrama nizova, njihovih spektara i korelacijskih funkcija ionosfernih kašnjenja, te sažetak, ključne riječi i životopis autora, na hrvatskom i engleskom jeziku.

Rad je podijeljen na sljedeća poglavlja:

1. Uvodne naznake
2. Satelitsko određivanje položaja
3. Svemirsko vrijeme
4. Ionosferska pogreška satelitskog određivanja položaja
5. GPS ionosferno kašnjenje u uvjetima izraženih promjena svemirskog vremena
6. Prijedlog modela ionosferske pogreške satelitskog određivanja položaja u ovisnosti o stanju svemirskog vremena i
7. Zaključak.

U poglavlju Uvodne naznake ukazuje se na značaj pojava i procesa koji se zbivaju u ionosferi, kao posljedica složenijih i opsežnijih procesa u međuplanetarnom prostoru, izazvanih promjenjivom aktivnošću Sunca, a nazvanih svemirskim vremenom. Prikazan je njihov utjecaj na mnogobrojne tehničke sustave na Zemlji, satelitske radiokomunikacijske sustave, a osobito sustave satelitskog određivanja položaja. Naglašena je težnja uvažavanja lokalnih posebnosti ionosfere za područje Republike Hrvatske i regije Jugoistočne Europe, a na temelju eksperimentalnih rezultata, uzetih s internetskih baza podataka. Zbog multidisciplinarnosti problematike potrebno je uskladiti nazivlje i način označavanja.

U drugom poglavlju opisan je postupak satelitskog određivanja položaja na primjeru sustava GPS. Definiran je izraz za pseudoudaljenost, a na temelju poznatih vrijednosti pogrešaka mjerenja i jedna točka trajektorije gibanja satelita. Od pogrešaka u određivanju položaja s pomoću satelita razmotrene su one uslijed netočnih satelitskih efemerida, netočnosti satelitskog sata, zbog višestrukih putova vala, uslijed šuma korisničkog prijamnika, te uslijed ionosferskog i troposferskog kašnjenja. Analizirana je geometrijska degradacija točnosti određivanja položaja, a uz pomoć korisničke razdiobe pogrešaka i ukupna pogreška satelitskog određivanja položaja, sve u uvjetima mirnog svemirskog vremena. U ekstremnim uvjetima

svemirskog vremena navedeni modeli nisu uspješni. Od predloženih statističkih modela uzroka pogrešaka prikazan je onaj kombinacije Klobucharovog i Gauss-Markovljevog.

U trećem poglavlju o svemirskom vremenu analizira se prostor između Sunca i Zemlje pod utjecajem solarne aktivnosti, kao uzrok poremećaja magnetskog polja Zemlje i ionosfere. Ionosfera je detaljno razrađena, od stvaranja ionosferskih slojeva do transporta i difuzije plazme, te neutralnih vjetrova. Gustoća slobodnih elektrona po visini razmotrena je njenim dnevnim, sezonskim, solarno ovisnim i geografskim promjenama. Dani su izrazi za procjenu kritičnih frekvencija pojedinih slojeva (E,F1,F2) i ukupnog sadržaja elektrona pri mirnom svemirskom vremenu.

Četvrto poglavlje bavi se ionosferskom pogreškom pri satelitskom određivanju položaja, te je definira ekvivalentnim ionosferskim kašnjenjem. Opisana je korekcija dvofrekvencijskim mjerenjima, fizikalnim modelima, te iskustvenim modelima (standardni GPS ili Klobucharov).

Peto poglavlje obrađuje GPS ionosfersko kašnjenje pri izraženim promjenama svemirskog vremena, kao što je to bilo tijekom listopada i studenog 2003. godine. Analizira se solarna aktivnost, stanje geomagnetskog polja i ionosfere te dinamika GPS ionosferskog kašnjenja procesiranjem rezultata mjerenja pseudoudaljenosti dvofrekvencijskim GPS prijamnikom, na referentnoj postaji Osijek, s internetske arhive. Dobivene (stvarne) vrijednosti mogu se aproksimirati Klobucharovim modelom s emitiranim koeficijentima, ili modelom korekcija, praćenjem dinamike GPS ionosferskog kašnjenja. Pokazano je, kako tok Sunčevog zračenja najranije počinje ukazivati na pojačanu solarnu aktivnost i poremećaje svemirskog vremena. Podaci o vertikalnoj komponenti gustoće magnetskog toka i kritičnim frekvencijama ionosferskih slojeva prikupljeni su na referentnoj postaji Atena, Grčka. Podaci su uzimani svakih 15 minuta, a za analizu su korišteni programski paketi dostupni na Internetu, kao i vlastita programska podrška za poslove nepokrivene gotovim paketima. Određene su apsolutne vrijednosti stvarnog i modeliranog GPS ionosferskog kašnjenja, te srednje vrijednosti pogrešaka Klobucharovog modela u odnosu na stvarno kašnjenje. Analizirani su spektri vremenskog niza izmjerenih maksimalnih dnevnih vrijednosti ionosferskog kašnjenja, kao i autokorelacijske funkcije takvog vremenskog niza po Klobucharu. Pokazano je kako Klobucharov model u navedenom razdoblju na području Republike Hrvatske ne pruža zadovoljavajuću korekciju kašnjenja, uz obrazloženje uzroka. Prikazana je ovisnost maksimalnog izmjerenog kašnjenja o broju Sunčevih pjega, o toku Sunčevog zračenja i o planetarnom indeksu Ap. U cilju prognoze GPS ionosferskog kašnjenja razmatra se mogućnost modela, koji će uzeti u obzir samo dinamiku promjena kašnjenja, za razliku od statičkih modela do sada. Temeljem Gauss- Markovljevog procesa prvog reda pokazano je kako se prognoza bazira na prethodnoj dinamici sustava, a ne na njegovom trenutnom stanju. Za minimiziranje varijance pogrešaka estimacije predlaže se Kalmanov filtar. Naveden je temeljni algoritam za potrebe određivanja GPS ionosferskog kašnjenja. Ponašanje filtra definirano je na 4 različita načina, od kojih su prva dva uspješno reducirali ionosfersko kašnjenje, treći djelomično, a četvrti neuspješno. Analizirani dinamički filtri pokazali su malu osjetljivost na ekstremne ionosferske poremećaje, za razliku od Klobucharovog algoritma spore i neadekvatne reakcije.

Šesto poglavlje predlaže model kompenzacije ionosferskog kašnjenja za jednofrekvencijske prijamnike, ovisno o stanju svemirskog vremena. Za slučaj mirnog svemirskog vremena ili njegovih manjih poremećaja predlaže se Klobucharov model, dok se za ekstremne poreme-

ćaje svemirskog vremena predlaže dinamički kompozitni model. On može biti integriran i s DGPS-om ili poboljšanim Klobucharovim modelom, koji generira koeficijente s obzirom na lokalno stanje ionosfere, ako su takvi sustavi dostupni, i ako je korisnik za to opremljen.

U Zaključku se konstatira važnost ionosferskog kašnjenja kao glavnog uzroka pogreške određivanja položaja. Ponašanje toga kašnjenja u uvjetima ekstremnog svemirskog vremena nije dosad opisano odgovarajućim modelom. Definiranjem vertikalnog profila broja elektrona ukazuje se na teorijsku vezu sa stanjem svemirskog vremena. Temeljem prikupljenih eksperimentalnih podataka s referentne postaje Osijek analizirana je dinamika promjena parametara svemirskog vremena, a time i dinamika promjena GPS ionosferske pogreške. Predlaže se opći kompozitni model korekcije GPS ionosferskog kašnjenja.

U svome radu pristupnik je pokazao da postojeći teorijski i eksperimentalni modeli korekcije pogreške određivanja položaja uslijed ionosferskog kašnjenja zadovoljavaju samo u relativno mirnim uvjetima svemirskog vremena. Rezultatima opažanja razvoja ekstremnih uvjeta u razdoblju od 1. listopada - 23. studenoga 2003. godine pokazano je da GPS ionosfersko kašnjenje slijedi dinamiku geomagnetskih i ionosferskih oluja, uzrokujući pogreške udaljenosti 4 do 8 m. Usporedbom statističkih parametara vremenskih nizova definirani su linearni modeli ovisnosti parametara svemirskog vremena (broja Sunčevih pjega i toka Sunčevog zračenja) i vršnog dnevnog GPS ionosferskog kašnjenja za područje sjeverne Hrvatske u navedenom razdoblju.

Predložen je novi, kompozitni model GPS ionosferskog kašnjenja, kao poboljšanje postojećeg standardnog Klobucharovog modela. Vrednovanjem rezultata istraživanja kašnjenja u raznim uvjetima svemirskog vremena pokazano je, da skalarni Kalmanov filtar, kao komponenta kompozitnog modela, uspješno opisuje dinamiku GPS ionosferskog kašnjenja, uzrokujući pogrešku manju od 1 m u cijelom vremenskom intervalu promatranja.

Izvorni znanstveni doprinos sastoji se u:

- predloženom teorijskom modelu ionosferske pogreške satelitskog određivanja položaja u ovisnosti o parametrima svemirskog vremena;
- identifikaciji dinamike promjena ukupnog ionosferskog sadržaja elektrona i ionosferske pogreške satelitskog određivanja položaja tijekom ekstremnih uvjeta svemirskog vremena, a na temelju vremenskih nizova eksperimentalnih rezultata s područja sjeverne Hrvatske;
- prijedlogu novog modela ionosferske pogreške satelitskog određivanja položaja u ovisnosti o dinamici i karakteru promjena svemirskog vremena; te
- vrednovanju rezultata istraživanja utjecaja ekstremnih uvjeta svemirskog vremena na ionosfersku pogrešku satelitskog određivanja položaja i u utvrđivanju uvjeta odabira pojedinačnih korelacijskih modela za određivanje ionosferske pogreške ovisno o stanju i dinamici promjena svemirskog vremena.

Dugogodišnjim istraživačkim radom uz primjenu opsežne literature pristupnik je pokazao vlastiti znanstveni pristup u rješavanju složene problematike. Analizom eksperimentalnih rezultata i primjenom suvremenih računalnih algoritama pokazao je sposobnost za samostalni znanstvenoistraživački rad.

Izv. prof. dr. sc. Tomislav Kos

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